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Introduction

The International Conference on Integrated Medical Imaging in Cardiovascular Diseases (IMIC 2016) will follow up on the most recent advances in the use of medical imaging in the management of CVDs and will support professional development in Member States. Non-communicable diseases (NCDs) are steadily increasing both in developed and developing countries, the situation is particularly alarming in low and middle income countries, as 80% of the mortality burden is borne by them. Medical imaging techniques such as single photon emission computed tomography (SPECT), positron emission tomography (PET), echocardiography, computed tomography (CT) and magnetic resonance imaging (MRI), offer strategic advantages in both diagnostic and therapeutic decision-making. These techniques represent very useful tools to understand the pathology of individual patients in detail and can therefore serve to facilitate specifically tailored clinical management. Each imaging modality has its advantages and limitations which need to be understood properly by health care professionals dealing with CVDs. Given their high usefulness, integrating these techniques into the health care systems of Member States can provide an invaluable contribution to improving CVD management.

This book of abstracts represents the compilations of abstracts contributed to the IMIC 2016 conference by professionals from all around the world in different thematic areas, including: Member States experience with nuclear cardiology (SPECT, PET); Member States experience with other imaging modalities in cardiology (MRI, CT, echocardiology); use of hybrid diagnostic imaging in cardiology; setting up a nuclear medicine and/or diagnostic imaging facility; radiopharmaceutical production using cyclotrons and radionuclide generators including good manufacturing practices and quality assurance aspects with special reference to imaging agents for CVDs; issues of medical physics, instrumentation and image processing and analysis; quality management, quality control, quality assurance and audits in nuclear medicine and/or diagnostic imaging; ethics, leadership and education in nuclear medicine and/or diagnostic imaging; and radiation protection for personnel and dose reduction for patients. Finally, it includes an index of authors, wherein primary and co-authors are listed.
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The Value of Tc-99m MIBI Washout Rate in Detection of Coronary Artery Ischemia

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Background: We aimed to estimate the rate of MIBI washout of myocardium in patients with possible coronary artery ischemia as compared to the degree of reversibility between stress and rest studies.

Methodology: This prospective study included 70 patients [42 males (60%) and 28 females (40 %)] with mean age 55.3 ± 10.1 years. All patients underwent ECG-gated SPECT Tc-99m MIBI myocardial perfusion imaging. Two days protocol (rest/stress) was used, the rest study was performed at 90 min and delayed images at 4 hours post-injection. Stress phase images were performed after 30 min. Polar map of 90 min was compared with delayed perfusion images at 4 h to calculate washout rate (WR).

Results: There was a higher WR in the ischemic myocardial region of LAD (21.18±7.2) compared to the normal one (9.96±2.49), (p < 0.001). Also, in the region of RCA, WR was 19.17±3.86 in ischemic wall versus 9.59±1.69 in normal walls (p<0.02) and (LCX) WR was 17.02 ± 2.6 in ischemic wall versus 9.63 ± 1.76 in normal walls (p<0.04). Additionally, the linear correlation of regional WR of each vascular territory was compared with the corresponding degree of reversibility with statistical significance for LAD (0.77), LCx (0.86) and RCA (0.64).

Conclusion: There is a higher WR of MIBI in ischemic walls in all vascular territories with significant correlation with its degree of reversibility that may potentiate the results of the stress study.
Gated Single Photon Emission Computed Tomography Detecting Silent Myocardial Ischemia: A Study in a Cuban Population of Type 2 Diabetic Patients

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Background: Myocardial perfusion studies (gated-SPECT) have an important role in the diagnosis of silent ischemia which is not evidenced clinically and it is not demonstrated with others test. However due to the high cost of this technique, it is necessary to improve the selection criteria. Aim: To identify markers of increased risk for silent myocardial ischemia (SMI) in type 2 diabetic patients. To define criteria for prescription of myocardial perfusion studies in type 2 diabetic patients without cardiovascular symptoms in the Cuban population.

Methodology: Electrocardiogram, stress test and gated-SPECT were performed on 280 type 2 diabetic patients without cardiovascular symptoms. The coronary angiography results were used as gold standard. Blood lipids tests and biomarkers of oxidative stress were determined. Two groups according to the positive or negative result of the gated-SPECT were created. Receiver operating characteristic curves were done to identify markers of risk for SMI. The odds ratio for cohort positive gated-SPECT was estimated on each atherogenic factor, taking into consideration the values recommended by the American Association of Diabetes. Classification and regression trees were developed to establish points of cuts indicators of ischemia in the Cuban population.

Results: SMI was detected in 28.5% of the patients. 80% of the electrocardiograms with non-specific changes and 70% of the uncertain exercise tests showed positive gated-SPECT (36.4% reversible perfusion defects of moderate intensity and 7.6% not reversible severe defects). Gated-SPECT showed values of sensibility, specificity, accuracy, positive and negative predictive value of 92%, 96%, 95%, 89%, and 97%, respectively. There was a good agreement between the results of gated-SPECT and coronary angiography (k =0.873). Individual factors: Increased lipid levels, fasting blood glucose, arterial pressure, family history of coronary artery disease and smoking increased from 2 to 5 times the risk for positive gated-SPECT. An LDLc ≥100 mg/dl was the individual variable with highest value of risk. Low values of HDLc linked with family history of disease showed significant association with results of the gated-SPECT and were thus identified as markers of increased risk for SMI; the predictive value was increased to 81.6%, a significant increase of 32% from random predictive value (50%). The coexistence of dyslipidemia, hypertension, and more than six years of diagnosed diabetes increased 5 times the risk for SMI. Protein oxidation was associated with a greater extension of the SMI. Higher levels of lipids and waist circumference were associated with increased protein oxidation, and impaired antioxidant defences.

Conclusions: Gated-SPECT demonstrated a high percentage of SMI in asymptomatic diabetic type 2 patients. The most important markers of SMI were dyslipidemia and family history of coronary disease. Dyslipidemia, hypertension and more than six years of diagnosed diabetes constituted an important criterion for the referral to gated-SPECT in type 2 diabetic patients in the Cuban population.
Utility of Gated SPECT in Cardiovascular Risk Assessment of Diabetic Patients Undergoing Major Non-Cardiac Surgery

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Background: Diabetes is a well-established risk factor for coronary artery disease (CAD). CAD in diabetic patients tends to be more extensive, involve multiple vessels, and be more progressive than in non-diabetic patients. Patients with diabetes are known to have an increased incidence of silent myocardial ischemia, which often causes a delay in diagnosing CAD. Myocardial perfusion single-photon emission computed tomography (Gated-SPECT) has been extensively applied in the clinical assessment of patients with diabetes mellitus. The aim of the current study was to evaluate whether gated-SPECT stratifies perioperative cardiac risk in noncardiac surgery of an asymptomatic diabetic population.

Methodology: 166 subjects (age: 59.1±6.9 years) with at least five years history of type 2 diabetes, and no suspected or documented myocardial perfusion imaging performed for CAD; angiography was also performed in patients with abnormal MPI. Myocardial perfusion and cardiac function were simultaneously evaluated in the SPECT examination. We sought clinical and imaging variables predictive of perioperative cardiac events, and estimated the prognostic value of SPECT.

Results: MPI results showed that 116 patients had normal myocardial perfusion, while 50 patients showed perfusion defects (46 reversible and 4 fixed) on MPI. 24 out of the 50 (48%) with abnormal MPI findings represented abnormal angiography. We observed that pretest likelihood of CAD (odds ratio 2.32; 95% CI: 1.05-5.13; p = 0.038) and higher HbA1c level (odds ratio 1.70; 95% CI, 1.07-2.71; p = 0.02) were independently associated with abnormal MPI.

Conclusion: Occult CAD was present on MPI in 1/3 patients with diabetes mellitus without abnormal electrocardiographic findings or evidence of peripheral arterial disease. Normal SPECT findings ensure a low likelihood of perioperative cardiac events in diabetic patients without chest pain; and perfusion and/or functional abnormalities are associated with adverse cardiovascular outcome.
Abstract ID: 10

**Detection of Ischemia in patients with intermediate Duke Score: gated SPECT MIBI early post stress imaging and stress echo study**

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**Background:** Both, early post stress gated SPECT MIBI imaging and stress echo have IA class indications for detection of ischemia in patients with intermediate probability of coronary artery disease (CAD). However, both functional tests have advantages and drawbacks. **Aim:** To compare Gated SPECT MIBI early post stress findings with stress echo in patients with suspected or known coronary artery disease, normal left ventricular function and intermediate exercise Duke Score. To evaluate sensitivity and specificity of Gated SPECT MIBI early post stress protocol in comparison to coronary angiography served as gold standard. To assess possible added value of Gated SPECT MIBI over stress echo in specific localization of myocardial ischemia.

**Methodology:** The sample included 63 patients, mean age 58±8 years, 47 men and 16 women with normal or mild impairment of the left ventricular function and intermediate exercise Duke Score. They underwent 2-day stress-rest gated SPECT MIBI protocol with early post stress data acquired 15 minutes after i.v. injection of 740MBq of 99mTc-MIBI. Perfusion and functional parameters were assessed by 4D-MSPECT programme. Stress echo was performed within two days and CA within one month of gated SPECT MIBI investigation.

**Results:** There was no significant difference between early gated SPECT and stress echo findings in detection CAD (Mc Nemar, p=1.000) with good agreement between methods (kappa 0.691, p<0.001). Spearman correlation between early gated SPECT and stress echo was also significant (s=0.448, p<0.01). In addition, early gated SPECT has added value over stress echo findings (NRI index = 0.2466, p<0.001) in detection of ischemia especially in inferior-lateral wall. Overall sensitivity of ES was 96% and specificity 83.33%.

**Conclusions:** Our data demonstrate comparative utility of early gated SPECT MIBI imaging and stress echo for non-invasive evaluation of CAD in patients with mild left ventricular dysfunction. The advantage of gated SPECT MIBI over stress echo is ability to concurrently detect and quantify ischemia in inferior-lateral wall and in patients with poor acoustic window.
Assessment of Myocardial Viability Using Technetium-99m Labelled Tetrofosmin Rest Myocardial Perfusion Imaging with Nitrates Administration

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Background: Myocardial perfusion imaging (MPI) SPECT is a reliable method to assess myocardial viability. The most accurate radiotracer for this indication is Thallium-201 which is a cyclotron product. We present the role of nitrate technetium-99m sestamibi imaging in predicting the post-revascularization outcome of chronically hypoperfused asynergic territories as a possible alternative to Thallium-201.

Methodology: 15 patients, with a previous myocardial infarction and left ventricular dysfunction scheduled for revascularization underwent technetium-99m sestamibi tomography under baseline conditions and during isosorbide dinitrate infusion. It was done on two days using a Gamma-Camera Symbia T6 system equipped with cardiofocal collimators and IQ.SPECT technology. Tomograms based on the three spatial plans were divided into 17 segments and regional tracer uptake was quantitatively analysed. Viability was defined as presence of tracer uptake >/=50% of peak activity on baseline studies or after reversibility.

Results: On baseline 99mTc-tetrofosmin studies, 83 of the 255 segments that were analysed had <50% of peak activity. 43 of these segments showed reversibility after nitrate administration, with an increase in 99mTc-tetrofosmin uptake to 61+/−7% of peak activity.

Conclusion: Short-term administration of isosorbide dinitrate immediately before injection of technetium-99m sestamibi increases tracer uptake in some chronically hypoperfused asynergic territories. It may be a good alternative to assess myocardial viability in countries where Thallium-201 cannot be available.
Abstract ID: 13

Application of Hybrid Imaging Methods in the Diagnostics of Patients Suspicious for Vascular Graft Infection

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Background: Although vascular graft infection is a rare complication, occurring in 2–6% of patients, it has a high rate of morbidity and mortality. Imaging with labeled leucocytes can provide specific visualization, which is of great importance for efficient treatment. The aim of the study was to evaluate the diagnostic value of “in vitro” labelled leucocytes, using SPECT-CT, in patients suspicious of vascular graft infection, and determine the activity of the inflammatory process and compare obtained data with our first results from PET-CT application.

Methodology: We examined 25 patients (pts), of whom 16 had aorto-bifemoral, 2 femoro- femoral, 2 axillo-femoral and 5 ilio-femoral bypass. Fourteen of the patients were still under the antibiotic therapy, although not heavily clinically affected. We used labeled leucocytes with 99mTc-HMPAO (370MBq) and applied a hybrid imaging technique: SPECT-CT, 2 hours post-injection (hpi). Results of all patients were verified microbiologically, surgically or with a follow-up. An index of accumulation (IA) was used for an objective quantification of the results and for evaluation of the infection process. IA was calculated as the activity of the suspected area divided by the activity of the contralateral area, after both were normalized to the background activity. Infection was ruled out when IA was below 1.1 (in 5 pts), low grade activity was considered at IA of 1.1–1.3 (in 12 pts) and active infection at IA above 1.3 (in 8 pts). Use of CT, allowed for exact localization of the infectious process, differentiating infection along the vascular graft (in 13 pts) from infection in adjacent soft tissues (in 7 pts). In 7/25 pts, additional PET-CT with 18F-FDG (300-370 MBq, 60 min p.i.) was performed. In one of them, a fistula was visualized and in another, an abscess localized next to the graft was better visualized than when using SPECT-CT.

Results: The overall diagnostic sensitivity with labeled leucocytes was 84.2%, specificity of 83.3% and accuracy of 83.9%. According to results from PET-CT examinations, no difference in the final diagnosis was found, in comparison between the two imaging modalities, with the exception of 4 out of 7 patients, in whom a larger area of the grafts had FDG uptake. The infected segments (corresponding to the segments from scintigraphy with labeled leucocytes), had SUVmax on average - 6.3 and in those without infection- 3.45. We consider that the higher FDG uptake was a result of a chronic inflammation or reaction to the synthetic graft material, but more studies are needed to confirm these hypotheses. For 30% of the patients, both modalities have contributed important additional information, which changed the therapy.

Conclusion: In summary, we suggest that “in vitro” labeled leucocytes, using SPECT-CT is a more specific, with a possibility for the measurement of the activity of infection, but time consuming modality. Therefore in heavily ill patients or in those without leukocytosis, PET-CT is preferable.
Strategic Diagnosis of Perfusion Abnormalities in Patients with Rheumatoid Arthritis in a Developing Country

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Background: Ischemic heart disease (IHD) is a common (40-65%) cause of mortality in patients with rheumatoid arthritis (RA). The presence of a chronic systemic inflammatory response has been suggested to be a predictor of cardiovascular mortality. Accurate diagnosis remains a challenge due to silent IHD. Impact of traditional cardiovascular risk factors (CVRF) and steroid treatment have been demonstrated to be different for age-sex-years with RA matched control patients. Gated-Myocardial Perfusion Single-Photon Computed Tomography (g-SPECT) is proposed as a strategic cardiovascular imaging technique to assess myocardial perfusion abnormalities. Objective: To evaluate myocardial perfusion in asymptomatic Mexican patients with RA and at least one traditional CVRF, assessed by g-SPECT.

Methodology: We prospectively evaluated g-SPECT results of 91 asymptomatic patients with RA, at least one CVRF, and without history of IHD. We performed a rest-stress protocol with Tc-99m sestamibi, using a gamma camera SIEMENS®-Symbia-S, with IQ-SPECT technology. Data was collected on clinical characteristics, type of treatment, and traditional CVRF. RA activity was evaluated by clinical examination and the the DAS28 scale. High sensitivity C-reactive Protein (hs-CRP) was quantified, reference range was: low risk 1.0 mg/L, medium risk 1 to 3.0 mg/L and high risk above 3.0 mg/L. Erythrocyte sedimentation rate (ESR) was assessed assuming normal values as 0-22 mm/hr for men and 0-29 mm/hr for women. We calculated relative risk (RR) and 95% CI of ischemia given the associated variables.

Results: Average age was 58.7±12 years, 90.1% were women. CVRF: 39.6% were obese, 33% had hypercholesterolemia, 31.9% had hypertension, 13% were current smokers and 9.8% had diabetes mellitus. Median number of years with RA diagnosis was 18.5 SD±7.9, (IQR 6-15). Steroid treatment combined either with disease modifying anti rheumatic drugs (DMARD) or with a biological treatment accounted for 78.8%; 19% underwent DMARD alone and the rest (2.2%) biological treatment. DAS28 scale: 49.4% scored low, 30.8% medium and 19.8% high activity. ESR values were abnormal in 56% (n=51), whereas hs-CRP values were high in 55% (n=50). Gated-SPECT was abnormal in 22 patients (24.2%); 50% were affected at the anterior descending territory. Perfusion abnormalities: 72.7% were mild ischemia and 27.3% were moderate ischemia or infarct. Smokers and patients under steroid treatment were statistically at more risk of presenting ischemia (RR 0.49 [0.24 to 0.98] and RR 2.04 [1.01 to 4.14], respectively) with a p=0.046.

Conclusion: Perfusion abnormalities are frequently present in patients with RA. Patients with RA presented ischemia independently of CVRF, disease’s characteristics and without recognized symptoms. Smokers and patients under steroid treatment were statistically at more risk to present silent ischemia. Gated-SPECT is a non-invasive cardiovascular imaging technic of accurate strategic diagnosis in asymptomatic patients with RA.
Comparison of Quantitative Parameters of Myocardial Perfusion Scintigraphy and Echocardiography in Patients of Coronary Artery Disease with and without Systolic Dysfunction

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Background: Systolic dysfunction leading to dilated cardiomyopathy is a major cause of cardiovascular morbidity and mortality. Few studies have compared quantitative parameters obtained from myocardial perfusion scintigraphy with those of echocardiography. The aim of this study was to compare the end systolic volume (ESV), end diastolic volume (EDV), summed rest score (SRS) as obtained from myocardial perfusion scintigraphy (MPS) to echocardiographically obtained left ventricular internal dimensions (in mm) during systole [LVID(s)] and diastole in patients of angiographically proven coronary artery diseases with and without systolic dysfunction.

Methodology: The study group comprised 20 male patients (mean±S.D = 54.5±9.3 years) with left ventricular ejection fraction <40% and 10 patients (8 males, 2 females) [mean±S.D = 51±9.4 years] with ejection fraction of ≥40% as determined by the echocardiography. All patients underwent rest gated MPS with Tc-99m MIBI as per the institution protocol. Each MPS study was processed in Emory Cardiac Tool Box (ECTB) software to obtain ESV(ml), EDV(ml) and SRS. LVID(d), and LVID(s) were obtained from echocardiography and tabulated separately for patients with and without systolic dysfunction. All patients had angiographically proven coronary artery disease with 8 of 20 and 2 of 10 patients demonstrating multi vessel involvement in those with and without systolic dysfunction respectively. Appropriate statistical tests were applied for the comparative analysis and a p-value less than 0.05 was considered significant.

Results: Results are summarized in table 1. ESV, EDV and SRS (all as mean±S.D) were 105.8±52.8, 152.0±63.4 and 18±6.3 respectively in patients with systolic dysfunction while they were 48±26.4, 103.8±33.3 and 13.6±5.6 respectively in patients without systolic dysfunction, the difference between the two groups being statistically significant (p=0.0005, 0.012 and 0.033 respectively). LVID(d) (mean±S.D) in patients with and without systolic dysfunction were 48.8±11.7 and 46±6.2 respectively while LVID(s) (mean±S.D) in corresponding patients were 40.7±9.3 and 37.4±12.6 respectively. The difference between the two groups was not statistically significant for both LVID(d) [p=0.57] and LVID(s) [p=0.62]. When patients with single vessel disease were compared to multi vessel disease across the groups only ESV, EDV, and LVID(s) showed a statistically significant difference.

Conclusions: Quantitative parameters derived from myocardial perfusion SPECT viz. ESV, EDV and SRS are more reliable than echocardiography parameters viz. LVID(d) and LVID(s) in distinguishing patients of coronary artery disease with or without systolic dysfunction. ESV, EDV as derived from MPS and LVID(s) as derived from echocardiography are more reliable parameters to distinguish between single and multi vessel involvement independent of systolic dysfunction.
Evaluation of Breast Attenuation in the Anatomical and Functional Correlation Between Scintigraphy and Coronary Angiography

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Background: Myocardial perfusion scintigraphy (MPS) is one of the most relevant techniques used in detection and quantification of myocardial ischemia. The gold standard for the detection of coronary stenoses is coronary angiography. However, it is observed that when comparing the results obtained by catheterization with the results of non-invasive methods for assessing ischemia, the correlation is not perfect. One reason for this discrepancy is attenuation artifact by soft tissue such as the breast in women. In this work we evaluated the degree of anatomical-functional correlation between myocardial scintigraphy and coronary angiography, in female patients who achieved perfusion defect in the territory of the anterior descending artery, to perform MPS.

Methodology: 30 patients undergoing myocardial perfusion scintigraphy with altered perfusion in the anterior wall that underwent catheterization were selected. The agreement between the techniques was made taking into account: 1) the equipment (SPECT/CT Siemens Symbia T2 or SPECT SIEMENS E.cam Duet); 2) the presence of coronary lesions: per patient or per vessel. We considered significant obstruction stenosis of 50% and 70% of the vessel diameter. Demographic characteristics for the group with positive catheterization were compared with the negative catheterization. We used Student t test, q² and Mann-Whitney. P-values under 0.05 were considered statistically significant.

Results: The average age of 8 patients who were examined by Symbia T2 was 65.37 ± 13.01 years, the average weight was 77.00 ± 12.69 kg and the average height was 1.63 ± 0.076 meters. While the average age of the 22 patients who were examined by E.cam Duet was 70.04 ± 8.82 years, the average weight in kg was 76.18 ± 14.10 and the average height in meters was 1.61 ± 0.068. Considering the criteria for patients and a significant stenosis of 50%, 62.5% and 54.5% of positive scans, analyzed by E.cam Duet and Symbia T2, respectively, had positive CAT. Considering a significant stenosis of 70%, 50% and 45.5% of the patients had a positive CAT for the same equipments mentioned above. Taking into consideration the criteria per vessel and 50% stenosis, 37.5 and 45.5% of positive scans, analyzed by E.cam Duet and Symbia T2, respectively, had positive CAT. Considering a significant stenosis of 70%, 50% and 45.5% of the patients had a positive CAT for the same equipments mentioned above. Taking into consideration the criteria per vessel and 50% stenosis, 37.5 and 45.5% of positive scans, analyzed by E.cam Duet and Symbia T2, respectively, had positive CAT. Still considering the criteria per vessel but with a stenosis of 70%, 25% and 27% of the patients had positive scans, analyzed by both equipments, respectively, had positive CAT. It was found that there was no significant difference in demographic variables between the groups with positive and negative CAT, p> 0.05. In all cases the anatomical and functional correlation between scintigraphy and CAT showed no significant association, both considering the criteria for patient and per vessel (p> 0.05).

Conclusion: The results suggest that the breast attenuation in women still is a concern in MPS. Attenuation correction do not completely solves this problem. In addition, the demographic characteristics do not seem to influence the correlation of results between the nuclear medicine and the catheterization.
Applicability of the Appropriate Use Criteria for Myocardial Perfusion Scintigraphy

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Background: Appropriateness Criteria for nuclear imaging exams were created by the American College of Cardiology (ACC) and the American Society of Nuclear Cardiology (ASNC) to guide the appropriate use of tests. Little is known whether these criteria have been followed in clinical practice. Objective: To evaluate whether the medical applications of myocardial perfusion scintigraphy (MPS) in a private nuclear medicine service of a tertiary cardiology hospital were suitable to the criteria of indications proposed by the American Medical Societies in 2005 and 2009 and compare the level of indications for both.

Methodology: We included records of 383 patients that underwent MPS from November 2008 up to February 2009. Demographic characteristics, patient’s origin, coronary risk factors, physician’s graduation time and appropriateness criteria of medical applications were studied. The criteria were evaluated by two independent physicians and, in doubtful cases, defined by a medical expert in MPS.

Results: Mean age was 65 ± 12 years. Of the 367 records reviewed, 236 (64.3%) studies were performed in men and 75 (20.4%) were in hospitalized patients. To ACC 2005, 255 (69.5%) were considered appropriate indication and 13 (3.5%) inappropriate. With ACC 2009, 249 (67.8%) were considered appropriate indications and 13 (5.2%) inappropriate.

Conclusion: We observed a high rate of adequacy of medical indications for MPS. Compared to the 2005 version, 2009 did not change the results.
Abstract ID: 27

**Trends in the Indications of Transesophageal Echocardiography in Cardiocentro, Santa Clara, Cuba**

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**Background:** The Transesophageal Echocardiography (TEE) hospital registry of Cardiocentro was analyzed retrospectively.

**Methodology:** No sampling was performed. All TEE registered in the years 2009 and 2014 were included.

**Results:** 216 and 224 TEE studies in 2009 and 2014 respectively were included, and in approximately 2/3 of the studies the presumptive diagnosis was confirmed. In both periods, TEE accounted for only 1.6\% of the total transthoracic echocardiograms performed in Cardiocentro. There were no statistically significant differences (p≥0.05) on age, sex, or the percentage of indications for prosthetic valve disease (14.4\% in 2009 and 11.6\% in 2014), pre-cardioversion (4.6\% and 5.4\%), assessment of the aorta (5.1\% and 3.6\%), congenital heart disease (8.3\% and 8.9\%) and others (24.1\% and 21.4\%). Significant differences (p <0.05) in the assessments for suspected endocarditis (28.2\% and 39.3\%) and native valve disease (15.3\% and 9.8\%) were detected; as well as in the assessment of patients with intracardiac devices (permanent pacemaker 4.9\% vs 9.1\% and prosthesis 13.1\% vs 18.2 \%). Complication rates were low in both years.

**Conclusions:** TEE is underused despite a safe and acceptable diagnostic positivity study in Cardiocentro. There is an upward trend in the indication of TEE on suspicion of endocarditis, mainly in patients with intracardiac devices.
Abstract ID: 28

Prognostic Value of Myocardial Perfusion Scintigraphy in Patients with Suspected or Known Coronary Artery Diseases

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Background: Myocardial perfusion scintigraphy (MPS) provides not only diagnostic information in patients with suspected artery disease, but also prognostic information of cardiac events due to coronary artery disease. The aim of this study is to investigate the prognostic value of MPS in the patients with suspected or known coronary artery disease.

Methodology: A retrospective study included patients with suspected or known coronary artery disease, who underwent exercise or pharmacological stress and rest single photon emission computed tomography/computed tomography (SPECT/CT) and were followed up the cardiac event from January 2013 to January 2016.

Results: Fifty seven patients (40 males, 17 females) with mean ages of 62 ± 10 (range: 44-82) were enrolled in this study. There were 6 patients (10.5%) with normal MPS and 51 (89.5%) with abnormal ones (myocardial ischemic, scar by myocardial infarction and both of them). Those patients were followed up to the endpoint time of study or to the time of cardiac death. During a mean follow-up of 18 months (1-38 months), 25 patients (43.9%) were reported no additional soft cardiac events (angina, myocardial ischemia) as well as hard ones (myocardial infarction, cardiac deaths). There were 32 patients (56.1%) with cardiac events, included 14 (24.6%) were hospitalized due to angina, myocardial ischemia and 12 (21.1%) due to myocardial infarction and 6 remaining ones (10.5%) were dead by cardiovascular disease. Among 6 normal MPS patients, one patient (16.6%) was hospitalized due to angina, myocardial ischemia in comparison with 31 of 51 (60.7%) abnormal MPS patients hospitalized due to cardiac events (angina, myocardial ischemia, infarction and cardiac death). Four of 40 patients with myocardial ischemia, 2/8 with both ischemia and infarction scar on MPS were died during follow-up mean time of 10±6 months. Seven of 40 patients with myocardial ischemia, two of 3 with myocardial infarction and 3 of 8 with both ischemia and infarction scar on MPS were hospitalized for non-fatal myocardial infarction during follow-up mean time of 20±6 months. Nine of 40 patients with myocardial ischemia, one of 3 with myocardial infarction scar and 3 of 8 with both ischemia and infarction scar on MPS were hospitalized for angina, ischemia during follow-up mean time of 21±8 months.

Conclusion: The patients have the normal MPS were less likely occurred the cardiac events than the ones get the abnormal results during 18 months of follow-up. The result of MPS may contribute an additional meaningful prognosis of cardiac events. A prospective study with more patients is necessary to validate these results.
Myocardial Perfusion Scintigraphy: Assessment of Myocardial Ischemia and Independent Predicting Factors in Patients Without Previously Proven Coronary Artery Disease

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Background: The aim of the study was to analyze the influence of individual risk factors and the incidence of myocardial ischemia diagnosed by myocardial perfusion scintigraphy (MPS) in patients with risk factors for coronary artery disease (CAD) but without a history of previously proven CAD.

Methodology: In period from 2008 to 2012, 801 patients (451 women, 350 men, aged from 28-83 years, mean 61.9±7.7 years) underwent MPS in our institution. All patients underwent a 2-day protocol that includes stress and rest study. In patients with negative stress MPS study, the remainder was omitted. The stress study was completed using exercise-dipyridamole combined test. Dypiridamol was intravenously injected in a dose of 0.56 mg/kg over 4 minute. During the dypiridamole infusion, patients were monitored for blood pressure, heart rate, rhythm and ECG changes. The stress test is continued with a 3-minute low level exercise of 25 W by bicycle ergometer and followed by 99mTc-MIBI injection (activity of 740 MBg). MPS was performed on dual head SPECT (E-CAM and SYMBIA, Siemens) gamma cameras. Multivariate logistic regression analyzed each risk factor and calculated the statistical significance on total model prediction.

Results: A positive MPS accounts for 18.1% of all studied patients. Significant ischemia (defined if >10% of the left ventricle is involved) was detected in 10.7% of patients. The most common type, reversible ischemia was detected in 73.8%, while the anteroseptal wall was the most usual site of ischemia (detected in 44.1%). Independent predicting factors for positive MP were: male gender, type 2 of diabetes mellitus (DM), smoking habit, elevated total cholesterol and obesity. The model predicting positive MPS in patients without CAD has a sensitivity of 77.9%, a specificity of 62.2% and a positive predictive value of 65%.

Conclusion: The prediction model based on gender and risk factors (type 2 DM, total cholesterol, body mass index and smoking habit) may predict positive MPS in patients with risk factors and without proven CAD with high sensitivity and moderate specificity.
Dipyridamole Stress Myocardial Perfusion SPECT: Medium-term Survival in Patients Assessed by Coronary Artery Disease


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Background: Dipyridamole (DIP) is the most employed pharmacological cardiac stressor in patients unable to reach adequate exercise load, due to its safety and availability. Aim: to characterize our local population submitted to DIP single photon emission tomography (SPECT) and to assess survival in a medium term.

Methodology: We studied 1000 consecutive gated myocardial DIP SPECT; 985 were adults, 44.6% women, mean age 67±11 years old. Indications were coronary artery disease (CAD) screening in 66% and known CAD assessment in the rest (37% with revascularization and 35% myocardial infarction); 16% with Diabetes Mellitus; 11% peripheral artery disease; 3% renal failure; 23% non-cardiac presurgical studies; 22% chest pain; 9% complete bundle branch block or pacemaker. The group had a mean follow-up of 65.5±25 months; there were 262 deaths between 0.15-161 months post SPECT, according to our national register, 256 with specified cause. Uni-, bi- and multivariate Cox regression analysis was applied.

Results: The myocardial SPECT was abnormal in 44.4%; 77% of them with ischemia (transient defect) and 60.8% with any fixed defect; 29.3% with abnormal systolic function. Rest left ventricular ejection fraction (LVEF) <45% was found in 21% and in 25.2% in post-stress; dilation at rest was observed in 24.5%. Almost 26% of deaths were attributable to cardiac/ischemic causes; 22% of those without cardiac death had cancer. - In this cohort and using uni- and bivariate analysis, to be a female had a significant lower Hazard Ratio (HR) for dying from a global cause than to be a male and to have known CAD a significant higher HR than not, as well as HR in multivariate analysis was higher for being older than 46 y.o. - Using bivariate analysis, for a death from cardiac cause, the HR of an abnormal SPECT was 3.74 [CI: 2.15-6.51; p<0.001]; for presence of SPECT ischemia was 2.12 [CI:1.31-3.46; p=0.002]. See survival Kaplan Meier curves below. - Rest and post-stress LVEF values and also left ventricular dilation HR were significant with bivariate (p<0.0001) and post-stress LVEF with multivariate analysis (p=0.006). - There was a trend for higher HR with a severe/extensive fixed perfusion defect versus a low/moderate one (p=0.059) with bivariate analysis.

Conclusion: Abnormal myocardial DIP SPECT, left ventricular ischemia and dilation as well as LVEF values mainly post-stress are independent predictors of cardiac death.
Abstract ID: 32

**Comparison of Left Ventricular Ejection Fraction with Gated SPECT Perfusion and QGS in Myocardial Perfusion: Institute of Nuclear Medicine - University of San Francisco Xavier de Chuquisaca**

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**Background:** The left ventricle ejection fraction (LVEF) is the percentage value of blood ejected by the left ventricle with each beat, considering normal values of 55% +/- 5%. This value is equivalent to the systolic function of the left ventricle (LV) determining evolution, prognosis and treatment of patients, especially ischemic myocardial involvement. The aim of this study was to compare LVEF, obtained by processing the following protocols: Gated SPECT Perfusion and QGS. The first allows areas of interest in end diastole and systole manually, while the second performs these areas automatically.

**Methodology:** A retrospective study was conducted between 2010 and 2015, reaching a total of 103 perfusion studies of myocardial. By random sampling, 50 studies for 18 women between the ages of 36 and 83 years old and 32 men between 30 and 82 years old were considered. Protocols of one or two days were applied, with MIBI-Tc99m as radiopharmaceutical. For clinical indications, some studies were made completed at rest. The myocardial perfusion acquisition process effort was 30 to 45 minutes after administration of the radiopharmaceutical. The study of myocardial perfusion at rest was 3 to 4 hours after the first study. As for the acquisition parameters, 64 images were taken with 64 * 64 matrix, starting angle 45 degrees, 180 degrees rotation, methodically forward / backward by thirds, automatic centering 10 beats. In the higher dose injected study, the image acquisition time was 20 seconds, while in the lower dose, it was 25 seconds per image; taxed 8 images between R-R wave, carried out simultaneously during SPECT acquisition.

**Results:** The results showed in women an average of 54.11% LVEF protocol processing Perfusion Gated SPECT and in men 54.48%. Protocol QGS LVEF was 71.64% for women and 60.14% in males. Standard Deviation of LVEF in women reflects a value of 12.39 and to 9.19 in males. However no statistical relevances sensitivity (p <0.10)

**Conclusion:** It concluded that the data obtained are significant so the operator should be made aware of conduct prosecutions considering that the data provided are vital for early treatment.
The Effect of Non-Fasting State Prior to Tc-99m Sestamibi Administration on Upper Abdominal Artifacts in Myocardial Perfusion Scan: A Pilot Study

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Background: To evaluate the effect of meal prior to radiotracer administration on upper abdominal artifacts, duration of the study and patient’s side effects in myocardial perfusion study. Factors which may correlate to the upper abdominal artifacts were also determined.

Methodology: Pilot study in twenty eligible patients who underwent myocardial perfusion study was done. All patients were instructed to have light meal 2-4 hours prior to radiotracer administration, both for rest and stress studies. Other patient preparation and protocol of the study were performed according to our division’s protocol. Visual analysis of myocardial perfusion images were evaluated by two experienced nuclear medicine physicians using raw data images in anterior, LAO 45 degree and left lateral views and SPECT short axis images. The images were scored from 0-3 regarding the artifacts in liver, gallbladder and intestines. Quantitative analysis was also done using mean counts of the radioactivity in inferior myocardial wall, right lobe of liver, gallbladder and intestines and also count ratio between myocardial wall and these organs.

Results: The visual analysis in 80% of all patients showed no artifact from the radioactivity in liver, gallbladder and intestine, while 10% showed some artifacts without disturbing scan interpretation and 10% showed artifacts which could be corrected by reconstruction technique without the needed for re-acquisition. The myocardial-to-intestinal ratio in patients without abdominal artifact tended to be higher than in those with abdominal artifacts in both rest and stress studies. Only one patient had transient dizziness after stress study, which was more likely due to side effect from adenosine rather than from meal ingestion prior to the study.

Conclusion: Meal ingestion for 2 hours prior to radiotracer administration in myocardial perfusion study had neither effect on both upper abdominal artifacts nor side effect in the patients. Thus, this study can be performed in patients who did not fast as instructed by delay radiotracer administration to 2 hours after last meal. Revision of the patient preparation by shortening the fasting period may be further considered in order to reduce patient’s discomfort as well as the risk from prolonged fasting state for several hours.
Abstract ID: 42

Our Experience in Myocardial Perfusion SPECT, its Value in Kawasaki and Congenital Diseases: Protocol Analysis


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Background: In children, Kawasaki Disease (KD) also called mucocutaneous lymph node syndrome could evolve with complicated coronary aneurysms that may even produce myocardial scars. Congenital heart diseases (CHD) could also require myocardial ischemia assessment. Our aim was to analyze the cases referred to us in pediatric patients with the intention of improving our cardiac SPECT protocols.

Methodology: Since 1998, we performed 43 studies in 34 children (20 boys) referred from other centers; 14 patients with KD with different therapies; 16 with CHD pre or post surgical correction, mainly great vessel transposition (26%) and ventricular septal defect (21%). 3 with cardiomyopathy and 1 due to anthracycline cardiac toxicity evaluation. Their mean age was 6 y.o., ranging from 2 months to 16 y.o. Pre SPECT evaluation included echocardiography in all, some coronary angiography and computed tomographic angiography.

Results: a. Technique. Stress was obtained using i.v. dipyridamol infusion (0,56 mg/kg) in 28/41 cases (4 required aminophylline); treadmill exercise using BRUCE protocol was accomplished in 6 children older than 7 y.o. Only rest SPECT was performed in 2 children unable to tolerate stress due to their baseline conditions. 99mTc-Sestamibi 1 or 2 days protocol was selected in 84% of the cases; 201Tl was employed in the only in 7 initial studies; in all, activity was adjusted by weight. Some children under 4 y.o. required general anesthesia (n=4); chloral hydrate (n=3) or sedation with midazolam (n=2); a cardiologist, pediatric cardiologist or pediatric anesthesiologist were present in the stress lab and/or during SPECT acquisition if sedation was needed. Sublingual nitrate was employed in the rest phase in 3 cases older than 5 y.o. presenting cardiomyopathy or myocardial sequelae. Double head gamma camera with heads in 90 degrees angle was employed since 2002; zoom during acquisition was applied in all cases. Not all the SPECT were gated initially but since 2005 was performed as a routine. Motion correction was applied when necessary. One patient required additional planar acquisition due to motion during SPECT acquisition. b. Findings: The stress test was positive for electrical ischemia in 4 cases. Stress test was well tolerated. In the whole group perfusion SPECT was abnormal in 20 studies (47%) and in 15 patients (44%). One CHD case was just dilated and another presented moderate systolic dysfunction. The 52% of studies in KD cases under medical therapy (immunoglobulins, aspirin) or submitted to revascularization presented ischemia and no systolic dysfunction. Preoperative and postoperative radionuclide follow-up studies in CHD were abnormal in 43% (ischemia, infarction and/or systolic dysfunction). The presence of a child’s relative was always encouraged. No adverse effects were observed in any case.

Conclusion: SPECT myocardial perfusion is helpful and safe in pediatrics patients for therapeutic management assessment. The implementation of this technique in a dedicated non-pediatric hospital requires special protocol considerations regarding radiation safety, sedation when necessary mainly in younger ages, acquisition parameters and even global family comfort.
Abstract ID: 44

**Epidemiologic Differences in Patients Referred to Myocardial Perfusion Scintigraphy in Cuba and Brazil**

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**Background:** Cardiovascular disease (CVD) is as an important public health problem for many developing countries. Increasing death rates and prevalence of risk factors have been observed in Latin America. Cuba and Brazil are among the top 10 countries in the world with highest mortality due to CVD in individuals age 34-75. Myocardial perfusion scintigraphy (MPS) is a well validated, non-invasive imaging technique, valuable to diagnose, stratify risk and guide management in coronary heart disease. **Purpose:** The goal of the present study was to evaluate and compare the current profile of patients in two referring centers in Cuba and Brazil who were sent to MPS.

**Methodology:** We studied 25141 patients between 34 and 75 years old who underwent a stress/rest gated-SPECT myocardial perfusion imaging during the period 2008-2014, 20,757 patients from Brazil and 4,384 from Cuba.

**Results:** High blood pressure had the highest prevalence both in Cuba (76.2%) and in Brazil (63.2%); dislipidemia was the second more frequent risk factor in Brazil (56.2%) and smoking in Cuba (45.3%). There was no difference in diabetes mellitus (24.7% Brazil vs. 18.7% Cuba). Both centers had a high prevalence of abnormal studies, but this was higher in Cuba (42.9% vs 29.1%). Logistic regression analysis demonstrated that patients with typical chest pain OR 2.03 (IC 1.75-2.37), diabetes mellitus OR 1.50 (IC 1.37-1.65), known coronary artery disease (KCAD) OR 5.79 (IC 5.31-6.32) and pharmacological stress test OR 1.63 (IC 1.42-1.87) in Brazilian had a greater likelihood of positive MPS results. In Cuban patients, smokers OR 1.34 (IC 1.14-1.58) and KCAD OR 8.14 (IC 6.55-10.12) showed the higher probability of abnormal MPS.

**Conclusion:** Cuba and Brazil had a high prevalence of abnormal studies, providing important information to guide patient management. Our findings are consistent with the current statistics that point to the high mortality rate due to CVD in Cuba and Brazil. The demographics, specially identification of modifiable and treatable risk factors, such as smoking and diabetes, can be helpful to design additional efforts on prevention for these two nations.
Abstract ID: 46

**Functional Parameters and Myocardial Perfusion in Patients with Chronic Heart Failure, Left Bundle Branch Block and Ventricular Dyssynchrony**

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**Background:** Patients with chronic heart failure (CHF) and complete left bundle branch block (LBBB) may present significant contractile dyssynchrony that could be diminished with appropriate resynchronization. Objective: To know the association between intraventricular dyssynchrony with left ventricular perfusion and systolic as well as with clinical parameters in patients with CHF and LBBB.

**Methodology:** We included our first 14 patients from IAEA Grant VISION, aged 66±9 y.o. NYHA≥II, 6 with known coronary artery disease 3 of them with prior myocardial infarction. 99mTc-sestamibi SPECT at rest was analyzed with Cedars® and Synctool®. Natriuretic brain peptide (pro-BNP), walking test (WT) and Minnessotta living with heart failure® questionnaire and echocardiography were obtained the same day.

**Results:** Minnessotta score was 67±17; distance achieved from predicted 68±26%; proBNP: 4263±3788 pg/mL; echo left ventricular (LV) ejection fraction (EF): 24±7%. All patients presented septoapical hypoperfusion with total perfusion defect (TPD) 17±11% and summed stress score (SRS) 17±11. Left final end diastolic volume (EDV) was 124±33ml and end systolic (ESV): 98±33ml; LV eccentricity: 0.78±0.04. Bandwidth (BW) and phase standard deviation (SD) corresponded to 136±108° and 37±20°, respectively.

**Conclusion:** Patients with CHF and LBBB present a good correlation between LV functional and perfusion abnormalities, intraventricular dyssynchrony, exercise tolerance and a neurohormone as indirect prognostic marker of CHF.
Influence of Prolonged Fasting on Patterns of 18F-FDG Uptake in the Left Ventricle of the Myocardium During Oncologic PET/CT Studies

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Background: Positron emission tomography (PET) with 18F-fluorodeoxyglucose (FDG) is widely used for evaluation of oncologic patients. Patterns of physiologic 18F-FDG uptake in the myocardium is widely variable. It has been suggested that fasting period and level of blood glucose may affect patterns of FDG uptake in myocardium. In this study, we investigated whether there is a relation between long fasting periods and patterns of FDG uptake in the myocardium.

Methodology: We retrospectively analyzed 18F-FDG uptake patterns in the left ventricle of non-diabetic 180 patients divided in two groups; 90 with long fasting period (more than 12 hours; over the night) and 90 with short fasting period (less than 8 hours), who underwent 18F-FDG PET/CT whole body scans for oncologic indications. Patients with hypermetabolic lesion inseparable from myocardium and patients with cardiac diseases were excluded from this study. We stratified 18 F-FDG uptake in the left ventricle into: diffuse uptake, irregular/segmental uptake and no significant uptake (uptake almost equal to mediastinal physiologic activity). Fasting periods were taken from the standard PET/CT questionnaires filled for patients before the PET/CT imaging. Statistical evaluation was performed using the Chi-square test, and p < 0.05 was considered statistically significant.

Results: In the first group with long fasting period, 38 patient showed irregular/segmental pattern, 28 diffuse pattern and 24 showed no significant uptake. In the second group with short fasting period, 32 patients showed irregular/segmental pattern, 30 diffuse pattern and 28 no significant uptake. There is no statistically significant difference between groups between both groups: the chi-square statistic is 0.8909. The p-value is 0.640522.

Conclusion: There was no significant relation between patterns of FDG uptake in the left ventricle and fasting periods in oncologic nondiabetic patients who undergo PET/CT. Overnight fasting is not a reliable method to expect a lower pattern of FDG uptake in the left ventricle of the myocardium.
Abstract ID: 50

**Preliminary Experience with Radiolabelled Macroaggregates in Detection of Extracardiac Right to Left Shunts**

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**Background:** The arteriovenous shunts from right to left (RLS) are most frequently from cardiac origin, although extracardiac shunts in patients without congenital heart disease can be difficult to detect and quantify. The current option is echocardiography contrasted use of microbubbles, which may occasionally have technical difficulties. The whole body imaging with albumin macroaggregates (MAA) labeled with 99mTc allows determining the presence and degree, but not the origin of an eventual RLS. Hepatopulmonary shunts usually have complex management and poor prognosis; they are presented with arterial deoxygenation and require high clinical suspicion in patients with liver disease in the absence of prior primary lung disease. Aim: To characterize the indications and results obtained of patients referred for evaluation of extracardiac RLS with MAA in different centers of our country.

**Methodology:** We reviewed our database since 2008. Whole body anterior and posterior images were made five minutes after I.V. injection of MAA (range 74 - 296 MBq) adjusted by weight in children, in supine position; an additional image in seated position was made to the patient with platypnea-orthodeoxia one day after the first image. Quantification of total body and lung counts was performed with geometric mean, drawing ROIs. Normal value was defined as pulmonary uptake ≥95% of the total. Follow-up was obtained from the institutional medical records and consulted for deaths in national civil registration until March of 2016. This retrospective study was authorized by the Ethics Committee of our institution.

**Results:** We studied eight patients between 2 and 87 years, seven females, five children under 14 years. Two of them underwent a second MAA between 2 - 8 months. Diagnosis reference in children was primary biliar atresia, surgically resolved before liver pretransplant period; in adults, hepatopulmonary syndrome in two cases with chronic liver disease (one with diffuse lung disease) and other with platypnea-orthodeoxia syndrome. Seven out of 8 cases were positive for RLS (87.5%), with an average of 76.2% of lung uptake (range 45-97%). At follow-up, 4 patients died with a median survival of 30 months (range: 10-57) after the study. Complications of chronic liver damage or acute respiratory distress syndrome superimposed to hepatopulmonary. See TABLE. The case of platypnea-orthodeoxia syndrome progressed with pleural effusion; computed tomography showed pleural thickening and nodular liquid cytology demonstrated inflammatory cells. The patient required pleurodesis by thoracotomy; pleural biopsy showed external infiltration (immunohistochemical profile of adenocarcinoma and lung tumor origin).

**Conclusion:** Radionuclide quantitation of RLS is useful in many patients with pulmonary hypertension secondary to chronic liver damage associated with lung disease and primary biliar atresia. Seven of 8 of our cases with suspected RLS were confirmed with MAA- 99mTc. The diagnosis should be considered in any unexpected deoxygenation due to sudden shunt opening, including patients after radionuclide therapy with extensive metastatic liver involvement.
Abstract ID: 51

**Nitrate-Augmented Myocardial Perfusion Imaging for Assessment of Myocardial Viability**

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**Background:** The identification of myocardial viability in patients with coronary artery disease and left ventricular dysfunction, is an important issue because it can be improved by revascularization in regions with poorly perfused but viable myocardium. Several techniques have been described to assess myocardial viability. 201 Tl and 18 F-fluorodeoxyglucose are not available in our country. 99m Tc sestamibi is widely available. Nitrate-augmented myocardial perfusion imaging has been demonstrated to improve the detection of myocardial viability and accurately predicts recovery of left ventricular function.

**Methodology:** A clinical case is presented. This is the first patient wherein assessed myocardial viability by nitrate augmented myocardial perfusion SPECT with 99m Tc Sestamibi in our centre.

**Results:** 55 year old type 2 diabetic patient, with a recent anteroseptal acute coronary syndrome. 90% stenosis of the DA with a failed PTCA. Left ventricular dysfunction with 30% ejection fraction. Patient underwent a 99m Tc Sestamibi SPECT study, at rest and after sublingual nitrate administration (0.5 mg NTG), for evaluation of myocardial viability. Viability was defined as the presence of > or = 2 segments with preserved tracer uptake (> or = 55% of peak activity), with a semiquantitative analysis of 20 steps. The SPECT showed a dilated left ventricular cavity with an intense and big ASA perfusion defect. SRS: 33, TPD: 32%, 37% extent. There was no significant viability in this territory. After nitrate image he had 55% or more tracer uptake in medium and basal anteroseptal segments as well as in inferoseptal.

**Conclusion:** Use of nitrate augmented 99mTcMIBI protocol in Cardiac SPECT imaging results in improved detection of viable but hypoperfused segments.
Abstract ID: 54

Association Between Autonomic and Peripheral Neuropathy with Silent Ischemia and Early Renal Damage in Cardiac Asymptomatic Diabetes Mellitus Patients


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Background: Diabetes mellitus (DM) is a complex condition that could present diverse systemic complications including silent myocardial ischemia, renal damage and cardiac or peripheral neuropathy involvement. Our aim was to assess the association between early electrocardiographic signs of autonomic dysfunction (AD), peripheral neuropathy (PN), early renal involvement and silent myocardial ischemia in non-insulin dependent diabetic patients.

Methodology: As a part of the multicenter trial IAEA-CRP-CHI-13636, we included 32 coronary asymptomatic DM-2 patients older than 45 y.o., 59% males, with a mean of 12 years of disease (range 5-30) and near normal basal electrocardiogram. A myocardial single photon emission tomography (SPECT) with exercise was performed initially and after 3 years, occasion when we measured in microalbuminuria and ultrasensitive reactive C protein (PCR). PN was evaluated with Michigan Neuropathy Screening Instrument (MNSI) and AD with corrected QT interval using Bazett’s formula (QTc) as well as heart rate recovery (HRR) at 1 and 2 min post-maximal stress. Alc hemoglobin (HbA1c), serum creatinine and fasting glycaemia were obtained in both occasions. Initial lipid profile was consigned. Means were compared using t test or Mann Whitney and correlation between variables with Pearson or Spearman according to normalcy distribution (significancy: p<0.05).

Results: Mean initial HbA1c was 8.0% (only 14/32<7.5%) with no difference in the follow-up (p=ns). They reach a mean of 8.7 metabolic equivalents (METS) diminishing their exercise capacity after 3 years (p=0.0204), more significant in the AD group of patients (p=0.0074); mean serum creatinine was 0.89 mg/dL that remained unchanged (p=ns). Initial fasting glycaemia was 174 mg/dL; total, LDL, HDL cholesterol and triglycerides were 185, 44, 108 and 164 mg/dL, respectively; the mean PCR 7.3 mg/l. Mean body mass index 29. - Initially, 11 patients present some degree of silent ischemia and only one has rest decreased global systolic function; 18 accomplished criteria for AD based on HRR and 10 cases PN criteria based on MNSI. - HRR in both measurements was inverse and significantly correlated with QTc, HbA1c, PN patient’s version, microalbuminuria and triglycerides. PCR was also direct and significantly correlated with QTc and ischemia presence. HbA1c was direct and significantly correlated with summed stress score (SSS) in SPECT and also with PN patients score. PN scores were direct and significantly correlated with microalbuminuria and glycaemia. The period with known disease did not associate with any measured parameter.

Conclusion: In cardiac asymptomatic diabetic patients, there was silent ischemia in around a third of them, with presence of early AD signs. In the whole group follow-up, we could demonstrate PN and early renal damage expressed with microalbuminuria. There was a clear association between AD parameters, PN scores, presence of silent ischemia and glycemic and metabolic control as well as PCR, as a marker of non-specific systemic inflammation. These features reinforce the concept of a good metabolic disease control, independent of the length of the disease.
The Significance of Thallium-201-Chloride SPECT Myocardial Perfusion Imaging in Management of Patients with Chronic Coronary Heart Disease

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Background: Functional evaluation of myocardial segments by scintigraphy has functional significance compared to anatomical significance expressed as percent of vascular lumen narrowing and it is useful to check the functionality of scintigraphic segments of the heart muscle before making management decisions which is in line with the recommendation of the European Society of Cardiology (ESC) advising non-invasive assessment of myocardial viability in chronic coronary artery disease within multi-disciplinary team (heart team) (1,6).

Methodology: In 159 patients diagnosed with chronic coronary disease by cardiologists, myocardial perfusion scintigraphy with thallium-201 (Tl-201 MPI) has been requested. All patients showed well-developed collateral circulation in the area of the culprit artery (87 men, 72 women, median age 60 years, range 38-84 years). All patients underwent standard exercise-redistribution thallium single-photon emission computed tomography (SPECT) and were followed up at >1 year. We compared the results of an echocardiography (ejection fraction-EF, wall motion), the degree of the achieved load (exercise test) as well as quality of life (the emergence of new ischemic attacks during the one-year follow up) after the pursuit of therapy (optimal medical therapy-OMT, or percutaneous coronary intervention-PCI). We investigated the correlation of anatomical (angiographic) and functional (scintigraphic) characteristics of the coronary vessels and determined the diagnostic and predictive characteristics of certain findings observed by measured variables: ejection ability or ejection fraction (EF), cardiac wall motion abnormalities, exercise tolerance, quality of life through a year in terms of the emergence of new ischemic attacks with a view to a better quality of selection and choice of therapy: the optimal medical therapy (OMT) and / or invasive treatment or PCI.

Results: In the subgroup of patients with reverse redistribution on scintigraphic images there was a significantly better exercise tolerance ≥85% (q2 test = 30.645; P <0.001), ejection fraction EF≥50% (exact test; P <0.001), wall motion parameters (exact test; P <0.001), a lower degree of myocardial necrosis and a smaller number of ischemic attacks during one year follow up (exact test, P = 0.020). Optimal medical therapy was more common in patients who did not have a new ischemic attacks. It has been shown that in patients with scintigraphic finding of myocardial ischemia, percutaneous coronary intervention (PCI) is the most common type of therapy in those who did not have a new attacks during one year follow up (exact test; P <0.001).

Conclusion: Reverse redistribution of Tl-201 on scintigraphic images is an indicator of myocardial functionality and sufficient reason for delay or cancellation of invasive treatment of patients with chronic coronary heart disease. Key words: coronary disease, scintigraphy, angioplasty, collateral circulation
Assessment of Left Ventricular Ejection Fraction in Left Ventricular Failure on a Gated Rest Redistribution Myocardial Perfusion Scintigraphy using Ultra Low Dose Thallium 201 (Tl201) using Fast Solid State Detector Gamma Camera: The Experience at Fortis Escorts Heart Institute, New Delhi, India.

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**Background:** The aim of the study was to assess the efficacy of solid state detector gamma camera in the assessment of left ventricular ejection fraction (LVEF) on ultra low dose gated Rest-Redistribution thallium-201 myocardial perfusion scintigraphy (G-RRT-MPS) and comparing it with 2-Dimensional Echocardiography (2DE) at our institute in patients with Left Ventricular Failure (LVF).

**Methodology:** A group of consecutive patients (n=92 :11 females & 81 males; mean age 62.8 yrs) with LVF from ICUs/emergency department were subjected to G-RRT-MPS for myocardial viability. Exclusions from the study include patients with arrhythmias. All patients were injected low-dose intravenous Tl201 (1-1.5 mCi) & immediate & 4 hrs post injection images were acquired under solid state detector SPECT gamma camera (GE- Discovery NM 530C) with the imaging time of 6 min each. The images were processed using 3D iterative reconstruction and interpreted by 2 nuclear physicians separately where LVEF were calculated using commercially available QGS/QPS software. All patients were subjected to 2DE and LVEF were calculated by modified Simpsons’ rule by two different cardiologists in a double blinded manner. The mean results of G-RRT-MPS & 2DE were compared for LVEF. 10 subjects with normal LVEF were subjected to Gated Tc99MIBI SPECT & 2DE for comparing the inter echo & gated MPS differences to use it as the standard.

**Results:** The results showed mean LVEF of 28.9%±07% & 29.3%±6.8% for 2DE & G-RRT-MPS respectively which showed almost comparable results(p=0.293). All LVEF measurements by both the modalities showed good correlation ( r=0.861, P=<.001) (fig 1). The concurrence was good as analysed by Bland-Altman method (fig 2). The mean discrepancy between the modalities was -0.4 with a 95% confidence range of -1.2 to 0.4. Thallium 201 (TI201) because of its physical characteristics (redistribution & non dependence on active mitochondria for myocardial uptake) continues to be the radiotracer of choice for the assessment of myocardial viability at our institute. The low energy as well as high radiation exposure are the drawbacks which reduces the quality of gated SPECT & thus makes it difficult to get proper assessment of LVEF. The direct energy conversion, increased spatial & energy resolution and pin hole detectors improves low dose image quality which showed increased efficacy over conventional camera & thus can depict LVEF with accuracy. Not many studies compared Left Ventricular Ejection Fraction (LVEF) by G-RRT-MPS with 2D-Echocardiography (2DE). The present study showed good LVEF correlation between 2DE & G-RRT-MPS.

**Conclusion:** The LVEF measurement on ultra low dose G-RRT-MPS by solid state detector gamma camera is quite accurate & can be used routinely for myocardial viability studies as well as dual isotope imaging.
**Impact of Gated SPECT Myocardial Perfusion Imaging in Clinical Management of Patients after Coronary Revascularization: An Observational Study**

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**Background:** Gated SPECT myocardial perfusion imaging (GS MPI) is a preferred modality for the non invasive assessment following coronary revascularization (CR) both in symptomatic and asymptomatic patients. There is inadequate data regarding impact of a post CR MPI on further management of the patients in Bangladesh. This study was designed to obtain and analyze information regarding this issue.

**Methodology:** GS MPI of 710 patients was performed at the National Institute of Nuclear Medicine and Allied Sciences over a period of 31 months from June 2011 to December 2013. Patients who were referred for assessment of revascularization were selected for this study. A semi-structured telephonic interview of patients to obtain information about the management plan adopted by referring physicians in response to the post CR GS MPI was conducted in December 2012 and in March 2016.

**Results:** Sixty eight patients (66M, 2F) with mean age of 56.9 ± 8.1 (range = 38 to 77) years underwent MPI for the purpose of post CR assessment. Follow up data of 55 patients (54M, 1F) with mean age of 59.6 ± 8.6 (range = 38 to 77) were available. MPI was performed in between six months to 13 years after CR (mean 43.8 ± 48.2 months). Categorically 33 patients had percutaneous transluminal coronary angioplasty (PTCA) with stent, 16 patients had coronary artery by-pass grafting (CABG) and 6 patients had both CABG & PTCA. All underwent one day stress-rest MPI; treadmill exercise stress was done in 19 patients, pharmacological stress with dobutamine infusion was done in 32 patients and adenosine stress was done in four patients. MPI results revealed 38 abnormal scans and 17 normal scans. Among the patients having abnormal scans, 19 had reversible defects in revascularized territories, 10 had fixed defects in revascularized territories, 7 had ischemia in previously non revascularized territories and two patients had fixed defect in previously non revascularized territory. Twenty seven among the 38 patients with abnormal scan and 12 among 17 patients with normal scans were symptomatic. Medications were kept unchanged in 25 (abnormal/normal = 15/10) patients, reduced in two (both having normal MPI) while maximization of medication was done in 16 (abnormal/normal = 13/3) patients. Coronary angiogram (CAG) was advised for 6 patients, all having abnormal MPI. Other management advises were extracorporeal shock wave myocardial revascularization in two (both had abnormal scan), further PTCA in two (abnormal/normal = 1/1), CABG in one (abnormal scan) and further work up with cardiac PET in one (normal scan).

**Conclusion:** This study based on the experience of a single institute shows that a post CR MPI could contribute to workable clinical management of patients by avoiding CAG, an invasive workup procedure, in a significant proportion of patients. Keywords: Gated SPECT, Myocardial Perfusion Imaging (MPI), Coronary Revascularization
Inter-observer Variability of Reporting Myocardial Perfusion Imaging

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**Background:** Myocardial perfusion imaging (MPI) is one of the most common nuclear medicine investigations carried out in the large hospitals. The value of this investigation in the clinical decision making for the patients with coronary artery disease (CAD) is well established. Common situation is that in the same department myocardial perfusion imaging is reported not by the single nuclear medicine physician. Low inter-observer variability between reporting nuclear medicine physicians of the same department is crucial, especially in the patients’ follow up. According to the literature, acceptable level of inter-observer variability in the same institution is up to 2%. The aim of our study was to verify the inter-observer variability in Vilnius University hospital Santariskiu Klinikos between the two most frequently reporting cardiac imaging nuclear medicine investigators.

**Methodology:** We have randomly selected 30 patients with known CAD, who were investigated performing cardiac MPI, in a period 2013-2015 years. Two investigators blindly evaluated and reported cardiac MPI tests. Myocardial perfusion was scored visually by use of a 17 segments, 5-point scoring method. Summed stress scores (SSS), summed rest scores (SRS), summed difference scores (SDS) and the number of ischemic segments at stress (NSS) and at rest (NRS) were collected by both investigators. Agreement between the data was investigated by use of Bland-Altman plotting, and correlation was assessed using Pearson’s correlation coefficient.

**Results:** The 95% limits of agreement found by Bland-Altman analysis were 1.1 ± 4.7 scores for SSS, 0.6 ± 2.9 scores for SRS, 0.1 ± 3.4 scores for SDS, 0.06 ± 1.03 for NSS and 0.03 ± 1.01 for NRS. Correlations between two investigators’ reports were very high for the SSS, SRS, NSS, NRS, and ranged between 0.937 – 0.948 (p<0.05). The SDS correlation was found to be 0.749 (p<0.05).

**Conclusion:** The agreement between both investigators reports was good, presenting no significant differences reporting MPI. However, the inter-investigator correlation for SDS, clinically the most important marker representing the extent of the LV ischemia, in our data was not sufficiently strong. These data suggest to review the reporting manner at Vilnius University hospital Santariskiu Klinikos to further eliminate possible misinterpretation of MPI, to ensure the proper treatment approach and follow up for the CAD patients.
Value of Cardiac SPECT as a Predictor of Cardiotoxicity in Patients with Prostate Cancer Treated with Abiraterone Acetate

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Background: Abiraterone is a selective, potent, and irreversible inhibitor of CYP17, a key enzyme in testosterone synthesis, and improves overall survival in postdocetaxel metastatic castration resistant prostate cancer (mCRPC). According to the international literature the overall incidence of adverse cardiac effects is lower, the frequency of cardiac failure is less of 5%. Heart failure is the most common manifestation of chemotherapy induced cardiotoxicity. The purpose of this study is to evaluate the incidence of heart failure by using gated cardiac SPECT with 99mTc-MIBI, in symptomatic patients post-treatment with abiraterone acetate plus prednisone.

Methodology: Twenty patients mCRPC with suspected heart failure after the treatment with docetaxel, and previous to received abiraterone acetate, were examined using gated 99mTc-MIBI SPECT (8 gates/cardiac cycle) 60 minutes after tracer injection at rest, between February 2014 to September 2015. End-diastolic/End-systolic volumes (EDV, ESV), and ejection fraction (LVEF) were calculated from gated 99mTc-MIBI SPECT using QGS software.

Results: Twenty patients aged 68.6 years (45% had hypertension, 35% had diabetes mellitus and 20% both), and the average serum creatinine level were 1.15mg/dl. The overall LVEF was 53.8 ± 1.4%, EDV 102ml, ESV 51ml; and the perfusion pattern was abnormal in 8 patients (2 patients with hypertension, 2 patients with diabetes mellitus and 4 patients with both). During follow-up period of 20 months ± 2 months; 5 patients (4 patients with hypertension and diabetes mellitus; and 1 patient with hypertension, the average of serum creatinine level of this 5 patients was 1.29mg/dl) developed heart failure, characterized by decline in LVEF of at least 5% to less than 55% with accompanying signs and symptoms of congestive heart failure, such as third heart sound (S3) gallop, tachycardia, dyspnea, peripheral edema and asthenia, after two-four doses of abiraterone acetate. The value of gated SPECT was higher obtaining sensitivity, specificity and PPV of 100%, 80% and 75% respectively.

Conclusion: We conclude that perfusion gated SPECT is a useful noninvasive screening test and may be proposed to help identify cardiac failure after the treatment with abiraterone acetate in patients mCRPC with hypertension, diabetes mellitus and chronic renal damage underlying with a high risk of poor clinical outcome. Abiraterone acetate plus prednisone treatment was generally well tolerated, and safety results were consistent with previous studies; however, this is the first study that includes postdocetaxel symptomatic patients with more than two comorbidities in Mexican population.
Abstract ID: 67

**Prognostic Utility of Biventricular Dyssynchrony Parameters Derived From Gated Blood Pool SPECT Phase Analysis in Patients with Non-Ischemic Dilated Cardiomyopathy**

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**Background:** Coronary resynchronization therapy (CRT) has emerged as a promising tool in the management of patients with heart failure. Planar ERNA and myocardial perfusion SPECT based phase analysis are increasingly being utilized in the assessment of degree of dyssynchrony and has shown its potential to assess the response following resynchronization. The utility of blood pool gated SPECT based phase analysis especially involving the right ventricle in these patients is not well addressed. Aim: The aim of the present study was to evaluate the utility of dyssynchrony parameters derived from phase analysis of gated blood pool SPECT in predicting cardiac death in patients with non-ischemic dilated cardiomyopathy.

**Methodology:** A total of fifty-three patients diagnosed with non-ischemic DCM (with normal coronaries on invasive angiography) were included in this retrospective study. All the patients underwent gated blood pool SPECT imaging for the assessment of right and left ventricular function including ejection fractions. Phase analysis of gated blood pool SPECT data was performed using Quantitative Bloodpool SPECT (QBS) software and global dyssynchrony parameters (Mean, SD) were derived, separately for both ventricles. Patients were followed-up clinically and / or telephonically and the most recent clinical follow-up was more than three months. Cardiac death (sudden / progressive heart failure) was considered as the end point. Univariate analysis of biventricular dyssynchrony parameters and available clinical/electrocardiographic parameters (NYHA class, BMI, QRSD) was performed. Multivariate Cox proportional hazards regression analysis was also performed using variables that showed significance on univariate analysis.

**Results:** Data of fifty-three patients (33 males, 20 females; mean age 44 ± 13 years) was analyzed. The mean LVEF on echocardiography was 31.2 ± 11.9 %. Seven of the 53 patients (13.2 %) had died due to cardiac events during the total follow up period (21.7 ± 8.5 months). On univariate analysis, patients died due to cardiac events had lower BMI (p=0.048), greater percentage of prolonged QRS duration (p=0.013) and severe LV dyssynchrony. No significant correlation was noted with the NYHA class (p=0.645) and presence of RV dyssynchrony (p=0.09). Multivariate Cox analysis showed that severe LV dyssynchrony alone (hazards ratio: 3.102; p=0.032) or in combination with RV dyssynchrony (hazards ratio: 5.163; p=0.018) was predictive of sudden cardiac death in these patients.

**Conclusion:** Our results suggest that severe LV dyssynchrony is predictive of cardiac death in patients with non-ischemic DCM. Presence of RV dyssynchrony in addition to LV involvement further increases the risk of cardiac death, requiring the greater need for CRT in patients showing biventricular (LV and RV) dyssynchrony.
Abstract ID: 72

Combined Assessment to Known Coronary Arterial Disease Using 64-slice Computed Tomography and Myocardial Perfusion Scintigraphy (SPECT) – A Multifactorial Analysis

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Background: Coronary artery calcifications are markers of coronary atherosclerosis, but do not correlate well with ischemia or stenosis severity. This study intended to evaluate the combined approach of myocardial perfusion imaging (SPECT) and severity of obstructive disease by 64-slice computed tomography (CT), in a Brazilian population with known coronary artery disease (CAD).

Methodology: We retrospectively analyzed 413 patients who underwent SPECT and CT in 2009. From this sample, 126 had known CAD, and 4 of them had no information about coronary arteries in the CT. Coronary artery calcium score (CACS) was automatically defined and Agatston score was semi-automatically calculated. SPECT and CT results were evaluated by semi-objective visual quantification. For stenosis severity analysis, a coronary score (CS) was created, dividing patients into two subgroups, non-obstructive (0,1,2) and obstructive disease (3,4,5). Associations of tests results with clinical and stress test variables were analyzed.

Results: We included 122 patients with known DAC (82.5% men, mean age 62.3 ± 10.9 years; range: 32-86 years). The majority of these patients had familial history of coronary disease (76.2%). Hypertension was present in 50.8%, diabetes in 21.3%, dyslipidemia in 41.8%, and smoking in 8.2%. Coronary calcification was observed in 92.1% of them, 74.6% had CS ≥ 3 and some ischemic abnormalities were seen in 24.6% of this subgroup vs 16.1% in the other. An association was observed among CS and diabetes (DM) (p=0.019), CS and CACS percentile (p< 0.001) and, CS and CACS (p<0.001). No association was observed among CS and any other variables, including ischemia.

Conclusion: Patients with obstructive disease (CS ≥ 3) were associated only with DM, and calcium on CT. We are unable to show association between ischemia and higher CS.
Abstract ID: 74

Does the Level of Stenoses in Single Vessel CAD Involving the Left Anterior Descending Artery Correlate with Thallium Defect Pattern in Myocardial Perfusion Scintigraphy?

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Background: Apart from being invasive, coronary angiography does not show the real effect of stenoses on myocardial blood flow. However, the myocardial perfusion scintigraphy shows the real ischemic burden on the myocardium in CAD patients and to correlate this reversible defect pattern with the level of stenoses, if possible; can be of good guidance to the clinicians, at least in single vessel disease patients.

Methodology: In continuation of our previous study in which we showed a relationship between the MPI defect pattern and level of stenoses in SVD patients; in this study, we aimed to validate our findings by reverse matching i.e the CAG findings to the thallium reversible defect patterns. We carried out this study in 245 patients out of 1000 patients in the study period of 8 months, who had SVD involving the left anterior descending based on recent CAG done in the same hospital. Of these, 132 patients had proximal stenoses (proximal to and including first major septal branch – as per SYNTAX scoring for coronary stenoses), 54 patients had mid stenoses (after S1 origin to ½ of distance up to apex) and 59 had distal stenoses (terminal portion of LAD). The MPI was done with a single isotope protocol in our department by injecting 18 mCi of 99m-Tc-Sestamibi at rest and acquiring images 30-40 minutes later; and injecting 28 mCi of at peak exercise and acquiring images 45-60 minutes later

Results: Five patterns of reversible perfusion defects were identified: type I (apex, anterior wall and septum), type II (apex and septum), type III (antero-septal wall), type IV (apex and anterior wall) and type V (apex).

Conclusion: On correlating with the CAG findings available, proximal stenoses (in 110 of 132) correlated with type I, II and III; mid stenosis (in 38 of 54) with type IV and distal stenoses (in 31 of 59) with type V. So, this study does validate our previous findings by reverse matching the stenosis level and the defect pattern. Hopefully this recognition will be useful for identifying patients with angina who are likely to have proximal LAD stenoses.
To Explore the Role of FDG-PET in the Evaluation of Disease Activity Status in Large Vessel Vasculitis and its Correlation with Inflammatory Markers

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Background: In addition to its established role in oncology, the potential role FDG-PET is being explored in a host of non-oncological applications. The metabolic information provided by PET imaging also is being utilized in assessing infective active inflammatory conditions like vasculitis. The diagnosis of large vessel vasculitis like Takayasu arteritis is made from clinical symptoms due to ischemia, imaging techniques and general inflammatory markers. The disease activity status is estimated from the levels of general inflammatory markers such as C-reactive protein and erythrocyte sedimentation rate. However, the non-specific nature of these markers limits their potential as good surrogate markers for evaluation of disease activity. In addition, the diagnosis of Takayasu arteritis often takes time because the discernible appearance of vascular lesions is a long process. Early identification of the inflammation in the vasculature may facilitate timely intervention in the early stages before vascular deformities are established.

Methodology: We explored the potential use of FDG-PET in identifying and localizing large vessel arteritis, following disease activity after therapy, and comparison of findings with acute phase reactants and clinical symptoms. FDG-PET scan was performed on a Siemens’ Biograph mCT of the referred patients.

Results: 18F-FDG PET images coregistered with contrast enhanced CT images demonstrated inflammatory activity in the aorta and its branches, in 3 patients with active Takayasu arteritis, one of which had normal levels of inflammatory markers. A diagnosis of large vessel vasculitis was arrived at based on the laboratory data and PET-CT findings, and large dose steroid therapy was initiated. Follow up scans demonstrated normalization of FDG uptake, demonstrating the role of FDG-PET in response assessment. In 2 patients out of which one had long standing Takayasu’s arteritis, no abnormal FDG uptake was evident despite raised CRP and ESR levels, underlying advantage of PET in differentiating active vasculitis from the chronic/quiescent phase of the disease.

Conclusion: FDG-PET was useful in correctly identifying active disease, even when serology was normal, signifying incremental benefits of PET. In the subset of patients with normal PET findings, abnormal serology was eventually ascribed to other conditions like arthritis and tuberculous synovitis; underlying the importance of PET in differentiating active disease from the chronic or quiescent phase in known cases and clinching diagnoses in suspected cases.
Abstract ID: 76

**GCB Type Primary Cardiac Lymphoma on FDG PET-CT**

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**Background:** Primary cardiac tumors are rare, and of these, primary cardiac lymphomas (PCL) account for less than 1%. It is defined in a strict sense as a non-Hodgkin lymphoma involving only the heart and pericardium; or the bulk of tumor is within the pericardium causing cardiac symptoms from lymphomatous cardiac infiltration. PCL was previously diagnosed largely at autopsy, but recent advances of imaging techniques, myocardial biopsy and cytology have made ante-mortem diagnoses possible. PCL favors the right side of the heart; a possible, novel, anatomic explanation being the finding that the thoracic duct drains lymph into the SVC, and subsequently into the right atrium and ventricle, meaning the right heart would more readily and frequently be exposed to any pre-existing nodal lymphoma. It occurs almost exclusively in elderly and immunosuppressed patients, but very infrequently can develop in young and immunocompetent patients also possibly because of subclinical immunosuppressive state.

**Methodology:** The clinical presentation varies, commonly involving AV block or heart failure; but presence of arrhythmia and LV involvement deems poorer prognosis. We report a 22-year-old young boy who presented with SVC syndrome; CECT scan revealed an infiltrative mass at the right atrium inlet, occluding the SVC flow. Urgent surgical resection revealed a soft mass which on histopathological-examination was found to be lymphoma. To look for any other local/distant focus and explore the possibility of it being primary cardiac lymphoma, FDG PET-CT examination was done which showed no other FDG avid focus (lymphnode or bone marrow involvement), though it has been suggested that PCL may show microscopical metastases in advanced disease.

**Results:** Most of the reported cases of PCL are diffuse large B cell lymphoma, with a minority of them being T cell type. Recently, DLBCL has been classified into germinal center B cell-like (GCB) and non-GCB according to the immunohistochemistry of CD10, BCL-6 and MUM1. In general, non-GCB type is more common and shows poorer prognosis than GCB. The present case was a rare GCB lymphoma which may indicate the better prognosis of the present case.

**Conclusion:** Abnormal F-18 FDG uptake has been described in several benign and primary malignant cardiac lesions (cardiac myxomas and angiosarcomas respectively). The utility of FDG PET-CT lies in making differentiation of the intracardiac structures much easier, more precise and giving a whole body perspective to decide whether it is lymphomatous involvement of extra-cardiac lymphoma or a primary cardiac lymphoma; because as discussed above, PCL itself has poorer prognosis.
Evaluation of the Role of 18F-FDG Cardiac PET and 99mTc-SESTAMIBI Resting Myocardial Perfusion Imaging in Assessing the Therapeutic Benefit in Patients with Coronary Artery Disease and Left Ventricular Systolic Dysfunction

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Background: Coronary revascularization could improve the survival rate and left-ventricular (LV) function in patients with coronary artery disease (CAD) with LV dysfunction. However, revascularization in these patients is often associated with high cardiac-mortality. Optimal evaluation of these patients before revascularization is very important for reducing the cardiac mortality. Myocardial viability imaging using 18F-FDG cardiac PET & 99mTc-sestamibi myocardial perfusion imaging is an established modality to identify and quantify extent of hibernating myocardium.

Methodology: Fifty-nine patients (43 males, 16 females, with CAD and LV systolic dysfunction, diagnosed with hibernating myocardium on myocardial viability imaging) were enrolled in this study. These patients were treated with either revascularization (interventional / surgical) or optimal medical treatment (OMT). All patients were followed for a mean duration of 7.9 ± 3.8 months for assessing therapeutic benefit. Therapeutic benefits were assessed under 3 categories namely: (a) improvement in functional class, (b) adverse cardiac -events during follow-up and (c) improvement in LV function and myocardial perfusion on follow-up resting 99mTc-sestamibi myocardial perfusion imaging (MPI).

Results: Twenty-nine patients underwent revascularization (49%) either by PTCA (n=11) or by CABG (n=18). Twenty-five patients received optimal medical treatment (42%). Five patients were lost to follow-up. There was no significant difference between revascularization and OMT groups in terms of baseline characteristics of patients. Significant improvement was noted post-revascularization in patient’s symptoms, NYHA functional class and CCS angina class. No significant improvement was noted in the OMT group in patient’s symptoms, NYHA functional class or CCS angina class. Twelve patients suffered from cardiac -events, including nine cardiac-deaths and three hospitalizations due to cardiac causes. The cardiac - event rate was significantly higher in “optimal medical treatment (OMT)” group than “revascularization” group (36% vs. 10.3 %; p = 0.046). At 1 year follow-up, event-free survival in revascularization group was significantly superior compared to OMT group (83.8% vs. 50.8%; p= 0.039). On follow-up resting MPI scan, significant improvements were noted in mean LVEF in both revascularization and OMT treatment groups. However, mean improvement in LVEF was significantly higher in revascularization group than in OMT group (6.0% vs. 1.4%; p=0.04). Improvement in LVEF correlated significantly with improvement in NYHA functional class (p =0.004 and CCS angina class (p = 0.046).

Conclusion: Myocardial viability imaging using 99mTc- Sestamibi myocardial perfusion imaging and 18F-FDG PET is a sensitive modality to identify the presence of hibernating myocardium in patients with coronary artery disease and left ventricular systolic dysfunction and predicting recovery following revascularization.
Abstract ID: 80

Demographics and Trends of Patients Who Underwent Myocardial Viability Imaging Using 18F-fluorodeoxyglucose (FDG) PET Imaging: An Institutional Experience

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Background: The determination of significant, viable myocardium in patients with severe left ventricular (LV) dysfunction is crucial as revascularization for these patients can reverse their LV dysfunction. Studies have shown that an 18F-fluorodeoxyglucose (FDG) PET scan and a Thallium-201 with re-injection protocol are comparable to each other in terms of sensitivity to detecting viability, while some studies also show that the former is more sensitive than the latter. Currently, however, FDG PET for detecting myocardial viability remains underutilized in clinical practice in the Philippines. As such, the aim of this study is to identify the demographics and characteristics of patients who have undergone myocardial viability imaging, using FDG PET, in the institution with the most number of referrals for the said study. The data gathered may serve as a valuable tool in identifying patients who would benefit more from an FDG PET as opposed to SPECT imaging and encourage clinicians to further utilize FDG PET.

Methodology: A retrospective chart review of the 32 referrals for myocardial viability using FDG PET from June 2002 to December 2015 was done. All of them underwent a SPECT perfusion scan and an FDG PET to assess myocardial viability. Results of the SPECT perfusion scan and the FDG PET were noted and compared.

Results: There were 32 referrals for myocardial viability using FDG PET from June 2002 to December 2015, which is less than 1% of the total referrals for PET/CT. There were 27 males and 5 females, whose ages ranged from 19 to 91 years old. The indication for all of the studies were for the evaluation of myocardial perfusion and viability. The top three co-morbidities in these 32 patients were as follows: 1) hypertension 2) Diabetes Mellitus and 3) dyslipidemia. Of these 32 patients, 31% had a previous diagnosis of myocardial infarction (MI) on SPECT imaging that also showed non-viable myocardium on PET. In contrast, 15.5% of the patients, who had MI on SPECT, were noted to have significant viable myocardium on FDG PET. Thirty eight percent patients who have no clinical or scintigraphic history of MI but had multiple co-morbidities, showed viable myocardium. Of these 32 referrals, there were also 15.5% who had no clinical or scintigraphic history of MI, but had multiple co-morbidities, were noted to have non-viable myocardium on FDG PET. Based on these results, patients who are noted to have non-viable myocardium on SPECT imaging and/or multiple co-morbidities, may benefit from further investigation of myocardial viability using FDG PET.

Conclusion: Despite the limited availability of FDG PET for myocardial viability and its increased cost compared to SPECT imaging, FDG PET for myocardial viability still offers the opportunity for a comprehensive, accurate and non-invasive evaluation that may greatly impact the management of severe LV dysfunction in certain individuals.
Normal Values for 131I-MIBG Myocardial Sympathetic Imaging: Thailand Database (Preliminary Report)

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Background: 123I-MIBG has been used for evaluating severity, and prognosis of patient with heart failure. In addition, the MIBG study showed markedly decreased myocardial uptake in some type of neurodegenerative brain disease such as Parkinson’s disease. Due to lack of 123I in some countries, 131I-MIBG may have value in these conditions. However, there is no normal database of cardiac 131I-MIBG in the literature. Our plan is to establish normal database for cardiac 131I-MIBG, which represent in term of early and late heart to mediastinum ratio (H/M), as well as washout rate.

Objective: This prospective study aims to establish normal values for 131I-metaiodobenzylguanidine (MIBG) myocardial sympathetic imaging using Thailand database. The secondary aim is to compare these values between normal subjects, and neuroendocrine tumor (NET) positive patients.

Methodology: We prospectively included patients who were sent for 131I-MIBG scan at King Chulalongkorn Memorial Hospital since Mar 2014. Patients with specific conditions which may interfere with cardiac MIBG uptake were excluded. Additional anterior planar images at chest were acquired at 20 min (early) and 180 min (late) after intravenous injection of 55 MBq of 131I-MIBG, then the routine protocol was acquired. Planar images were obtained in 256 × 256 matrices, using high energy collimator. Acquisition time was 300 sec. The energy for 131I was centered at 364 keV with a window of 20%. The patients were categorized as the case group if there was confirmed evidence of NET from laboratory and/or imaging results. A region of interest (ROI) was set over the heart and a rectangular ROI on the upper third of the mediastinum. The early and late H/M average count ratios, and washout rate were calculated. Unpaired T-test was used to compare the values between normal and case group.

Results: There are 5 patients in each groups. The age range between 17-64 years in normal, and 14-52 years in case group. The mean± standard deviation (SD) of early H/M, late H/M and washout rate are 2.15± 0.47, 1.93± 0.44, and 24.66± 8.72 in normal, and 1.75± 0.28, 1.60± 0.32, and 37.16%± 19.85 in case group. The early and late H/M tend to be higher in normal group, while the washout rate tends to be lower. However, this does not reach statistical significance (P-value = 0.052, 0.104, and 0.150, respectively).

Conclusion: Myocardial MIBG uptake has role in both cardiac, and non-cardiac diseases. The normal database of cardiac 131I-MIBG is useful in some countries lacking of 123I. This is the first preliminary report of normal database for cardiac 131I-MIBG scan.
Abstract ID: 84

Current Status of Nuclear Cardiology in Romania

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Background: Non-invasive myocardial perfusion imaging (MPI) is an important tool in detecting and in risk stratification of obstructive coronary disease. Despite the relatively low specificity – myocardial perfusion SPECT is the most frequently used worldwide cardiac imaging technique. With a population of 22 million people Romania is one of the largest countries in Eastern Europe. According to data published by IAEA and WHO, 80% of cardiovascular disease deaths occurred in low- to middle-income countries. In a report published in 2008, in Romania there were the highest cardiovascular related mortality rate in the EU countries, with more than 25% of these deaths being in patients younger than 65. Aim: To asses and present the current status and future direction of development in the field of Nuclear Cardiology in Romania

Methodology: In Romania, Nuclear Medicine specialists are trained and licensed to perform and report Nuclear Cardiology studies, after completing formal training in nuclear medicine and after being licensed in the use of unsealed sources by the radiation control department of the Government. However there is a matter of concern in performing stress studies which is not allowed to be done without the cooperation with a cardiologist. In this paper we have reviewed the main issues concerning the use of Nuclear Medicine techniques in the field of cardiology. Data were collected from websites of Nuclear Medicine departments, but also from the Romanian Society of Nuclear Medicine and from the National Insurance Company website.

Results: Currently, less than 10% of Nuclear Medicine studies are nuclear cardiology examinations. In Romania, there are 30 Nuclear Medicine departments, 6 of them with PET-CT capabilities. 9 Nuclear Medicine departments are in the private sector. There are only 7 departments in which MPI SPECT is performed – 6 in public, 1 in private. The limited budget for radiopharmaceuticals seems to be the main reason which influences decision of head of departments to perform more general NM studies and few MPI. This together with low reimbursement is discouraging departments to start real projects in Nuclear Cardiology. Private sector faces similar issues, because most patients are insured in the National Public System, with only a minority privately insured. Currently, no department is using PET-CT for myocardial imaging, mainly because reimbursement in PET is allowed only for oncologic indications. However there are several projects which include installation of PET-CT scanners in some university-related hospitals where new procedures including cardiology and neurology will be introduced. With a high prevalence and mortality related to CVD and various co-morbidities, efforts should be made in order to increase capabilities of departments to perform nuclear cardiology studies in order to ensure a higher diagnostic precision, risk stratification and a better management of patients.

Conclusion: Increased use NM applications in the field of cardiology will require a larger number of nuclear medicine specialists to increase their skills by accessing dedicated courses/trainings. Efforts should be made in this respect, to ensure high quality inves- tigations and improve diagnostic management.
Abstract ID: 86

**Supine Stress Position as a Maneuver to Improve Positivity in Cardiac Gammagraphy in the Diagnosis of Ischemic Heart Disease**

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**Background:** Ischemic Heart Disease is now a pandemic. It is the leading cause of death in the West and increasingly imposes a significant economic burden. There are different methods for diagnosing Coronary Ischemia, which include the Stress Test Electrocardiogram. This test is one of the main tools for the study of these patients, based on availability and ease of use. It is supplemented by heart scans to improve diagnostic accuracy. Physiologically, after stress in the supine decubitus position, there is an increase in venous return to the heart, which increases the intracavitary telediastolic pressures and parietal stress. This physiologically favors the increase of the consumption of myocardial oxygen and can exacerbate Myocardial Ischemia obtaining increased positivity of the Stress Cardiac Gammagraphy. This maneuver increases the positivity of this procedure, although this assumption has not been fully validated. Purpose: The purpose of this paper is to take advantage of this physiological effect and use this method to increase the sensitivity of the Cardiac Scintigraphy Stress Test. If validated, this maneuver would be a simple enhancement to this procedure. Additionally, there is no cost for its implementation.

**Methodology:** This study included 80 patients, altering the supine position randomly. These patients were divided according the results of Cardiac Gammagraphy and the Stress Test. This was a comparative, descriptive, and retrospective study.

**Results:** Of the 80 patients, 36 were not put in supine position of which 4 had normal Gammagraphy study; 44 patients were placed in supine position and 6 had normal scintigraphy. Twelve patients had anginal pain and 68 denied any symptoms during the stress test. Twelve patients were not placed in a supine position in the scintigraphic study, 20 patients had ischemia and when placed in supine position, showed ischemia in the grammagraphy study. The uses of the supine position on the scintigraphic results were compared.

**Conclusion:** It is believed that the results of this study may lay a foundation for future research with a larger number of patients, establishing their sensitivity and specificity. If there is significant support, their use to place all patients’ supine position routinely at the end is physical stress before the acquisition of scintigraphic imaging cardiac ischemia seeking.
Background: Regadenoson (REG), a selective agonist of A2A adenosine receptors, has a much lower risk of bronchoconstriction when compared to adenosine, due to negligible activity through the A2B and A3 receptors. Several studies support the use of REG in patients with mild to moderate chronic obstructive pulmonary disease (COPD). In addition, the combination of low-level exercise during administration of REG has been shown to be safe with a significant improvement in the adverse events profile together with a higher image quality. We aim to assess the safety of REG, combined with low-level exercise in subjects with severe COPD, referred for myocardial perfusion imaging (MPI).

Methodology: We studied prospectively 14 patients (13 male, age 70 ± 6 years) with severe COPD without any of the exclusion criteria (active wheezing and oral corticosteroid therapy for pulmonary disease). Stress was 4 minutes of low-level exercise with bolus injection of REG (0.4 mg) at 1.5 minutes, followed by saline flush and 99mTc-MPI agent injection and a new saline flush. Demographics, medical history, adverse events, oxygen saturation (SatO2), changes in systolic blood pressure (SBP), and heart rate (HR), were registered.

Results: The observed adverse events profile of REG was similar to that of patients with mild-moderate COPD. There was no clinical exacerbation of COPD, and SatO2 did not change from baseline (96% vs 96%). Adverse events were self-limiting: dyspnea (35.7%), fatigue (28.6%), chest pain, headache, gastrointestinal discomfort, and feeling hot (21.4% respectively), dizziness (14.3%), dry mouth and flushing (7.1%, respectively). 21.4% of patients did not report any symptom. We observed significant increases in SBP and HR from baseline (141.4 mmHg ± 20.2 vs 152.5 mmHg ± 18.5, and 81 b.p.m. ± 19 vs 107 b.p.m. ± 22, respectively; p<0.05).

Conclusion: Regadenoson combined with low-level exercise is safe and well tolerated in stable patients with severe COPD undergoing MPI.
Utility of Regional Wall Dyssynchrony, Inter- and Intra-ventricular Delay Estimation using Fourier Phase Analysis in Patients with Dilated Cardiomyopathy

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Background: Ventricular dyssynchrony is increasingly being employed as a predictive factor of response to cardiac resynchronization therapy (CRT). Although global ventricular dyssynchrony assessed using phase analysis provides a comprehensive measure of the pattern of mechanical activation, the utility of regional wall dyssynchrony, inter- and intra-ventricular delays assessed using phase analysis is not widely evaluated. Aim: The aim of this study was to assess the regional wall dyssynchrony, inter- and intra-ventricular delay in patients with DCM using Fourier phase analysis of gated blood pool SPECT (GBPS) and evaluate its utility if any.

Methodology: A total of 68 patients with dilated cardiomyopathy (DCM) on medical management and regular clinical follow up were included on the study. GBPS was performed in all the patients for assessment of LVEF and RVEF. All the studies were acquired on a dedicated dual headed gamma camera after in-vivo radiolabeling of red blood cells. The studies were reconstructed and phase analysis was performed using Quantitative Blood pool SPECT (QBS) software. Phase parameters (Mean, SD, Entropy) were derived for the individual walls of the left ventricle (anterior, lateral, inferior, septal) and RV free wall. Also, inter- and intra-ventricular delay was assessed as differences between the SD of septal-RV free walls and LV septal-lateral walls respectively (expressed as milliseconds). All the patients were followed up clinically or through telephonic contact. Death due to progressive cardiac failure / sudden cardiac death was considered as the study endpoint. Student t-test was utilized for comparison of continuous variables between the survivor and cardiac death groups.

Results: Of the 68 patients, three patients received CRT on follow up and were excluded from the study. A total 65 patients (39 males, 26 females; Mean age 49 ± 15 years) were included in the final analysis. During a mean follow up of 28.4 ± 6.2 months, 9 cardiac deaths (13.8%, 9/65) were recorded. Conduction abnormalities on electrocardiography were noted in 38 patients (LBBB: 23/65 (35.3%); RBBB:8/65, (12.3%); others:12/65 (18.4 %)). Presence of prolonged QRS duration was associated with the presence of both inter-ventricular and intra-ventricular delay (p=0.02). Among the regional wall parameters, abnormal mean and SD of LV lateral wall were significantly predictive of cardiac death (p=0.036), while the rest of the regional wall parameters showed no significant correlation. Intraventricular delay (LV septal-lateral wall) showed significant association (P=0.021) of greater values of positive delay predictive of cardiac death (stronger association than global dyssynchrony, P=0.032). No significant difference is noted in the interventricular delay parameters (LV septal-RV free wall difference) between the survivors and cardiac death groups.

Conclusion: Fourier phase analysis derived intra-ventricular delay (assessed as the difference in SD of LV septal-lateral wall) and lateral wall dyssynchrony are stronger prognostic markers of cardiac death than global LV dyssynchrony in patients with DCM. However, validation of these parameters in larger cohorts is warranted.
Use of Adenosine Intervention During Myocardial Perfusion Imaging is Safe in Heart Failure Patients

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Background: Our institute caters to the poorest of patients and many have severe coronary artery disease (CAD) with heart failure (HF). Surgical revascularisation (CABG) is considered as a method of choice in the presence of viable myocardium. However, an important cause of morbidity and mortality in these patients is arrhythmias. Due to HF, these patients are not usually subjected to stress myocardial perfusion study. Adenosine, a drug, acts by coronary vasodilation has been extensively used for pharmacological stress testing. During a pilot study at this centre, it was found that the use of adenosine is safe in patients of HF, thus more patients were enrolled. NYHA Class III and IV patients were excluded.

Methodology: Post consent, in absence of contraindications, when vitals were appropriate, patients underwent both rest and adenosine [intravenous, 140 microgram/kg/min., for 6 min - utes] myocardial scan in presence of a cardiology experienced doctor using Tc99mSestamibi. Total 129 patients were enrolled. [Average age: 57.95 years (Range 35 to 76 years); Males 93%, Females 7%; Single Vessel Disease (VD) 33%, Double VD 25%, Triple VD 42%; EF on echocardiography ranged from 15-54%]. Same intravenous line was used for tracer injection at 3 minutes after start of adenosine infusion. Vitals and ECG monitoring was carried throughout the procedure.

Results: Hemodynamic effect of adenosine was noted as a rise in pulse rate and a fall in blood pressure in the majority of patients. In this study, no serious morbidity and no mortality happened. There were very few side effects from adenosine and were mainly noticed in patients having triple vessel disease (Dysopnea 9%, Heaviness in Chest 9%, Headache 3%, Abdominal discomfort 3%, Coughing 2%, ST depression on ECG 2%, Pain Chest 1%, Heaviness in Head 1%, Uneasiness 1%, Flushing 1%). Side-effects disappeared immediately on completion of adenosine infusion. One study was terminated due to complaint of severe chest heaviness and dyspnoea. Contrary to the reports that adenosine vasodilator myocardial perfusion results in side effects in large number of less serious patients, in our experience it was found to be safe even in HF. Furthermore, contrary to the reports that in such cases, stenosed coronaries are already fully dilated and adenosine may not cause further vasodilation, this was not the case. In a substantial number of patients, ischemia could also be induced.

Conclusion: Heart failure patients may also die from ischemia induced arrhythmias. Deciding on revascularisation procedure merely on the basis of presence of viable myocardium may be fraught with poor outcome. Patients with lack of significant amount of viable myocardium, if are not taken for CABG, can be considered for PCI in case of evidence of ischemia. In the patients of HF, the use of stress testing (exercise/drug) is contraindicated. However, from this study, it seems that ischemia can be ruled out safely using adenosine induced coronary vasodilation in HF patients and thus can be very useful for guiding further management in this group of patients.
Abstract ID: 92

Comparison of Software Programs for the Assessment of Left Ventricular Ejection Fraction Using 99mTc-Sestamibi-Gated SPECT: Correlation with Equilibrium Radionuclide Ventriculography in Patients with Fixed Perfusion Defects

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Background: The goal of this study was to compare Emory Cardiac Toolbox (ECTb), quantitative gated SPECT (QGS) and Myometrix cardiac software programs for the assessment of left ventricular ejection fraction (LVEF) using 99mTc-sestamibi-gated SPECT/CT [myocardial perfusion SPECT (MPS)] and correlate them with the LVEF values derived from equilibrium radionuclide ventriculography (ERNV) in patients with fixed perfusion defects.

Methodology: A total of 55 patients (43 men, 12 women) with a fixed perfusion defect in at least 3 segments were recruited. All the patients underwent previously to MPS, and then submitted to ERNV as standard protocol. ERNV was processed by a single nuclear cardiologist, using the vendor-provided ‘EF analysis’ and gated MPS was processed using individual software programs.

Results: In this study, 44 patients (80%) had previous myocardial infarction (MI), 16 patients (29.1%) Coronary Artery Bypass Graft (CABG) and 24 (43.6%) had percutaneous coronary interventions (PCI). On correlation analysis, a very strong positive correlation (0.7 < r < 0.90) was observed between LVEF values derived by ERNV and those derived by the MPS software programs: ECTb (r=0.747, P<0.0001), QGS (r=0.766, P<0.0001) and Myometrix (r=0.835, P<0.0001). Significant correlation was also seen for LVEFs among the three software programs.

Conclusion: A strong correlation was observed among ECTb, QGS and Myometrix software programs when compared with ERNV and also between them, for assessment of LVEF, even in patients with fixed perfusion defects. However, there are subtle differences in the objective values of ejection fraction generated by individual software, which must be taken into account for clinical studies. It seems that Myometrix had the strongest correlation with ERNV, in patients with fixed perfusion defects.
Clinical Usefulness of Sequential Subtraction Technique in Gastrointestinal Bleeding

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Background: To evaluate the clinical usefulness of sequential subtraction technique in gastrointestinal bleeding.

Methodology: Twenty-two patients referred for 99mTc-labeled RBC scintigraphy were included in this study. Sequential conventional scintigraphy and subtraction images at 5-minute per frame were processed. Sequential subtraction technique was done wherein each 5-minute frame were subtracted from its precedent frame. Three independent nuclear physicians blinded to the history, clinical set-up of the patients and processing technique interpreted the images in terms of time of bleed, localization and detection confidence.

Results: Although there was a decrease in the mean detection time in between conventional scintigraphy with sequential subtraction technique and conventional scintigraphy alone, there was no statistically significant difference in between the mean time to bleed detection between the two techniques. There was also an increased mean detection confidence observed with conventional scintigraphy plus sequential subtraction technique than conventional scintigraphy alone, however, no statistically significant difference was noted between both techniques.

Conclusion: Sequential subtraction technique is a useful adjunct with conventional scintigraphy in gastrointestinal bleeding.
Evaluation of Effect of Coronary Artery Bypass Graft on Hibernating Myocardium by Cardiac PET Viability Study

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Background: Left ventricular (LV) dysfunction secondary to coronary artery disease is a potential reversible process. Improvement in LV function following revascularization of ischemic myocardium can significantly reduce mortality in these patients. Preoperative estimation of the extent of hibernating myocardium is demonstrated to predict the degree of improvement in LV function. Non-invasive and functional nature of radionuclide imaging techniques facilitates accurate estimation of hibernating myocardium. Previously, many studies have pre-operatively assessed hibernating myocardium, however very limited number of studies has been done to assess the perfusion and functional status of the myocardium post coronary artery bypass graft (CABG). Aims & Objectives: The aim of the present study was to evaluate the utility of pre- and post-operative gated PET imaging in assessment of the extent of hibernating myocardium and improvement in LV function respectively in patients undergoing CABG.

Methodology: Thirty-six patients with known CAD were enrolled in this prospective study. All the patients were fasted for a minimum duration of 6 hours. Gated perfusion imaging was performed after injection of 666-740 MBq of 13N-Ammonia. Metabolic imaging with injection of 370-440 MBq of 18F-FDG PET/CT post 45-60 min was performed in the patients demonstrating perfusion defects of moderate to severely reduced intensity. Reconstructed images of perfusion and metabolism PET/CT studies were evaluated to determine the extent of hibernating myocardium. No patients demonstrated a scarred myocardium more than 40% and hence all the patients underwent CABG. A total of five patients were excluded from the study, one died in post-operative period due to surgery related complications and four patients were lost to follow up. Rest of the patients (31/36) were followed up with regular clinical, echocardiographic examinations and a gated 13N-Ammonia perfusion study done at mean duration of 96 days (67-155 days) post CABG to assess the functional improvement.

Results: Data of total 31 patients (26 males, 5 females; mean age: 59 years, range: 39-75 years) were finally analyzed. Most common complaint was chest pain (84% of the patients, 26/31) followed by shortness of breath (77%) and palpitation (52%) respectively. Prevalence of known risk factors including diabetes, hypertension and previous myocardial infarction were 33%, 50% and 25% respectively in the patient population. The mean extent of hibernating myocardium was 16% and mean ejection fraction (EF) was 32.5% ± 8.2% on pre-operative perfusion PET imaging respectively. On post-operative perfusion study, mean increase in perfusion was 10.4% with a maximal increase of 30%. Mean EF on post-operative PET was 41.1% ± 12.1%. Paired t-test of the pre- and post-operative EFs demonstrated significant improvement in post-operative EF (p-value <.001).

Conclusion: The present study demonstrates the potential utility of pre- and post-operative non-invasive gated PET imaging in assessment of the extent of hibernating myocardium (that predicts the degree of improvement in EF) and estimation of degree of LV functional improvement following CABG respectively.
Myocardial Perfusion Imaging - A Cornerstone for Selecting Therapy of Patients with Left Ventricular Aneurysms

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Background: Among the most important complications that may occur after myocardial infarction are left ventricular aneurysms. A poor prognostic can arise, from its aggravation, like embolisms or rupture. The study evaluated myocardial viability with myocardial perfusion imaging, in stress and rest conditions, in patients with left ventricular aneurysms.

Methodology: We find a number of 19 patients, 16 (84,2%) men and 3 women, with age between 52-74 years, from January 2015 to February 2016, all of them with previous myocardial infarction and consecutive left ventricular aneurysms. We performed myocardial perfusion scintigraphy in stress and rest conditions and correlated it with cardiac ultrasound and coronary angiography. Protocol for the myocardial perfusion imaging included upright bicycle exercise to an adequate workload (at least 85% of age-adjusted maximal predicted heart rate, or symptom-limited) to evaluate, risk stratification of post-myocardial infarction patients. The parameters include: reversible pathological uptake, myocardial viability, segmental kinetics, ejection fraction, and other additionally parameter (total perfusion deficit (TPD), extent of the perfusion defect and summed stress, rest and differential score).

Results: Our findings revealed reversible pathological uptake in only 15,7% (3) patients, the rest of them (84,3%) had fixed uptake defects (no myocardial viability). In patients with myocardial necrosis, scintigraphy has mostly find severe hypokinesia and dyskinesia including aneurysm area, and the ejection fraction was below 35%, both in stress and rest conditions. In comparison with cardiac ultrasound, scintigraphy confirmed alteration of parietal kinetics in almost all of the segments, but has found a lower ejection fraction both in stress and rest conditions. Coronary angiography was performed before scintigraphy and revealed different degrees of stenosis (above 70%) or occlusion in all the patients. The majority of patients (12 / 63,1%) were with triple vessel disease, the rest were with double vessel injury (3 / 15,7%) or unique coronary lesion (1 / 5,2%). The decision for subsequent therapy, based on the results of myocardial perfusion imaging, so only 15,7% patients was sent to myocardial revascularization, the rest followed conventional therapy.

Conclusion: The utility of the myocardial perfusion scintigraphy was to evaluate the functional significance of coronary artery disease revealed by coronary angiography to the myocardium and also to direct therapy to conventional or interventional methods.
Abstract ID: 99

18F-FDG PET/CT for Diagnosis and Treatment Response Evaluation in Large Vessel Vasculitis

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Objectives: To evaluate the role of 18F-FDG PET/CT scan in assessing treatment response in patients with large vessel vasculitis (LVV).

Materials and methods: In this retrospective study, 40 (age: 38.9 ± 12.03 years; 57.5% female) patients with LVV were evaluated with 18F-FDG PET/CT at baseline and 6 weeks after starting immunosuppressive therapy. It includes 14 patients who presented with pyrexia of unknown origin and on FDG PET/CT detected to have LVV which was later confirmed and treated. A total of 80 18F-FDG PET/CT scans were done in 40 patients having median age of 42 years (range: 12-73). Of 80 PET/CT scans, scan was done for diagnosis/staging (n=40), and for assessing treatment response (n=40). PET/CT image interpretation and analysis was performed qualitatively (visually) and semi-quantitatively using standardized uptake value (SUVmax). Additionally SUVmax of the vessel to liver ratio were also generated. Combination of clinical, imaging follow up, biochemical parameters and/or histopathological examination were taken as reference standard.

Results: Abdominal aorta (n = 18), arch of aorta (n = 11), and common carotid artery (n = 7), were the most common disease sites detected on PET/CT. The entire initial evaluation patients (n=40) had either solitary or multiple vascular lesions with marked increased FDG uptake (mean SUVmax 6 ± 2, range 3.43-14.51) on PET/CT. In those studies performed for assessing treatment response (n=40), there was no significant pathological FDG uptake (mean SUVmax 1.4, range 0.5-2.2) in patients consistent with complete treatment response (n=32) and decreased but persistent metabolic uptake (mean SUVmax 4.6, range 3.23-8.6) was noted in patients with partial response (n=8). The results correlated with normalization of the serological levels of inflammatory markers. Significant improvement in aortic wall thickening was evidenced by reduced SUV PET values that were followed up after treatment.

Conclusion: 18F-FDG PET/CT has definitive role in diagnosis/staging and for assessing treatment response in LVV.
Abstract ID: 101

A Case Report: Incidental Finding of Lipomatous Hypertrophy of the Inter-atrial Septum on FDG-PET

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The case of a 59-year-old man with high level of Ca 19-9. Patient was sent to perform PET FDG scan to look for a sign of malignancy. Incidental finding of FDG uptake was seen at interventricular septal. Cardiac tumors are rare. A cardiac mass most likely represents a thrombus or vegetation. Most primary cardiac tumors are benign. PET FDG scan could identifying cardiac involvement inpatients with metastatic tumors, atrial myxoma, and lipomatous septal hypertrophy. Lipomatous hypertrophy of the interatrial septum is associated with the presence of coronary artery disease in proportion to the degree of atrial septal thickness. This disorder is indistinguishable from lipoma except that the location of lipomatous hypertrophy occurs in the atrial septum with a typical distribution (generally sparring the fossa ovalis). In the absence of symptoms of atrial arrhythmias, heart block or rare vena caval obstruction, they do not require resection.
Abstract ID: 102

Transient Ischemic Dilation Ratio as a Predictor of Perfusion and Functional Improvement in Irreversible Severe Perfusion Defects after Coronary Artery Bypass Graft


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Background: Perfusion and functional improvement could be observed in cases of irreversible severe perfusion defects on 201Tl myocardial perfusion scan (MPS) as proved by the presence of normal thallium uptake and better myocardial function after revascularization on the following scans. Transient ischemic dilation ratios (TID), the indicator of multivessel disease reflecting the ischemic status, were sometimes present in those cases. The objective of this study was to find out the significance of the presence of TID in detecting severe perfusion defect area that will show viability after coronary artery bypass graft (CABG).

Methodology: Subjects of this study were coronary artery disease (CAD) patients who had irreversible severe perfusion defects on Thallium-201 rest/dipyridamole stress technetium-99m methoxyisobutylisonitrile (MIBI) gated myocardial SPECT in 2009. Perfusion and functional improvement or viability of the irreversible severe perfusion defects were determined on the following MPSs or FDG PET. Qualitative analysis was performed using 17-segment cardiac model, while wall motion and TID ratio analysis were performed using Quantitative Gated SPECT (QGS) developed by Cedar-Sinar Medical Center).

Results: Irreversible perfusion defects (3 to 7 segments) were observed in 8 subjects (7 males, 1 females; age 68.6±7.1). All of the segments were hypokinesia (2 with global hypokinesia). Twenty-four-hour delayed imagings performed in 5 subjects also showed no perfusion improvement. On the following scans after CABG, perfusion improvement in some area was observed. Wall motion was improved in 6 of 8 subjects. Myocardial viability was also observed in 1 subject. The mean TID ratio of the basal MPSs was 1.34±0.10 (range: 1.20 – 1.47) which was significantly higher than control group consisted of subjects with persistent irreversible severe perfusion defects (1.09±0.13; range: 0.78 – 1.32).

Conclusion: The presence of transient left ventricular enlargement in the form of high TID ratio in subjects with irreversible severe perfusion defects may suggest the possibility of perfusion a functional improvement after CABG.
The Role of ECG-Gated SPECT Stress-Rest Myocardial Perfusion Imaging in Coronary Ischemic Disease

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Background: Heart disease is one of the leading causes of death in the world. Myocardial perfusion scintigraphy (MPS) is one of the most used procedures to diagnose and assesses coronary artery disease and cardiomyopathy. When using the ECG-gating, important information concerning the myocardial function are obtained and moreover, the misinterpreting of artifactual defects are avoided. Aim: The aim of the study is to emphasize the role of gated-SPECT in patients with coronary ischemic disease, especially in those with three coronary artery involvement.

Methodology: We included 30 consecutive patients who underwent one-day stress-rest ECG-gated SPECT, using 99mTc-MIBI. We used a large field gamma camera (Dual-head AXIS, PHILIPS Picker / Marconi, USA) with a low-energy, general-purpose parallel-hole collimator. We connected electrodes for a three-lead ECG and checked for good R-R intervals. The computer set-up for the 99mTc window at 140 keV was 20%. The SPECT stress and rest studies are synchronized with the EKG. The stress SPECT study was done first, at 30 minutes after the administration of 10 mCi 99mTc-MIBI (370 MBq); the radiotracer was injected intravenously during the maximal response on the stress test. 2.5 hours later we performed the second administration of 20 mCi 99mTc-MIBI (740 MBq) for the rest study; images of the myocardial rest perfusion were acquired 30 minutes after the second injection.

Results: 10 out of the 30 patients (33.3%) revealed perfusion defects consistent with three coronary vessel ischemic disease. We analyzed first perfusion studies at stress and rest; second, the combined ECG-gated perfusion and function studies were assessed: regional ejection fraction, wall thickening, and synchrony. In patients with three coronary artery ischemia the combined use of perfusion stress-rest studies with ECG-gated function analysis helped better distinguish between the myocardium with decreased blood flow by yielding a greater number of abnormal segments per patient and a better differentiation between the reversible and partially reversible defects in patients with ventricular dilation.

Conclusion: MPS and ECG-gated SPECT studies play an increasingly important role in the noninvasive diagnosis and evaluation of ischemic coronary artery disease. For the patients with three coronary vessel ischemic disease, the combination of perfusion SPECT and ECG-gated function analysis plays a significant role in the assessment of the pumping function of the heart and in therapy management by guiding which territories can benefit from revascularization.
Diastolic Function Measured by 13N Ammonia PET: Comparison Between Hypertension and Control Group


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Background: In Mexico, the prevalence of hypertension is estimated at approximately 31.6%. One of the most common causes of cardiac failure is hypertension. Several studies have shown that isolated hypertension could lead to diastolic dysfunction. PET myocardial perfusion scanning represents a useful tool to evaluate the diastolic function through the peak-filling rate (PFR) and the time to peak filling (TTPF). The objective of this study was to compare diastolic function in patients with hypertension vs normal patients using PET-CT.

Methodology: We included eight patients with hypertension and six controls subjects, all with normal or minimal ischemia and asymptomatic. All patients underwent a rest and adenosine-stress PET perfusion scan with 13N Ammonia. Static, dynamic and GATED data were reconstructed for the evaluation of PFR-TTPF. A non parametric Mann-Whitney U test was performed between the two groups. A p-value < 0.05 was considered statistically significant.

Results: The two groups showed no difference in demographic and clinical data. Median age was 66.16 and 55.1 years old in hypertension and normal patients respectively. The correlation analyses were performed on data from all subjects. PFR rest and stress was significantly different between both groups. Stress 10.2 vs 5.0 EDV/s normal and hypertension group respectively (p-value 0.019) and Rest 10.6 vs 4.75 EDV/s normal and hypertension group (p-value 0.006). TTPF stress and rest was no statistically different between groups (p-value 0.093 and 0.435 respectively).

Conclusion: Rest and stress PFR was significantly lower in the hypertension group compared with normal patients measured by PET. This shows that hypertension by itself confers a risk in developing diastolic dysfunction even in asymptomatic patients with normal myocardial perfusion on PET study. On the other hand, PET study offers useful information even in non-ischemic patients and allows to evaluate quantitative values of diastolic function. Given the limitation of this study further patients are needed to determine if this measurement could be useful in clinical practice.
Analysis of Left Ventricular Synchrony in Myocardial Ischemia with 13N-Ammonia Gated PET


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Background: Intraventricular dyssynchrony is an uncoordinated contraction within the left ventricular segments due to a disruption in the activation sequence. This inevitably leads to impaired systolic function and mechanical efficiency, reduced cardiac output, increased wall stress and a higher metabolic cost of the LV contraction. Phase analysis in gated SPECT MPI studies evaluate global ventricular synchrony through standard deviation and entropy as the more reproducible parameters, however even large perfusion defects have not shown to affect them. Gated PET MPI allows for real-time imaging during rest and stress, so myocardial stunning during stress may be demonstrated by phase analysis through standard deviation and entropy with this method.

Methodology: We selected 175 consecutive patients who underwent rest/stress 13N-Ammonia Gated PET referred for evaluation of ischemia. Comparison of standard deviation and entropy in the phase analysis between rest and stress, and according to the severity of myocardial ischemia determined by summed stress score was made using student’s T and ANOVA tests respectively.

Results: Results are summarized in Table 1. There was only a statistically significant difference between rest and stress SD in the group with severe ischemia. On the other hand, entropy showed significant differences between rest and stress in all groups, and also shows a linear correlation both at rest and stress with the severity of ischemia.

Conclusion: Phase analysis with gated PET allows for an accurate measure of global LV dyssynchrony. Entropy is the parameter which shows a better correlation between the severity of ischemia in both rest and stress. Also demonstrates significant differences between rest and stress with a direct relation to the degree of ischemia. Entropy is probably the best parameter that reflects myocardial stunning during induced ischemia in gated PET. Table 1. Comparison of SD and entropy in rest and stress according to the severity of ischemia.
Assessment of Left Ventricular Synchrony with Tc-MIBI 99 and its Relationship to Myocardial Ischemia


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Background: With the use of Gated single photon emission computed tomography (SPECT) ventricular function and mobility information is obtained, as well as synchrony of the ventricular contraction, through phase by phase analysis. Subsequent stunt myocardium to a period of ischemia, can manifest as a decrease in left ventricular ejection fraction (LVEF), regional mobility abnormalities or alter the patterns of ventricular synchrony. Synchrony is consider a valuable prognostic marker of ischemia. Objectives: To demonstrate the relationship ventricular synchrony and myocardial ischemia, and correlation with coronary vascular disease.

Methodology: 90 consecutive studies in which patients underwent gated SPECT with Tc MIBI 99 at rest and stress, without evidence of transmural infarction; stress phase analysis using the QGS software. Patients were classified into mild, moderate and severe ischemia, comparing the peak phase values, standard deviation and peak phase bandwidth between the three groups. Subsequently their were grouped according to condition of 1, 2 or 3 vessels and were compared with parameters ventricular synchrony already mentioned above.

Results: See Table 1 and 2.

Conclusion: There is a significant relationship between the severity of ischemia and ventricular asynchrony in stress. There is a directly proportional trend between coronary disease and the degree of asynchrony. Ventricular synchrony is a useful marker of myocardial ischemia and coronary disease.
The Assessment of Viable Myocardium in Patients with Dilated Cardiomyopathy with $^{99m}$ Tc MIBI SPECT During Nitrate Administration

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Background: Tc-$^{99m}$ MIBI myocardial SPECT has shown promise for evaluation of coronary artery disease, but its role in predicting myocardial viability is still under investigation. The aim of the study was to determine clinical use and efficacy of the $^{99m}$TcMIBI with nitrate (ISDN) administration for detection of viable myocardium in patients with dilated cardiomyopathy.

Methodology: Thirty-seven patients (47 male and 20 female) with dilated cardiomyopathy were studied. All patients were examined under baseline study, at rest, and after administration of ISND. The data were reconstructed in transaxial slices and then reoriented into short, vertical long and horizontal long axis slices. The images were divided into seven different segments for qualitative analysis. The images were interpreted by two independent observers.

Results: The results showed that out of 68 segments with hypoperfusion at resting SPECT, 29 segments (42.67%) had an increase in Tc-$^{99m}$ MIBI uptake during administration of ISDN. The degree of improvement in perfusion was related to the age of patients.

Conclusion: The data suggest that use of Tc-$^{99m}$ MIBI SPECT in patients with dilated cardiomyopathy during administration ISDN may be useful for assessing myocardial viability because ISDN augmented $^{99m}$TcMIBI protocol in Cardiac SPECT imaging resulting in improved detection of viable but hypoperfused segments.
Myocardial Contractility Assessment as an Additional Parameter in Determining Viability Using Nitrate Augmented MPI Gated SPECT

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Background: By using myocardial perfusion imaging (MPI) gated SPECT examination with radiopharmaceutical 99mTc-sestamibi / tetrofosmin, perfusion and myocardial contractility could be examined simultaneously. Nitrate augmented will improve blood flow in viable myocardial, so that the nitrate administration can be used to determine myocardial viability by assessing perfusion and myocardial contractility. The purpose of this study was to determine the magnitude of contractility assessment as an additional parameter in determining viability through nitrate augmented MPI gated SPECT.

Methodology: Patients with myocardial infarction, MPI gated SPECT performed at rest. When the result obtained for perfusion defect was 3 and 4, nitrate augmented MPI gated SPECT examination was conducted. Analysis was performed on 20 segments which were obtained from MPI gated SPECT examinations both at rest and after nitrate augmented. Score for the assessment of perfusion defect is 0-4 according to the ECT software. Contractility score is 0-5 according to G. Germano and D. Berman. Analysis was conducted using Wilcoxon signed rank test, with p≤0.05.

Results: Twenty two subjects consisting of 20 men and 2 women, aged 47-76 years (mean 58.95). In total, there were 64 segments with perfusion defects score of 3; 42 segments (65.6%) with unchanged perfusion defect score, 22 segments (34.4%) had their scores improved after nitrate augmented (p=0.000); 21 segments (21.9%) with contractility score remaining the same, 43 segments (78.1%) with contractility score improved after nitrate augmented (p=0.000). However, there was no correlation between perfusion defect improvement and improvements of contractility (r=0.031;p=0.405). The number of viable segments based on contractility assessment (43 segments / 67.2%) is more than the number of viable segments based on assessment of perfusion defects (22 segments / 34.4%).

Conclusion: In gated SPECT MPI examination, nitrate augmented could improve perfusion defects and myocardial contractility. Assessment of myocardial contractility in nitrate augmented MPI gated SPECT can improve the detection of myocardial viability.
Coronary Flows Measured by 13N-Ammonia/PET and its Correlation in Patients with Hypertension Without Coronary Artery Disease

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Background: Hypertension is a long term pathological condition that can manifest with cardiac failure, stroke, left ventricular hypertrophy. This led our supposition that it may affect alteration in coronary blood flows. In a study conducted this year, they evaluated coronary reserve flow (CRF) in patients with hypertension using single photon emission computed tomography (SPECT), they obtained a significant decrease in the hypertension patients group (p=<0.0001). The aim of this study is to evaluate the relationship of a decrease in myocardial blood flow (MBF) and myocardial flow reserve (MFR) in patients with hypertension measured by positron emission tomography (PET) without coronary artery disease (CAC) that has been previously ruled out by coronary computed tomography angiography (CCTA).

Methodology: We retrospectively studied 41 patients who underwent 13N-ammonia/PET and CCTA due to an intermediate likelihood of CAD. All patients underwent for quantification of MBF and LVEF during rest and pharmacologic stress with adenosine. Resting MBF was corrected with RPP for each patient. The presence of CAD was ruled out by CCTA. In a per vessel analysis we studied differences between patients with and without hypertension.

Results: In our population, mean age was 57 ± 11 years, 75% were male, 87% hypertensive, 81% dyslipidemic, 57% active smokers and 27% diabetic, LVEF was 69% ± 10, and BMI was 28 ± 6 kg/m2. We did not find any statistically significant difference among hypertensive and healthy patients in baseline characteristics. MBF during rest was significantly higher in hypertensive patients (1.1 ± 0.4 ml/gr/min vs. 1.0 ± 0.3 ml/gr/min, p = 0.03). We did not find a statistically significant difference MBF during stress among groups (2.0 ± 0.8 ml/gr/min vs. 2.1 ± 0.8 ml/gr/min, p = NS). However, MFR was significantly lower in hypertensive patients (2.4 ± 1.2 ml/gr/min vs. 2.9 ± 1.0 ml/gr/min, p = 0.005).

Conclusion: A decrease in MFR is thought to precede atherosclerosis. Some previous reports described several pathologic conditions associated with higher resting MBF (Cho et al.). Our results support the fact that low MFR does not necessarily mean a reduction in stress MBF. Our study supports the performance of the use of PET in rest and during stress even in the absence of Coronary Artery Disease ruled out by CCTA in patients with hypertension.
The Correlation Between Electrocardiographic Q-waves and the Presence of a Transmural Infarction Determined by Perfusion SPECT.


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Background: On an electrocardiogram, the presence of a transmural infarction determines an electrical window that mirrors the cavitary electric activity thus resulting in pathological Q-waves. Single Positron Emission Computed Tomography (SPECT) is a useful tool for the determination of the extent and depth of a myocardial infarction. There is anatomic and pathologic evidence of poor correlation between the presence of pathological Q-wave and the presence of transmural infarction. The objective of this study was to evaluate the correlation between the presence or absence of pathological Q-waves in the surface EKG and the finding of a transmural infarction assessed by SPECT. Secondarily, we assessed the sensitivity and specificity of the finding of pathological Q-waves for determining the presence of a transmural infarction.

Methodology: We included 37 patients (mean age 59.7± 11.4 years) that underwent a rest- stress myocardial SPECT for suspected ischemia. All of them with parallel EKG assessment. Twenty patients (54%) presented a transmural infarction and 17 a non-transmural infarction (46%) with SPECT. EKGs were analyzed by 2 experts in order to determine whether pathological Q-waves were present. We performed a Pearson’s chi-square test for evaluating the correlation between the presence of Q-waves and the transmurality of the infarction. Sensitivity and specificity were calculated form the contingency table.

Results: Demographic variables were similar in both groups. The presence of a Q wave in the electrocardiogram did not demonstrate a significant relationship with the presence of transmural infarction as evaluated by SPEC, $q (1) = 0.487, (p = 0.485)$. Although there was a tendency between the Q-wave and transmural infarction (OR = 2.6). The sensitivity and specificity of a Q-wave finding for detecting a transmural MI was 45% and 72%, respectively.

Conclusion: The presence of pathological Q-waves did not correlate to the presence of a transmural myocardial infarction in SPECT. Consequently, its ability to determine a transmurality of an infarction is suboptimal. Therefore, we have demonstrated that in clinical practice, the presence of EKG Q-waves should not translate into transmurality of an infarction on nuclear studies.
Pathological Q-waves in Patients with Non-transmural Myocardial Infarction: Is Quantitative Perfusion a Factor?


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Background: The presence of a Q wave in an electrocardiographic study is traditionally interpreted as indicative of a transmural myocardial infarction, but there are cases in which a non-transmural infarction also presents a pathological Q wave. PET myocardial perfusion scanning represents a useful tool to evaluate the myocardial blood flow and infarction transmurality. The objective of this study is to compare the myocardial blood flow (MBF) and perfusion reserve (MPR) of patients with a Q-wave in the ECG to patients with no Q-wave using 13N-Ammonia PET scan.

Methodology: Fifteen non-transmural myocardial infarction patients were retrospectively included, six with pathological Q-waves (40%) and nine without this ECG finding (60%). All patients underwent a rest and adenosine-stress PET perfusion scan with 13N-ammonia. Acquisition data was reconstructed for the semi-quantitative evaluation of ischemia and the quantitative evaluation of rest and stress MBF as well as MPR. A Mann-Whitney U test was performed between the two groups. A p-value < 0.05 was considered statistically significant.

Results: There was no significant difference in demographic and clinical data. No residual ischemia was documented in any of the patients through semi-quantitative analysis. Median age was 60+13.68 and 68.11+ 7.6 years old, for Q-wave patients and non-Q-wave patients, respectively. Total MBF rest and stress was not significantly different between both groups, rest (p=0.22) and stress (p-value=0.11). Global MPR was not significantly different between both groups (p=0.1).

Conclusion: The ECG finding of pathological Q-waves in patients with a previous non-transmural MI does not relate to their PET-measured myocardial blood flow or myocardial perfusion flow reserve. It is possible that other factors, such as infarct extension, might explain the presence of pathological Q-waves rather than transmurality or perfusion status. Further research is therefore warranted.
Enhancement of Diagnostic Accuracy of N13-Ammonia PET for the Detection of Coronary Artery Disease by the Quantification of Coronary Calcium

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Background: Positron Emission Tomography (PET) is the standard technique for assessing myocardial function, myocardial ischemia, and myocardial blood flows (MBF), but provides limited information on the anatomy of cardiac structures, while Coronary Computed Tomography Angiography (CCTA) is a well-validated imaging modality for the assessment of myocardial anatomy and quantification of coronary artery calcium (CAC). CAC is an early marker of atherosclerosis and usually precedes the development of obstructive coronary artery disease (CAD). Hybrid PET/CT allows simultaneous evaluation of coronary anatomy and quantitative myocardial perfusion in a single scanning session, as a noninvasive technique for the diagnosis of CAD. However, the impact of the CAC is not clear in the performance diagnostic of PET/CT for CAD. Objective: To determine the impact of CAC in the improvement of the diagnostic performance of N13-Ammonia PET to predict CAD.

Methodology: We retrospectively evaluated a total of 201 patients referred to our unit with the suspicion of CAD between 2006 and 2015. They underwent 13N-ammonia PET/CT in rest and pharmacologic stress with adenosine, and CCTA for measurement of CAC in Agatston Units (AU). A coronary lesion >50% was determined as significant. Ischemia was classified with the presence of a Summed Stress Scores (SSS) >4, MBF <1.9 ml/gr/min, Coronary Flow Reserve (CFR) <2 ml/g/min and the decrease in the Left Ventricle Ejection Fraction during stress (DEF). We considered a p<0.05 as significant.

Results: A total of 201 patients were included, age 62±10 years, 65% men, BMI of 27 Kg/m2 (P25:24, P75:30). The prevalence of cardiovascular risk factors was 57% for hypertension, 21% diabetes, 51% dyslipidemic, 37% were smokers and 40% with prior angina. The prevalence of obstructive coronary lesions was 16%. The AUC was 0.75 (p<0.001), 0.64 (p=0.01), 0.55 (p=NS), 0.54 (p=NS) and 0.65 (p=0.005) for SSS>4, hyperemic MBF <1.8ml/g/min, CFR <2 ml/g/min, abnormal DFE and CAC > 400UA respectively. By combining SSS>4 and CAC>400AU, the AUC is increased to 0.79 (95% CI 0.72 to 0.86, p<0.001).

Conclusion: The combination of quantitative measurement of myocardial perfusion with the presence of CAC >400AU increases the diagnostic performance of N13-Ammonia PET for the diagnosis of obstructive CAD.
Myocardial Bridging: Evaluation of Myocardial Blood Flow with 13N-ammonia PET

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Background: The aim of this study was to evaluate the role of quantification of myocardial blood flow (MBF) and myocardial perfusion defects (MPD) by 13N-ammonia/PET in patients with myocardial bridging (MB).

Methodology: We retrospectively studied 33 patients who underwent PET with 13N-ammonia during rest and pharmacological adenosine stress due to intermediate likelihood of Coronary Artery Disease (CAD); all patients underwent Coronary Computed Tomography Angiography in order to rule out CAD and detect MB. MPD, MBF during stress, and Coronary Flow Reserve (CFR) were analyzed in the vascular territory of the MB.

Results: 16 patients with a MB in the LAD and 17 healthy controls composed our study population. Mean age was 58±10 years, 49% were male, 62% hypertensive, 10% diabetic, 62% dyslipidemic, and 21% reported active smoking. We did not find any statistical difference among groups. We found a statistical significant decrease in mean MBF during stress and CFR of the LAD in patients with a MB compared to healthy controls, 2.3±0.8 vs. 3.0±0.8 ml/g/min (p=0.02) and 2.7±1.1 vs. 3.6±0.9 ml/g/min (p=0.02), respectively.

Conclusion: Our findings suggest that coronary vasodilator capacity impairment is present in MB. Our results support the assessment of MB by PET/CCTA in order to verify its clinical significance; nevertheless, further studies are needed to fully understand the hemodynamic impact and prognosis of a MB.
Normal Values of Left Ventricular Parameters in the Mexican Population
Assessed with 13N-Ammonia-Gated PET

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Background: The role of Positron Emission Tomography (PET) in cardiovascular imaging allows measurement of myocardial perfusion, myocardial blood flow, and function. Gating of myocardial perfusion images is an additional feature that allows assessment of ejection fraction (EF) and cardiac volumes. These functional parameters obtained by gated PET have been validated in several studies against Single Photon Emission Computed Tomography, echocardiography, cardiac MRI, and contrast ventriculography. However, the validation of these parameters have mainly been made in European and American populations, which can differ in many characteristics to those from Mexican population. Even among Latin-American populations, heterogeneity of cardiovascular disease can be demonstrated. Objective: To establish the normal left ventricle functional parameters (EF, end-diastolic volume [EDV], end-systolic volume [ESV] and stroke volume [SV]) obtained by hybrid gated PET/CT in Mexican population.

Methodology: Data were compiled from 57 patients (mean age±SD, 57±10 y.o.; 65% men; body surface area [BSA] 1.7±0.2 in women and 1.9±0.2 in men) referred to our center from 2006 to October 2015 with no previous cardiovascular disease. Some of them however, presented cardiovascular risk factors: 51% with hypertension and 9% with diabetes. Normal anatomical information of coronary arteries was assessed by contrast-enhanced 64-slice coronary computed tomography angiography (CCTA) showing absence of atherosclerotic plaques. Functional parameters and perfusion in rest and adenosine-stress were assessed by 13N-NH3 gated PET. Perfusion in these patients was labeled as normal and the EF, EDV, ESV and SV were calculated using Cedars-Sinai automated quantitative gated single photon emission computed tomography.

Results: Volumes and EF showed significant differences between genders that were not corrected when indexed by BSA. The EDV, ESV and SV (median, P25-P75) in men were 48 (45-55), 16 (13-18) and 34 (28-40) ml/m2, and in women were 34 (31-40), 10 (8-10) and 25 (22-27) ml/m2, respectively. EF was 66±6% in men and 73±6% in women. Following administration of pharmacological stress with adenosine demonstrate no significant changes were observed in EF (68 vs. 69%, p=0.5). When comparing both EDV and ESV with populations in other studies a significant difference is observed.

Conclusion: In Mexican individuals without ischemic heart disease, left ventricular functional parameters are significantly lower than the ones reported in studies where Saxon populations were involved. So it is necessary to have local reference values for a better assessment of Mexican population.
Benefit of the Initial Evaluation with SPECT or CCTA in Patients with Suspected Coronary Artery Disease

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Background: The diagnostic and prognostic value of myocardial perfusion methods are well established. In this paper, we propose the comparison of the effectiveness between initial assessment with single photon emission computed tomography (SPECT) at rest/stress against cardiac computed tomography angiography (CCTA) for decision making in the management of patients with intermediate risk of coronary artery disease (Framingham criteria, ATP III). The aim of this study was to determine whether patients who undergo an initial SPECT study have a benefit by requiring less subsequent imaging studies compared to those who undergo CCTA.

Methodology: We conducted a prospective study in 68 patients referred to the National Institute of Cardiology with suspected coronary disease. They were randomized in patients who underwent SPECT at rest/stress (52%, 36 patients) and those who underwent CCTA (48%, 32 patients) as initial diagnoses. Fisher test and Chi-squared was used to compare proportions. A p-value less than 0.05 was considered statistically significant. Statistical analysis was performed using SPSS version 21.

Results: 59% were men and the mean age was 59 +/- 12 years. The findings are that those patients in whom the protocol began with a study of CCTA required further noninvasive imaging studies for decision making compared to those who began with a SPECT study, CCTA 47 % (n = 15) vs SPECT 3% (n = 1), p<0.001.

Conclusion: Patients undergoing SPECT as the initial assessment, required less invasive imaging studies in regarding patients who started with CCTA diagnostic process for decisions making about medical or invasive treatment.
SPECT: A Diagnostic Tool in Heart Failure and its Correlation with Poor Cardiovascular Prognosis Parameters


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**Background:** The prevalence of heart failure is increasing and coronary artery disease (CAD) is one of its main causes. The newest therapies have improved the prognosis of patients with moderate - severe heart failure. However, once it reaches the terminal stage, survival remains poor, with high risk of major coronary events (myocardial infarction or nonfatal cardiac death). Since the findings of isolated perfusion tend to underestimate the extent of the disease (coronary flow is not heterogeneous), it is very important to have additional signs that provide a diagnostic and prognostic guidance especially in patients with ischemic heart disease. In this paper, we try to determine the presence of poor prognostic factors using a myocardial perfusion study in patients with ischemic dilated cardiomyopathy.

**Methodology:** We enrolled 122 patients with systolic dysfunction VI (≤ 40%) and known coronary disease who were sent to myocardial perfusion study for evaluation of ischemia.

**Results:** The mean age was 58.74 years within comorbidities was associated 51% had hypertension, 46% diabetic and only 33.45% had experienced previous smoking. In the anatomical study the presence of trivascular disease was found at 23.77%, and the others had two-vessel disease including AD (34.7%). LVEF average was 33.08%, with a VFD VFS 155.66 ml and 111.2 ml, respectively, the degree of ischemia was evaluated by polar map with a SSS 20.66, 16.25 SRS and SDS 3.9.

**Conclusion:** To investigate myocardial perfusion with 201TI or using radiopharmaceuticals labeled with 99mTc SPECT studies can show elements of high-risk directly related to perfusion. In addition to the extent and severity of perfusion, increased end-diastolic and end-systolic volumes, a stress score (SSS) can differentiate patients at high risk for cardiovascular events. In our study, we observed that patients with low ejection fraction but with a VFS 90ml greater or high, had a higher degree of ischemia than those in VFS which was less than 90ml with a SSS of 20,066 which classifies them as high-risk patients if they are above > 13.
Usefulness of the [13N]-Ammonium by Positron Emission Tomography (PET) in the Diagnosis of Coronary Artery Disease


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Background: Coronary flow stresses (CFE) and coronary flow reserve (CFR) are recognized as noninvasive indicators of functional impact on coronary stenosis. We study the diagnostic performance of CFE and CFR with 13N-ammonia by positron emission tomography (PET) for the detection of obstructive coronary artery disease by coronary angiography diagnosed.

Methodology: We enrolled 258 patients who were referred to our center, who underwent PET with [13N] ammonium at rest and pharmacological stress with adenosine, as well as coronary angiography the same day. The equipment used was Biograph True Point PET/CT 64- Multislice Scanner; Siemens Medical, Erlangen, Germany. CFE and CFR were analyzed using automated software QPET. It was calculated by analysis of the ROC curve (Receiver Operating Characteristic) the best diagnostic threshold for CFE and CFR to detect a diameter of coronary stenosis ≥70%, definde by coronary angiography.

Results: In our population the average age was 62±11 years, 62% were men, 63% had hypertension, 23% diabetes, 61% dyslipidemia, and 46% active smokers. In an analysis per vessel (n = 774), an CFR ≤ 2.38 ml/min/g showed a sensitivity of 93%, with a specificity of 32% and negative predictive value (NPV) of 99 %, for detection obstructive coronary artery disease (CAD). CFE values ≤1.95 mL/min/g had similar accuracy for detecting obstructive CAD with a sensitivity of 80%, a specificity of 55% and NPV of 98%.

Conclusions: The CFE and CFR quantification with pharmacological stress measure with 13N-ammonia PET had a good diagnostic sensitivity. As suggested by previous studies, this approach may be useful to exclude the presence of obstructive coronary disease in patients with low risk.
Analysis of Diastolic Function in Type Two Diabetes Mellitus Patients with Ammonia PET


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Background: Prevalence of type 2 diabetes mellitus (DM2) is estimated around 14% in our country. The cardiovascular complications that are associated produce a high morbidity and mortality. Nowadays, positron emission tomography (PET) is an excellent non-invasive tool to assess perfusion and myocardial blood flow. Likewise, the combination of diverse imaging methods allows to assess diastolic function through the peak filling rate (PFR) and time to peak filling rate (TTPF). In this study, we evaluate the difference in diastolic function parameters between patients with and without DM2 using ammonia PET.

Methodology: We included 50 patients with DM2 and 99 controls, which underwent perfusion evaluation with ammonia PET at rest and pharmacological stress with adenosine. Static, dynamic and synchronized data for assessing perfusion and PFR-TTPF were reconstructed. The difference between the means of both groups with a parametric test was calculated. P=<0.05 was considered significant.

Results: Mean age, body mass index and myocardial infarction history were similar between both groups. Regarding cardiovascular risk factors, the DM2 patient group: 76% had hypertension, 68% dyslipidemia and 52% tobacco smoking; compared to 60%, 59% and 48% of the control group, respectively. The PFR in stress showed a trend towards statistical significance between the DM2 group compared to controls [0.7 vs. 1.88 ± 0.6 ± 2.08] (p = 0.06), which was not observed in the PFR at rest [1.92 ± 0.8 vs 2.09 ± 0.6] (p = 0.21). There was a statistical significance between TTPF stress groups [195 ± 51 vs. 170 ± 47] (p=0.6), not the same at rest [180 ± 50 vs 170 ± 51] (p=0.23). Statistical tests were corrected according to differences in the size of the groups.

Conclusion: Among the parameters of diastolic function, TTPF in stress was significantly higher in patients with DM2 compared with controls. Likewise, the PFR in stress was shown to be lower in the group of DM2 with a trend toward statistical significance. The parameters at rest showed no significant difference between the two groups. We believe that future studies will be useful to evaluate the clinical impact of diastolic function in patients with DM2.
Abstract ID: 133

The Role of SUV SPECT Perfusion Defect Quantification of the Lung as a Predictor of Severe Cardiovascular Events in a Cohort of Patients with Congestive Heart Failure

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Background: The aim of this study was to investigate the use of SUV SPECT to quantify lung perfusion defects in both non-CHF and CHF patients and to explore its correlation index as an outcome predictor for CHF patients.

Methodology: 30 patients were enrolled in the study. 17 CHF patients were followed for 16±5 mo (mean±SD) and 13 patients were a non-CHF control group. All patients underwent a SPECT/CT lung perfusion scan, an independent diagnostic CT plus echocardiography. The lung perfusion scan was reconstructed using the software ‘SUV-SPECT’ (Hermes Medical Solutions AB, Sweden) to convert the recorded counts per voxel into activity per unit volume to allow for SUV calculations. The diagnostic CT was co-registered with the SPECT perfusion scan in order relate the perfusion function to anatomy. Using the software ‘Hybrid 3D Lung Lobe Finder’, the right and left lungs were automatically detected from the CT. The lungs were further split semi-automatically into individual lobes by placing 10 to 15 points along each fissure. Using the computed anatomical volumes it was possible to record the total SUV and volume of each lung and lobe. The SUV difference between the CHF group and the control group were compared. Cardiac death, acute MI, unstable angina, and late revascularization (>3 mo) experienced by the patients during follow-up were defined as cardiac events. Multivariate Cox regression analysis was applied for different kinds of cardiovascular events patients and different SUV index.

Results: Patients without CHF showed a fairly uniform lung perfusion while CHF patients had a heterogeneous distribution with defects. Preliminary results show that there were no significant differences between the total lung SUV of the two groups. There were 10 patients (33.3%) who had cardiac events, including 2 acute MI, 3 late coronary artery bypass grafting, and 5 unstable angina pectoris during the follow-up. Upon completion of the study, a differential SUV analysis between the CHF group and the control group will be presented.

Conclusion: SUV SPECT perfusion defect quantification of the lung is a promising method for assessing pathology, physiology state and the rate of severe cardiovascular events in CHF patients.
Patients with Normal Exercise Stress Myocardial Perfusion Studies who Achieve Less than 75% of Maximum Predicted Heart Rate are at Increased Risk for Cardiac Events

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**Background:** Exercise stress myocardial perfusion imaging (MPI) provides important diagnostic and prognostic information. However, when patients with normal MPI at submaximal exercise level are not subjected to careful clinical follow-up, then the prognostic value of this state is uncertain. We hypothesized that patients with normal stress MPI who achieve<75% Maximal Predicted Heart Rate (MPHR) with the Bruce protocol are at higher risk for cardiac events compared to those who achieve higher levels of MPHR.

**Methodology:** We studied 1000 patients (614 male, 386 female; mean age 60±12y) with normal MPI in whom Bruce protocol stress MPI was performed. The patients were divided into two groups based on MPHR; 116 patients with MPHR<75% were placed in the Group 1 and 884 patients with MPHR≥75% were placed in Group 2. Follow-up data over 2±0.3 year were obtained from hospital records. Death, myocardial infarction (MI), myocardial revascularization procedures (PTCA, CABG) and unstable angina were considered as adverse cardiac events. Associated cardiac risk factors, medications and prior cardiovascular medical history were compared in these two groups, and prognostic value of exercise treadmill stress variables analyzed.

**Results:** Of the 1000 patients studied, 116/1000 (11.6%) failed to achieve 75% MPHR with the standard Bruce protocol. In all of the patients studied, there were a total of 30 adverse cardiac events. In Group 1, with less than 75% MPHR, there were 16 events (16 / 116=14.0%). In Group 2, with≥75% MPHR, there were 14 events (14/884 = 1.5%). The difference in number of events in the two groups was highly significant (p< 0.001). Group 1 patients were more likely have a history of MI, PTCA, diagnosed CAD, symptoms of typical angina, smoking history, hypertension, or treatment with b-blockers. Resting HR, peak HR, peak SBP, METS, frequency of ST depression ≥1 mm and EF were significantly higher in Group 2 patients; the Duke score was significantly lower in the Group 2 patients. Stepwise regression analysis demonstrated that the variables most likely to be related to cardiac events were MPHR, followed by ischemic ECG changes, and METS. Duke score and systolic blood pressure did not have a strong influence on adverse cardiac events.

**Conclusion:** Patients that had a normal exercise MPI who failed to achieve 75% of MPHR with the Standard Bruce protocol are at about 9-fold higher risk for adverse cardiac events compared to those who reached higher levels of MPHR. Thus patients with normal exercise MPI with MPHR below 75% should be evaluated with pharmacological stress testing or other appropriate procedures for protection from future adverse cardiac events.
Left ventricular Dyssynchrony in Hypertensive Patients With Normal Systolic Function Detected by Myocardial Perfusion Scintigraphy

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Background: LV systolic and diastolic dyssynchrony are not uncommon in patients with hypertension. Dyssynchrony is associated with increasing incidence of heart failure, cardiovascular morbidity, and mortality. Objective: The objective of our study was to assess left ventricular (LV) dyssynchrony in hypertensive patients with normal systolic function using myocardial perfusion imaging (MPS).

Methodology: A total of 70 individuals were enrolled in this study. They were divided into two groups. Group A included 20 hypertensive patients with good LV systolic function (ejection fraction ≥ 50%) and narrow QRS on the ECG (<120 ms). We excluded individuals with any of the following: acute coronary syndrome, diabetes mellitus, atrial fibrillation, significant valvular heart disease, chronic renal failure, pulmonary hypertension, or myocardial or pericardial disease. Group B included 50 age-matched and sex-matched healthy volunteers and represented the control group. All participants underwent standard two-dimensional echocardiography and MPS.

Results: The hypertensive group had no significant perfusion abnormalities as compared with the control group. Hypertensive patients had septal wall and posterior wall thickness than the control group on echocardiography. In addition, dyssynchrony analysis showed significantly higher bandwidth and standard deviation in hypertensive patients than in controls (P < 0.05). There was no correlation between dyssynchrony and perfusion abnormalities in both groups. The severity of dyssynchrony is significantly related to the LV mass, septal wall thickness, posterior wall thickness, and left ventricular end-diastolic dimension.

Conclusion: Patients with systemic hypertension and normal systolic function may demonstrate LV dyssynchrony by MPS. The severity of dyssynchrony is significantly related to LV mass, septal wall thickness, posterior wall thickness, and left ventricular end-diastolic dimension. Systolic dyssynchrony may identify hypertensive patients at risk for the development of further complications, and who may benefit from more intensive hypertension control at an earlier stage in their disease process.
Assessment of Mechanical Dyssynchrony by Myocardial SPECT Imaging is Predictor of Mortality in Congestive Heart Failure Patients With Normal QRS Duration

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Background: Researchers have assessed the prevalence of mechanical dyssynchrony in patients with CHF with normal QRS duration by echocardiography techniques such as tissue Doppler imaging. It is established now that mechanical dyssynchrony has some role in prognosis of congestive heart failure patients. Although echocardiography technique is widely available in a developing country such as Pakistan, lack of expertise in newer echocardiography techniques of dyssynchrony analysis such as TDI and Speckle tracking echo limits its use as predictor of future cardiac events. In comparison, Myocardial SPECT imaging is not only widely available, its negligible interobserver variability can make it a valuable tool for assessment of myocardial dyssynchrony as a predictor of mortality and morbidity in CHF patients with normal QRS duration.

Methodology: Group A consisted of 50 patients with congestive heart failure with normal QRS complex who met the following criteria were retrospectively analyzed: Patients with NYHA function class II, III, IV for at least three months; bilateral pulmonary congestion on admission; and LV EF <35% and QRS duration ≤120 ms at the time of presentation. Patients with atrial fibrillation, significant structural valvular disease, cardiac or cerebral ischemic event within the previous three months, coexisting malignant disease, coronary revascularization during the study period and above age 80 were excluded. Group B comprised the control group.

Results: A total of 50 age and sex matched normal patients were assessed as control for calculation of normal values of standard deviation (SD) and histogram bandwidth (HBW) in our population. Dyssynchrony analysis was performed in patients and control group. Patient records were analyzed at 6 months follow up for cardiac events and mortality and it was correlated with SD and HBW in CHF patients with normal QRS complex. Detection of LV systolic dyssynchrony using Tc99m Myocardial SPECT was found to be an important independent predictor of clinical events and cause of mortality in CHF with normal QRS duration (significance value P<0.05) regardless of age, EF, QRS duration, etiology of CHF, and use of beta-blockers.

Conclusion: Left ventricular dyssynchrony analysis with Tc99m Myocardial SPECT was found to be an important independent predictor of clinical events and cause of mortality in CHF patients with normal QRS duration.
18F-FDG PET/CT in the Diagnosis of Prosthetic Valve Endocarditis

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Background: This case report aims to support the role of 18F-FDG PET-CT as an important tool in diagnosing prosthetic valve endocarditis (PVE). Accuracy in diagnosing PVE using the traditional diagnostic tools, like transesophageal echocardiography and transthoracic echocardiography, decreases in the presence of intracardiac devices, valvular prosthesis, severe pre-existing lesions and a very small or no vegetation. 18F-FDG PET/CT imaging has been reported as an important diagnostic tool in the early diagnosis of PVE, as it has the ability to detect the condition even before the development of structural changes. Few studies emphasize its contribution in increasing the accuracy of Duke’s criteria in diagnosing infective endocarditis and moved to include abnormal FDG uptake as a novel major criterion for PVE.

Methodology: Here we report the case of a 74-year old female with post transcatheter aortic valvular implantation (TAVI) who presents with fever of unknown origin and persistent leukocytosis and thrombocytopenia. Patient underwent serial blood cultures, 99mTc-HMPAO-WBC scintigraphy, transesophageal echocardiography, 18F-FDG PET/CT scans (initial scan and two weeks after), and bone marrow aspiration biopsy.

Results: Work-ups showed negative blood cultures, equivocal bone marrow aspiration biopsy, unremarkable 99mTc-HMPAO-WBC scintigraphy, and negative transesophageal echocardiography. Initial 18F-FDG PET/CT scan showed increased FDG uptake surrounding the aortic valve prosthesis, more intense posteriorly. Follow-up 18F-FDG PET/CT, done 2 weeks after the initial, revealed abnormal FDG uptake surrounding the aortic valve prosthesis, as well as peripheral hypermetabolism in a soft tissue/ fluid collection posterior to the graft. Computed tomography angiography (CTA) done immediately after 18F-FDG PET/CT supported the finding by demonstrating an abscess and peri-graft pseudoaneurysms. This was confirmed by the post-surgical histologic findings of prosthetic valve infective endocarditis, abscess, and pseudoaneurysm of the ascending aorta and aortic root.

Conclusion: 18F-FDG PET-CT can be utilized to diagnose PVE, especially in the early stages, where conventional diagnostic tools are indeterminate.
Apical Artifact on Myocardial Perfusion Imaging Due to the Use of IQ-SPECT

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Background: IQ-SPECT (Siemens) consists of SMARTZOOM, cardio-centric and 3D iterative SPECT reconstruction and makes it possible to perform myocardial perfusion imaging (MPI) scans in a short time. Through this study, we report a current ascertainment of a significant lower apical myocardial tracer uptake which is problematic while interpreting MPI scans.

Methodology: Sixteen patients (fourteen women and two men with mean age of 59.52 years) who underwent MPI were included in the study. All patients underwent a 2 days stress-rest protocol. The stress test was done by a bicycle ergometer (5 patients) or by dipyridamole administered intravenously (11 patients). 444 MBq of technetium-99m-tetrofosmin was injected during the bicycle ergometry at the time when 85% of the age-predicted maximal heart rate was achieved or 5 minutes after persantin injection. Acquisition was performed on a Symbia T6 equipped with a multifocal SMARTZOOM collimator and reconstruction was performed with X-ray CT-derived attenuation correction (AC). A semi-quantitative myocardial perfusion was analyzed by a 17-segment model with a 5-point visual scoring. The left ventricular functions and myocardial contractility were analyzed by Corridor 4DM software.

Results: For all our patients, there was a tendency toward decrease perfusion in the apical or apical anterior segments by IQ-SPECT with attenuation correction while the other entire myocardial segments had a normal uptake. These results were in contrast with a normal end-diastolic volume, end-systolic volume and left ventricular ejection fraction. All the patients had also a normal systolic myocardial thickening and a preserved myocardial contractility. A follow-up of one year later was conducted showing that no patient had developed a cardiac infraction or a coronary accident.

Conclusion: According to the few studies comparing IQ-SPECT and conventional MPI acquisitions, images are comparable. However, in our daily practice, we notice that with IQ-SPECT collimator, there was a tendency to show apical and apical anterior defect that can be considered as an artefactual defect. Further assessment by means of a phantom study is required to clarify whether this defect is real or artefactual.
Utility of Combined Supine and Prone Positioning for IQ-SPECT System for Correcting the False Positive Results

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Background: Myocardial perfusion SPECT studies using IQ-SPECT Symbia S system (Siemens, USA) with SMARTZOOMTM collimators and with dedicated reconstruction software provides shorter scan time using lower levels of radioactivity compared to the conventional SPECT systems. However, false positive findings due to soft tissue attenuation artifacts can be detected with this acquisition method too. The aim of this study is to determine the utility of combined supine and prone positioning for IQ-SPECT system for correcting the false positive results without using CT based attenuation correction.

Methodology: One hundred and eight patients (65 female age 33-81, mean 61; 43 male age 42-80, mean 60) who underwent myocardial perfusion SPECT on February 2013 were enrolled in the study. Two days acquisition protocol was used. All of the patients had equivocal or ischemic post-stress supine images and all of them had a delayed post-stress acquisition in prone position, and resting images on the following day. Both supine and prone studies were evaluated and the results were interpreted as normal or abnormal (as equivocal or ischemic). The patients hospital data records were checked for follow-up in one year. Myocardial perfusion GATED SPECT imaging results are compared with the clinical outcomes of the patients.

Results: Evaluation of combined supine and prone poststress images revealed that ninety nine of 108 patients (91.6%) had normal myocardial perfusion SPECT results. Among the normal results, 1 patient (1%) had a cardiac event and/or symptoms underwent LAD stenting, 98 patients (99%) had no cardiac event/symptoms in one year of follow up. Myocardial perfusion SPECT of 9 patients (8.3%) were interpreted as ischemic. Five of 9 patients (55.5%) had cardiac event/symptoms and had coronary angiography afterwards. Two of these patients underwent coronary artery bypass surgery, one had noncritical LAD lesion, one underwent LAD stenting and one underwent CX stenting in following year. Four of 9 patients (44.4%) having ischemic MPI scan results had coronary angiography revealed as normal. According to the results, sensitivity of the study is 83.3%, specificity is 96%, false negative rate is 16.6%, false positive rate is 4% and accuracy of the method is 95%.

Conclusion: We concluded that after one year follow up of the patients that we evaluated as normal with both supine and prone positioning in post stress images, studies were normal, as patients did not have any cardiac event or symptoms. These findings are convincing that combined supine and prone position acquisition for post-stress myocardial perfusion imaging is reliable for IQ-SPECT system.
SPECT MPI in the Assessment of Post Infarct Therapeutic Attitude

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Background: Prognosis following MI depends on a number of factors including geographic location, patient’s health, extent of heart damage, and treatment given. However early risk stratification post-MI and therapeutic strategy are important to determine patients at increased risk for a recurrent ischemic event and those at increased risk for cardiac death (arrhythmic or non-arrhythmic). Objective: To assess the therapeutic approach by SPECT MPI imaging by allowing an accurate assessment of prognosis and guiding of post-MI management.

Methodology: 430 patients in the early phase of post myocardial infarct have been investigated by SPECT/MPI. Patients have been classified in two groups: those who have received thrombolysis with or without revascularization and those who have not been thrombolysed. All patients recruited during two months underwent a two days protocols with physical/pharmacological stress/rest Gated SPECT MPI using tetrofosmine (Myoview) and a dual head gamma camera (Symbia T6).

Results: Average age of patients was 60.6 years with a ratio men/women of 4:1. Identified risk factors were: hypertension (56%), diabetes (43%) smoking (39%) and dyslipidemia (26%). 54% of patients did not receive thrombolysis nor revascularization. Meanwhile, 46% received thrombolysis treatment (14%) or revascularization by coronary artery bypass grafting (CABG, 12%) or percutaneous coronary intervention (PCI, 20%). Gated SPECT MPI showed in 357 patients (85%) fixed defects in 357 patients (85%) and reversible defects in 270 patients (63%). It was noted that more reversible defects were seen in patients who did not receive thrombolysis (57%) than in those patients who did receive a thrombolysis or a revascularization. Patients who benefited from revascularization showed better summed stress score and less stress ischemia in other territories than patients who have not been thrombolysed (ratio of 0.7). Average post effort ejection fraction was better (59%) in patients who have been revascularized than in not thrombolysed patients. Average of transient index dilation (TID) was more elevated (>1.18) in non thrombolysed patients.

Conclusion: SPECT/MPI is an important tool to assess post MI therapy and it is useful to stratify patients according the MPI findings in order to predict with better accuracy the outcomes of post infarct therapy strategy.
SPECT MPI Findings in the Prognosis of Dilated Cardiomyopathy

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Background: The prognosis for dilated cardiomyopathy (DCM) is very specific to an individual and their particular anatomy. Some people with the condition can lead a normal life and remain essentially symptomatic. Others develop symptoms that can progress. MRI and SPECT/MPI are an important imaging modalities to assess and to establish a prognosis of the DC. Objective: To assess the role and the place of SPECT/MPI in the therapy management of DCM.

Methodology: 84 patients have been referred to nuclear medicine department for DCM in 4 months. All patients recruited underwent a two days protocols with physical/pharmacological stress/rest Gated SPECT MPI using tetrofosmine (Myoview) and a dual head gamma camera (Symbia T6). A SPECT MPI analysis using the 4DM SPECT was done and comparison done between perfusion findings and clinical, risk factors and echocardiography results.

Results: Average age of patients was 61 years with a ratio men/women almost equal to one (53% vs 47%). The risk factors were dominated by hypertension (66%) then diabetes (45%), dyslipidemia (26%), smoking (21%) and heredity (8%). 84% of patients were symptomatic and the dyspnea was the most frequent symptom (68%) followed by pectoris angina (42%). 26% of patients presented and LBBB and underwent a pharmacological stress SPECT MPI. Average ejection fraction obtained by echocardiography was 43%. SPECT MPI showed fixed defects in 66% of patients, reversible defect in 53% and normal patterns in 8% of patients. Among patients with fixed defects, 60% have had more than 3 segments involved, 30% between 2 to 3 and 10% less than 2 segments. Regarding patients with reversible defects, 35% have had more than 3 segments involved, 40% between 2 to 3 and 25% less than 2 segments. Number of reversible defects as well as number of fixed defects were correlated to the clinical symptoms. SPECT MPI has assisted in most cases to find out an appropriate therapeutic strategy.

Conclusion: SPECT MPI in dilated cardiomyopathy is an important prognostic tool and has a major place in adjusting initial therapy in order to reduce cardiac events and improve quality of life.
Abstract ID: 150

Role of Nuclear Imaging in Cardiac Amyloidosis - Case Report

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Background: Amyloidosis refers to large group of disorders caused by extracellular deposition of insoluble abnormal fibrils of misfolded proteins, which can alter tissue structure and impair function of multiple organs, including the heart. Cardiac amyloidosis is often misdiagnosed. Histological analysis of endomyocardial tissue is still the gold standard for the diagnosis of cardiac amyloidosis, but it has its limitations. Accordingly, there is a need for non-invasive modalities to diagnose cardiac amyloidosis. Echocardiography and magnetic resonance imaging can detect thickened ventricular walls and systolic/diastolic dysfunction, characteristics that are not very specific for cardiac amyloid. Among nuclear medicine techniques, scintigraphy with bone-seeking tracers (diphosphonates) is very useful in the evaluation of transthyretin (TTR) (both hereditary and wild type) related cardiac amyloidosis. However, the diagnosis of the type of cardiac amyloidosis is not always straightforward.

Methodology: We present a case of a cardiac amyloidosis that highlights the potential difficulties in determining the diagnosis and the role of nuclear imaging.

Results: A 53-year old Caucasian male was admitted to the hospital for the first time after an episode of syncope. Electrocardiogram revealed paroxysmal atrial fibrillation and left bundle branch block. Transthoracic echocardiogram showed severe left ventricular hypertrophy, bilateral atrial dilation and decreased ejection fraction. Since infiltrative cardiomyopathy was suspected, the subcutaneous fat pad biopsy was performed with negative result. Few months later he complained of marked dyspnea on exertion and palpitations. Coronary angiography was performed and no abnormalities were found. In the next two years, his status was stable. Three years after the first hospitalization, his condition deteriorated. He was admitted to the hospital several times with chest pain and paroxysmal atrial fibrillation. Another coronary angiography with stenting of 70% stenosis of right coronary artery was performed. Two years later, he presented with severe right sided cardiac decompensation. At that time, thickened rectal mucosa on computer tomography of abdomen was observed. Rectal biopsy was performed and light chain (AL) amyloidosis was confirmed histologically. Serum protein electrophoresis and bone marrow biopsy did not show any abnormalities. In the meantime, our nuclear medicine department was asked if we could offer any additional diagnostic method to elucidate his condition. We decided for 99mTc-aptotinin scintigraphy which showed accumulation in the heart as well as in the liver, kidneys, bladder and right lobe of lung. Additionally, we performed a 99mTcDPD (99mTc-3,3-diphosphono-1,2-propanodicarboxylic acid) bone scintigraphy. We confirmed an intense myocardial uptake of the tracer. As intense 99mTcDPD retention is characteristic for TTR and not AL amyloidosis, we proposed to revise histopathological specimen. With immunohistochemistry study, TTR amyloid deposition was found. Finally, genetic testing confirmed c.425C>T TTR gene mutation.

Conclusion: Once the diagnosis of amyloidosis is made, specific type of amyloidosis should be determined because the prognosis and the treatment plan depends on it. Our case supports the important role of 99mTc-aptotinin scintigraphy for the evaluation of the extent of disease and 99mTcDPD bone scintigraphy as a non-invasive method in the diagnosis of TTR-related amyloidotic cardiomyopathy.
Abstract ID: 152

**Relationship Between Transient Ischemic Dilatation Without Perfusion Defects and Changes in Heart Rate During Acquisition**

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**Background:** Transient ischemic dilation (TID) is a well known phenomenon in myocardial perfusion SPECT (MPS), generally associated with ischemic claudication post-stress and thus with prognostic value. However, it has been suggested that some of these cases are due to apparent volumetric changes secondary to differences in heart rate (HR) at the time of acquisition of the post-stress and rest study. We proposed to assess the correlation between TID and HR in patients (pts) with no perfusion defects.

**Methodology:** We retrospectively analyzed patients sent for MPS during a period of 18 months. We used a two-day protocol 99mTc-MIBI gated SPECT (exercise n = 50, dipyridamole n = 13), recording the average HR during the acquisition and the HR difference between rest-stress (HRD) and we also obtained the medium ventricular volume (MV), end-diastolic volume (EDV) and end-systolic volume (ESV), data provided by the QGS software. We included those pts in which the ratio between stress and rest MV (TIDMV index) was at least 1.2. TID index was also calculated for EDV and ESV (TIDEDV and TIDESV). We excluded pts with perfusion defects, rhythm or intraventricular conduction disorders and/or ESV less than 10 ml. For Pearson correlations between all variables we consider a = 0.05.

**Results:** From a total of 2,006 pts, 63 met the above criteria for analysis of TID vs changes in HR (44 men, age 63.8 ± 9.7). The TIDMV had an average of 1.29 ± 0.09 and HRD an average 9.8 beats per min (bpm) (range between -10 and 41). We found a positive correlation between TIDMV and HRD during acquisition (r = 0.51, p <0.001). There was also positive correlation between TIDEDV and HRD (r = 0.5, p <0.001), but not between TIDESV and HRD (r = 0.23, p = 0.07). Dividing the population in pts with HRD <10 bpm (n = 36) and with ≥10 bpm (n = 27), in the first group there was no correlation between TIDMV and HRD (r = 0.15, p = 0.39) while in the second group, an even stronger correlation than the total group was found (r = 0.67, p <0.001).

**Conclusion:** In this series of low ischemic risk pts without perfusion defects, the TIDMV showed a positive correlation with the HRD during acquisition, MV being greater at lower frequencies. HR changes affected the MV at the expense of EDV and not of ESV and correlation was significant from a HRD of at least 10 bpm (higher at rest). Although the sample may have included pts with balanced ischemia, TID without perfusion defects should be interpreted with caution in the presence of differences in HR during acquisition.
Impact of Prone Acquisition After Stress on Attenuation Artifacts Resolution in Men and Women

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Background: Prone imaging can reduce both diaphragmatic and breast tissue attenuations and improve interpretive ability of myocardial perfusion images. Objective: The aim of this study was to evaluate the impact of prone acquisition after stress on attenuation artifacts resolution in both genders.

Methodology: We have included 564 consecutive patients (mean age 62 +/-11 years old, 59% females) who were referred for evaluation of myocardial ischemia. All patients underwent routine electrocardiogram-gated supine SPECT imaging and when necessary non-electrocardiogram-gated prone-position SPECT imaging after stress. The patients that were submitted to both supine and prone after stress images, the myocardial 99mTc-MIBI uptake’s defects were compared between these two positions according to gender.

Results: From a total of 564 myocardial perfusion imaging (MPI) included, 301 (53%) performed supine and prone acquisitions after stress to improve interpretive certainty of myocardial uptake defects. In relation to gender, 75% (175/232) of men performed prone acquisitions compared to 38% (126/332) of women, p<0,05. In women, prone acquisition revealed defect improvement in 87 patients (69%); 33 (26%) remained with the myocardial defect and in 6 women (5%), the prone acquisition was considered “useless”. In men, prone acquisition revealed defect improvement in 115 patients (66%); 50 (28,5%) remained with the myocardial defect and in 10 (6%), the prone acquisition was “useless”.

Conclusion: About 50% of patients that were submitted to MPI, prone acquisition after stress was required to improve interpretive ability of images. Prone images were more needed in men than in women. However, for both genders, prone images after stress solved attenuations artifacts approximately in the same proportion.
Mirror Image Tc-99m Sestamibi Localization in a Patient with Situs Inversus Totalis Presenting with Right Sided-Chest Pain

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**Background:** Situs solitus is the normal anatomic position, and situs inversus is the mirror image of situs solitus. In the Philippines, the frequency of such condition in the general population is undocumented but it is presumed to follow similarly with U.S. statistics of about 0.01%. We are presenting a case of a 47-year-old, diabetic, dyslipidemic male, smoker, with situs inversus totalis presenting with chest pain and referred for myocardial perfusion imaging (MPI) to rule out ischemic heart disease. The lack of proper understanding of the reversed anatomy in this condition can produce errors during the performance of the procedure, during processing of raw images, or more importantly, during interpretation of results that can affect subsequent patient management. Cardiac situs is determined by the location of the atria. In situs inversus, the morphologic right atrium is on the left and left atrium is on the right. The normal pulmonary anatomy is also reversed. The remaining internal organs are also mirror images of the normal. Since these conditions have some variations, it is highly advisable to have films/results from the patient’s prior radiologic examinations on hand in order to anticipate any modifications the technologist would need to do during MPI.

**Methodology:** For this case, we reversed the limb and chest leads for proper ECG recording (Figure 1). We also reversed the arc during SPECT acquisition, which is from 45 degrees left anterior oblique position to 45 degrees right anterior oblique position (Figure 2). Appropriate processing of SPECT data is also vital since the lateral and septal left ventricular walls are reversed (Figure 3).

**Results:** The illustrated patient has situs inversus totalis or situs inversus with dextrocardia. As the planar and cine images illustrate, the location of the internal organs are the mirror image of the normal anatomy. The SPECT images showed a small, mild reversible defect in the inferior region that was interpreted as inducible ischemia. Analysis of images, case outcome and technical considerations relating to situs inversus will be presented.

**Conclusion:** Early recognition of situs inversus through proper communication with the referring physician or with good history taking, as well as coordination with your technical staff, would avoid mistakes and delays, thereby assuring smooth performance of myocardial perfusion imaging in this subset of patients.
Nuclear Cardiology – Status in Brazil for 2016

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Abstract ID: 161

Background: The Latin American region, and especially Brazil, has experienced several social, demographic, and economic changes that have had a significant impact on public health. Nuclear Cardiology is an important diagnostic application of nuclear medicine (NM) in Brazil. Our aim is to review the availability and utilization for nuclear cardiology procedures in Brazil.

Methodology: As a means to establish the current state of nuclear cardiology in Brazil, we evaluated the National Registry of Public Medical Procedures (www.datasus.gov) and the annual report of supplementary health procedures (www.ans.gov.br). Brazilian demographics were obtained in the National Institute of Geography and Statistics site (www.ibge.gov.br). Nuclear Medicine services and nuclear physicians are authorized to operate and practice in Brazil by the Brazilian National Committee of Nuclear Energy (www.cnen.gov.br). A standardized questionnaire was emailed to all NMS in all centers performing cross-sectional myocardial perfusion imaging (MPI) studies in Brazil, and a local leader provided the answers for data collection. The number of Myocardial Perfusion Imaging procedures was correlated to the number of people that have access to the procedures according to the private or public status of the health system. Projections for the future were made.

Results: There were 403 nuclear medicine services operating in Brazil by February 2016. In Brazil, there are 660 certified nuclear medicine specialists most located in Southeast (55%). Nuclear medicine specialists comprise only 0.25% of all physicians in Brazil. Brazilian population is estimated at 205,493,445 inhabitants: only 150 million have access to the public health system and 51 millions people use the private practice nuclear cardiology procedures. The number of MPI procedures in private practice is 1,683 MPI per year / 100,000 inhabitants compared to 152 MPI per year/100,000 inhabitants in public institutions. The number of procedures is growing by 4.5% per year. The Brazilian Society of Nuclear Medicine recently launched Brazilian guidelines of nuclear cardiology in order to harmonize clinical practice. Specialized cardiologists perform most nuclear cardiology stress procedures. The most frequently radiotracer in the clinical practice is 99mTc-sestamibi followed by Thallium. Injected activities of technetium-99m exceed the threshold recommended by the IAEA (36mCi) in 52.86% of the 56 nuclear medicine services that answered the survey. There are 830 equipment of nuclear medicine in the country and 5 solid state CZT equipment. Only cardiac 18F-FDG procedures are done for myocardial viability research and cardiac infections detection. PET CT is not used for MPI because 13N-amonia and 82Rubidium are not available.

Conclusion: The Brazilian experience with nuclear cardiology is evolving and the observed growth within the last decade is impressive. At this time, there is an asymmetrical distribution of resources that results in a limited availability to this technology to a large number of Brazilians. Efforts to provide new radiotracers and more equal distribution of resources and specialists must be considered in order to strengthen the care of patients with cardiovascular diseases.
18F-FDG PET in Myocardial Viability Assessment and Left Ventricular Function Improvement in Post-Myocardial Infarction Patients

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Background: In post-myocardial infarction (MI) patients with severe left ventricular (LV) dysfunction, F-18-fluorodeoxyglucose (18F-FDG) PET imaging is considered by many to be the best means for defining myocardial viability and has proven useful in predicting regional and global recovery of LV function following revascularization. Objective(s): the aim of this study was to determine the amount of viable myocardium predicting recovery of LV function among post-MI patients with LV dysfunction.

Methodology: a total of 30 post-MI patients with EF% reduction underwent SPECT myocardial perfusion and 18F-FDG PET scan for myocardial viability assessment. Ejection fraction (EF%) of these patients have been followed-up at 1 month, 6 months and 12 months after medical therapy or coronary artery revascularization.

Results: 66.7% of these patients with LV dysfunction had hibernating myocardium (perfusion-metabolism mismatch defects) since then underwent to revascularization. The percent of hibernating myocardium in large, moderate and small were 30%, 50% and 20% respectively. The improvement of EF% was significant after 6 months and 12 months and between group of revascularization and medical therapy. The EF% change was related to the amount of hibernating myocardium.

Conclusion: In post-MI patients with LV dysfunction, the amount of viable myocardium dictates the improvement of left ventricular function after coronary artery revascularization.
Background: Left ventricular mechanical dyssynchrony may reflect abnormal regional contraction and bears an unfavorable prognosis in patients with coronary artery disease. Objective: The aim of this study was to describe relationships between abnormal myocardial perfusion imaging and characteristics of mechanical dyssynchrony parameters measured by phase analysis gated single photon emission computed tomography (GSPECT) in suspicious coronary artery disease (CAD) patients.

Methodology: 80 suspicious CAD subjects were divided into two groups including fifty patients with abnormal myocardial perfusion imaging and thirty patients without CAD with normal myocardial perfusion imaging (control group). GSPECT with technetium-99m sestamibi was performed in Nuclear Medicine Department, Tran Hung Dao hospital, Hanoi, Vietnam. SPECT myocardial perfusion size, total perfusion defect, left ventricular volumes and ejection fraction (EF) were assessed. Parameters of left ventricular dyssynchrony including QRS width, histogram bandwidth (HBW) and phase standard deviation (PSD) were measured from GSPECT using the Emory Cardiac Toolbox software.

Results: Total perfusion defect was 26.9 ± 13.3%. Average mean of EF was 34.2 ± 12.61%. The single-vessel myocardial hypoperfusion was 87.5%, multivessel disease was 13.5%. Patients with abnormal myocardial perfusion imaging had dyssynchrony mean parameters significantly higher compared with a cohort of 30 control subjects by both HBW (187.6 ± 68.99 vs 60.5 ± 27.7, p<0.05) and SD (61.4 ± 19.45 vs 26.7 ± 9.7, p<0.05). HBW correlated with perfusion defect size (r = 0.45, p<0.05), end-systolic volume (r = 0.54, p<0.05), end-diastolic volume (r = 0.57, p<0.05) and EF% (r = 0.58, p<0.05).

Conclusion: Patients with abnormal myocardial perfusion imaging exhibit mechanical dyssynchrony as measured by GSPECT correlating with parameters of left ventricular function.
Background: Myocardial perfusion single photon emission computed tomography (MPS) is one of the most used imaging methods in the evaluation of patients with suspected coronary artery disease due to its diagnostic and prognostic values. Two of its major limitations are the use of radiation and scan duration. Recently, concerns about radiation exposure and patient safety have emerged, leading to new development in nuclear cardiology. In this context, new gamma cameras using cadmium zinc telluride detectors (CZT-GC) have been created, with an important increase in spatial and energetic resolutions, allowing reductions in tracer dose and acquisition time. However, the prognostic value of these new protocols is not established yet. Objective: To determine the prognostic value of a new, ultrafast, low dose protocol in a CZT-GC.

Methodology: For our study we selected 1,500 patients with suspected coronary artery disease undergoing MPS in a CZT-GC at a single center in Rio de Janeiro, Brazil, between 11/2011 and 10/2012. One-day protocol was used, initiated by the resting phase with a dose of 5 mCi and subsequent stress with dose of 15 mCi of 99mTc-MIBI. The acquisition times were 6 and 3 minutes, respectively. The tests were classified as normal or abnormal and perfusion scores (SSS, SRS and SDS) were calculated. Patients were followed through semiannual telephone contact. The events evaluated were death and nonfatal myocardial infarction, defined as hard events. Cox method was used to identify predictors.

Results: 1500 patients were followed for 26 ± 4 months (3-26). The mean age was 64.2 ± 12.7 years, and 53.2% were male and the mean BMI was 27.2 ± 4.8. Hypertension was the most frequent risk factor (59.5%), followed by dyslipidemia (51.9%) and diabetes (23.3%). Physical stress was used in 825 (55.0%) patients. 1170 (76.7%) scans were classified as normal. The average dosimetry of scans was 6 mSv and the mean duration was 48 ± 11 minutes. During follow-up there were 32 deaths and 6 nonfatal heart attacks. The annual rate of hard events was higher among those with abnormal MPS, especially with higher SDS (p <0.001).

Conclusion: This new CMP protocol in a CZT-GC allows much faster, lower radiation studies without compromising prognostic and risk stratification abilities of this imaging method.
Carcinoid Heart Disease: Illustrated Clinical Case

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Background: The incidence of neuroendocrine tumours (NETs) is approximately 1 in 75000 people: about 50% will develop a carcinoid syndrome, approximately 50% of which will evolve into carcinoid heart disease. NETs produce various secretory products such as serotonin, histamine, tachykinins, kallikrein and prostaglandins. Histamine and kallikrein are likely mediators of pruritus and flushing whereas serotonin is most likely to induce diarrhoea. In the setting of liver metastases or direct secretion of these substances into the systemic circulation, systemic effects occur leading to characteristic symptoms. Carcinoid heart disease occurs primarily on the right side of the heart but there can also be minimal involvement of the left side. Fibrous deposits adhere to the surface of the valvular endocardium. Thickening of the endocardium of the cardiac chambers, valve cusps and chordae tendinae can lead to heart failure. The fibrous deposits usually involve the ventricular aspect of the tricuspid valve.

Methodology: We present a clinical case involving a metastatic NET complicated by carcinoid syndrome and by cardiac valve involvement. Multidisciplinary approaches have improved the prognosis and quality of life of patients with carcinoid heart disease. This case illustrates the clinical approach, tumour stratification imaging, echocardiographic results, valve surgery, intraoperative findings, histological results and follow-up data until the patient’s demise.

Results: In 2009, a 65- yo female was diagnosed with advanced-stage functioning low grade NET most likely originated in the small intestine and presenting with lung, liver and bone metastases. Long-acting octreotide analogues (30 mg every 21 days) were started in February 2010 and embolization of liver metastases was performed 4 months later. Somatostatin-analog scintigraphy with 99mTc-HYNIC TOC (September 2010) showed somatostatin receptor-expressing lesions in the left hemithorax and in the ipsilateral lung hilum. Bone metastases were observed in T12, L1, L5 and left ilium. The patient was treated with external-beam radiation therapy (ten 30-Gy sessions including T10-L1) and Lutetium-177 DOTA TATE (800 mCi divided in four 200-mCi sessions). Episodes of flushing, diarrhea and thoracic pain prompted a full heart work-up under suspicion of carcinoid heart disease that revealed tricuspid and pulmonary valve involvement and severe pulmonary valve insufficiency. ECG reported low voltage in all derivations and left anterior fascicular block. The echocardiogram displayed diastolic dysfunction type II secondary to a restrictive condition. The left ventricular ejection was 62%; Other findings included: left atrial dilation, severe right atrial dilation and mild right ventricular dilation; severe tricuspid and pulmonary valve insufficiency, with a stenosis component in the former. In 2013 the patient underwent tricuspid valve replacement. Tumour lesions have remained stable during follow-up. The patient succumbed to tumor relapsed in 2015.

Conclusion: A significant proportion of patients with carcinoid syndrome and cardiac involvement can obtain survival benefit from the combination of medical therapy, radioisotope therapy and surgery.
Challenges in Performing Pharmacological Stress Myocardial Perfusion Imaging in a Center with Limited Resources

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Background: Coronary heart disease is a great burden to the health system due to the changing lifestyle of the world population and Mauritius is no exception to it. The coronary heart disease death reached 1,148 or 14.49 % (2014). The age adjusted death rate is 86.46 per 100,000 population and rank 92 in the world. The life expectancy is male 70.4 and female is 78. Important measures are taken to address this situation by the health authorities. Nuclear cardiology has an important role to play in the management of coronary artery disease (CAD).

Methodology: The department has two SPECT gamma camera an Ecamm Siemens camera (2001) and a dual head Mediso camera (2008). A motion error on the Ecamm could never be resolve and we are limited to only one camera. Supply of Technetium generator is one weekly for an activity of 14.5 Gb. Initially, patients were stressed on a bicycle ergometer which was very uncomfortable to women. Later we shifted to a sophisticated 12 leads exercise treadmill when patients were more comfortable. Most of the cases referred to us were those who did not perform well on exercise treadmill (non conclusive result or physical handicap). Some time was taken prior to introducing dypiridamol as a pharmacological stressor for Myocardial Perfusion Imaging (MPI). Due to the non regular availability of persantine, Dobutamine stress test was recently introduced. Nuclear cardiology became more accessible now for a wider range of patients. Findings: MPI was difficult to pick up initially when only exercise stress was available. Persantine-induced stress has increase the capability to deal with more cases and with the new technique using dobutamine stress, the patient workload has further increased. Additionally, dobutamine is more readily available than persantine.

Results: The number of MPI investigations is increasing and a long waiting list is inevitable now. Recovery of patients symptoms post dypiridamole is less smooth as most patients complain of headache and weakness which requires reversal by aminophylline than with post dobutamine which often has some cardiac arrhythmias but where patients are mobilised earlier.

Conclusion: Introduction of pharmacological stress MPI is an important decision to sustain nuclear cardiology in the service. In a near future, introduction of a dedicated camera for cardiology is projected. By 2017, with the installation of a hybrid system, we hope to be up-to-date in Nuclear Cardiology. The next challenge ahead will be human capacity building.
Regadenoson in Myocardial Perfusion Study – First Institutional Experiences in Bosnia and Herzegovina

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**Background:** Regadenoson is a selective A2A agonist that has been used in Europe since 2011 for myocardial perfusion imaging (MPI) as a pharmacologic stress agent. Applied in a fixed dose of 400 ug/5ml as an intravenous bolus, it dilates coronary arteries reaching peak in circulation within 1-4 minutes.

**Methodology:** We analyzed 50 patients who underwent MPI for evaluation of coronary disease, 29 males and 21 females between 44 and 80 years, median of 59.2 years. 27 patients were imaged in coronary artery disease work-up, 21 patients in follow-up including myocardial infarction, and 2 patients for reasons such as cardiomyopathy. 9 patients had been treated with PCI, and 4 with CABG before the imaging. Standard one-day stress-rest protocol with Tc-99m-sestamibi in weight-adjusted dose was applied. Regadenoson-only method was used for inducing coronary dilatation before stress imaging. Clinical signs and hemodynamic parameters were closely followed and noted upon administration.

**Results:** Out of 50 patients, 33 (66%) experienced one or more adverse events in the form of dyspnea, chest discomfort, warmth, vertigo, palpitations and cough. In all cases but one (94%), the symptoms were mild and of short duration. One moderate case presented with shortness of breath and cough, and was controled by holding a patient in the upright position and reassurance. No further intervention was required, and the study was finished per protocol. No AV block, bradycardia or hypotension were noted. Heart rate changed by 16 + 31 bpm. No significant changes in blood pressure occurred as only four cases of mild hypertension were registered. ST segment changes up to 1 mm occurred in 4 cases (8%), and in 3 cases on T-wave (6%). Please see Table 1 in attachment for full results. Discussion: Our first clinical experiences proved regadenoson as a pharmacologic stressor to be safe, tolerable and easily used. The adverse effects were common and in all but one case mild, self-resolved and attributable to the direct stimulation of sympathetic nervous system. In one case, the shortness of breath and cough caused by bronchospasm were moderate but still limited. Use of regadenoson enabled a faster throughput of patients through the nuclear medicine department resulting in more efficient use of radiotracer. The only disadvantage was more frequent high abdominal activity of Tc-99m-sestamibi, which intererfered with interpretation of the inferior wall. However, this is not specific for regadenoson but instead has been recognized for all pharmacologic stressors.

**Conclusion:** Due to its selective action and safe use, regadenoson can be used in COPD and renal impairment.
Our Experience in the Usefulness of Myocardial Perfusion SPECT (MIBI SPECT) in the Diagnosis of Ischemic Heart Disease in Patients with Normal Exercise Stress Test

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Background: Due to the high incidence of diagnosis of ischemic heart disease (ID) in patients with normal exercise stress test, we decided to quantify our experience. We considered this to be very important for improved treatment and follow up.

Methodology: We reviewed all the patients (79) who underwent a MIBI SPECT, done in the Centro de Medicina Nuclear Modelo between July 2015 and March 2016 with normal exercise stress test (EST) (more than 600 km).

Results: all of them had risk factors (RF). The most common risk factors founded were smoking, hypertension, diabetes and hipercholesterolemia. We found 3 groups of patients: Group 1 with normal perfusion image (40 patients). Group 2 with diagnosed mild disease which included 23 patients, and Group 3 (16 patients) with moderate to severe ID. A case was considered moderate to severe when we found more than 10% of the myocardial quantification positive for ischemia.

Conclusion: MIBI SPECT is a very important tool in the diagnosis of ID in patients with normal EST with associated risk factors. In almost 50% of patients, the results of the MIBI SPECT changed the treatment. 21% of patients underwent hemodynamics study, which allows for an early diagnostic and a better treatment plan.
Abstract ID: 180

A Comparative Study of the Congruence Between Positive Myocardial Perfusion Imaging Studies and Coronary Angiography Reports of Patients with Coronary Artery Disease

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Background: The incidence of cardiovascular diseases (CVD) amongst the Mauritian population has been increasing considerably over the past decades owing to the parallel recrudescence of non-communicable diseases namely arterial hypertension, type 2 Diabetes Mellitus, dyslipidaemia and obesity. The introduction of cardiac nuclear imaging since 2003 as a well established service offered by the Nuclear Medicine Department has been a valuable asset to cardiologists in the diagnosis and better management of CVD in Mauritius. Presently, the four standard diagnostic methods for CVDs are (1) cardiac physical stress test by the Bruce protocol, (2) myocardial perfusion imaging studies, (3) coronary angiography, (4) dobutamine stress echocardiography. Objectives: To compare the correlation between the positive MPI findings and the coronary angiography reports of a group of patients with CVD from January 2014 to January 2016.

Methodology: Studied group included 287 patients with:

• Effort angina / exertional dyspnoea
• Previous episodes of acute coronary syndromes / myocardial infarction
• Inconclusive cardiac stress test
• Positive angiography reports to consider eligibility for CABG

Materials include:

• Dual Head Gamma camera (Mediso’s Nucline SPIRIT)
• LEHR collimator
• Technetium 99m SESTA-MIBI radiotracer
• Dobutamine infusion (starting rate 10micrograms/kg/min with gradual increase by 10 micrograms every 3 minutes to a maximum rate of 40 micrograms/kg/minute). Light accessory physical exercise is performed during the infusion and IV Atropine bolus simultaneously administered when needed.
• Dipyridamol (Persantine)

MPI Protocols: One or Two day-Stress/Rest Gated/Non-Gated MPI. Pharmacological stress using Dobutamine or Persantine (Dipyridamole): 0.56mg/kg over 4 minutes(max = 40mg)

Results: From the total group of 287 patients who underwent stress/rest MPI, 106 patients subsequently underwent coronary angiography and the reports of both investigations were compared. Tabular representation + MPI scintigram (attached file) Stress/Rest MPI vs Coronary Angiography (LAD/LCX/RCA): 106 vs 48 (45.2%)
Conclusion: SPECT MPI is the most commonly used non-invasive method for diagnosis and risk stratification of CAD. Both MPI and Coronary Angiography have good diagnostic value although they provide different and complementary information for the diagnosis and evaluation of CAD. However SPECT MPI with TC99m sestamibi may underestimate the extent of CAD compared to coronary angiography specially with vasodilator stress imaging. SPECT MPI has significant advantages over a coronary angiography by the fact that besides indicating the coronary vessel(s) involved, it also conveys valuable information on the viability of the myocardium supplied by the involved vessel that is whether ischaemia is reversible or not as is the case in myocardial infarction. Reasons for incongruence of results compared include microvascular disease, balanced ischemia and diffuse abnormal coronary flow, and suboptimal stress imaging. Future solutions include: (1) PET MPI, (2) Hybrid imaging, (3) PET-CT Angiography, (4) Use of alternative radiotracers e.g. Thallium201, (5) CZT cameras. Nuclear cardiology has become an essential diagnostic tool for coronary artery disease and all efforts to develop and improve this branch of Nuclear Medicine must be maintained to ensure the better management of CAD in Mauritius and worldwide.
Abstract ID: 184

**Relationship Between Post-Stress LVEF Drop and Myocardial Perfusion Defects in Routine Gated SPECT Scans**

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**Background:** Automated programs are available for assessing left ventricular ejection fraction (LVEF) from technetium-99m sestamibi gated myocardial perfusion single-photon emission computed tomography (gated MPS). It has been known that the post-stress LVEF drop is associated to regional myocardial perfusion defects and predicts the presence of severe coronary artery disease (CAD). However, many factors, like overestimation and software processing variability of LVEF, time delay of post-stress image acquisition, and cutoff point of post-stress LVEF drop can interfere on the real and correct assessment of this endpoint. The aim of this study was to assess the relationship between post-stress LVEF drop and myocardial perfusion defects in routine gated MPS.

**Methodology:** A total of 356 patients (mean age 60 +/- 10 years old, 58% females) with available rest and post stress gated MPS data were enrolled. Rest and post-stress LVEF were automatically generated and the difference between rest and post-stress was calculated. Post-stress LVEF drop ≥ 5 units was considered significant. Visual myocardial perfusion analysis and automated total perfusion defect (TPD) were compared between the groups according to significant post-stress LVEF drop: G1, without significant drop; G2, with significant drop. A p value <0.05 was considered statistically significant.

**Results:** From a total of 356 gated MPS evaluated, 264 (74%) did not present a significant post-stress LVEF drop (G1, mean LVEF: 65±14% x 68±14%, rest x stress, respectively) and 92 (26%) presented a post-stress LVEF decrease ≥ 5 units in relation to rest (G2, mean LVEF: 70±14% x 62±14%, rest x stress, respectively). In relation to visual myocardial perfusion analysis, we did not observe a significant difference between groups. In G1, 155 (59%) MPS were normal; 29 (11%) were ischemic scans; 71 (27%) were infarction scans; and 9 (3%) were ischemic/infarction scans. In G2, we observed 52 (56.5%) normal scans; 10 (11%) ischemic scans; 25 (27%) infarction scans; and 5 (5.5%) ischemic/infarction scans. The post stress TPD was 5.1±7.4% in G1 versus 6.4±10.2% in G2, p=0.09.

**Conclusion:** In routine gated MPS, a significant post-stress LVEF drop did not show significant association with the presence of myocardial perfusion defects. Perhaps, this index may only be considered in conjunction with the presence of others risk factors to CAD. Furthermore, overestimation and software processing variability of LVEF and time delay of post-stress image acquisition could impact on the LVEF measurement by gated MPS.
Myocardial Perfusion Imaging with a Novel Single Photon Emission Computed Tomography Camera Implemented with Multiple Ultra-fast, Cadmium-zinc-telluride Detectors

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Background: Myocardial perfusion imaging has been widely used as a non-invasive method for evaluation of coronary artery disease. However, using high radiation doses and the need to remain stable for around 20 minutes for better images are unfavorable characteristics of this method. By implementing ultra-fast cadmium-zinc-telluride detectors to a novel SPECT camera, better images can be obtained injecting lower activity doses and in a shorter period of time. It is the aim of this study to evaluate the diagnostic accuracy of nuclear myocardial perfusion imaging with a novel single photon emission computed tomography (SPECT) camera with ultrafast dedicated cadmium-zinc-telluride (CZT) solid-state semiconductor detectors in order to detect coronary artery disease (CAD).

Methodology: The study population enrolled 145 patients (96 male, 59 female; mean age 66 ± 11 years). All patients underwent a 2-day stress-rest gated SPECT myocardial imaging protocol using 99mTc-methoxyisobutylisonitrile (MIBI) as the imaging agent. Patients were injected approximately 5 mCi (185 MBq) of 99m Tc-MIBI following physical activity according to Bruce protocol or pharmacological exercise using IV dipiridamol injection and imaged after 45 minutes with a 6 min acquisition time. Rest images were obtained in the following day using the same dose regimen again with a 6-min acquisition time. Two readers blindly categorized each scan as indicating CAD or not and the results were compared with those of invasive coronary angiography, the reference method which was performed within 3 months. On angiography, 50% or greater luminal narrowing was considered as the significant finding for CAD. The sensitivity, specificity, positive predictive value (PPV), negative predictive values (NPV), and accuracy of the method were determined on a per-patient for detection of coronary artery disease.

Results: The prevalence of coronary artery disease was 77% according to angiographic findings in the study population. The sensitivity, specificity, PPV and NPV of the method were 88%, 76%, 92% and 60% respectively. The overall accuracy of multiple ultra-fast, Cadmium-zinc-telluride myocardial perfusion imaging method was 82%.

Conclusion: SPECT imaging using a novel camera with multiple ultra-fast cadmium-zinc-telluride detectors enables myocardial perfusion imaging with lower radiation doses and in shorter imaging sessions. This novel camera makes myocardial perfusion imaging even more suitable for the detection of coronary artery disease.
Evaluation of Myocardial Perfusion in Patients with Systemic Lupus Erythematosus by Using 99mTc-Sestamibi Gated-SPECT

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Background: Systemic lupus erythematosus (SLE) is a multisystem autoimmune disease that is associated with high risk for cardiovascular disease (CVD). Main cause of long term morbidity and mortality in patients with SLE is CVD. Accelerated atherosclerosis and adverse cardiac events in this population are due to the combined effect of traditional as well as SLE-specific inflammatory and immunologic risk factors. By means of 99mTc- sestamibi gated-SPECT myocardial imaging, presence of coronary artery disease (CAD) in SLE patients can be noninvasively detected with extent and severity of disease evaluated, as well as its impact on LV function assessed.

Methodology: Both reversible and fixed perfusion defects have been found in as many as 20-40% of SLE patients. Gated-SPECT imaging can be especially useful tool in identifying CAD in a subset of high-risk patients that are asymptomatic. Confirmation of significant myocardial ischemia would lead further to elective invasive coronary angiography and coronary revascularization if necessary, which along with intensified and optimized medical treatment can improve cardiovascular prognosis in this group of patients. In some individuals abnormal myocardial perfusion on gated-SPECT imaging without angiographically significant coronary stenosis can be found. Severe endothelial dysfunction that is usually present in patients with multiple risk factors has been blamed for this finding.

Results: We examined 12 asymptomatic patients with SLE (11 women, 1 man), age 26-62years (mean 45y±13), all diagnosed >5years and on therapy with corticosteroids. 99mTc- Sestamibi gated-SPECT imaging was performed with one day rest-stress protocol by using dipyridamole as stressor. Stress induced ischemia was detected in 5/12pts (42%), enlarged left and right ventricle were found in 4/14pts(33%) and 6/12pts(50%) respectively. In one patient lower LVEF was found.

Conclusion: In conclusion, myocardial perfusion 99mTc-Sestamibi gated-SPECT imaging can be used for screening purposes in patients with SLE who are at high risk for future adverse cardiac events, such as patients with multiple risk factors, women with SLE and patients with longstanding disease.
Anatomical Distribution of Coronary Calcium Score and Myocardial Perfusion Abnormalities Detected by 13N-Ammonia PET-CT

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Background: Cardiovascular imaging has developed rapidly, adding anatomical and functional evaluation as a fundamental part in decision-making about management of ischemic heart disease. It has established the predictive value, sensitivity and specificity of most of image studies, it is likewise recognized that anatomical and functional evaluation techniques give an incremental value to cardiovascular diagnoses and prognosis. PET-CT has been placed in a preferred position by demonstrating its diagnostic value using both tomography and perfusion, getting the most out of both studies, with greater sensitivity and specificity. Coronary calcium score evaluation is reached by this method relatively easy to obtain without greater exposure of the patient, it offers information, forecasts and has proven to be a superior method. Risk according to the units obtained with the total calcium score are well established; however it’s possible to use this tool in each of the coronary arteries as a predictor of perfusion abnormalities in the respective territory. Objective: Evaluate the correlation between calcium score of each coronary artery and perfusion abnormalities in their territories with 13N-ammonia PET CT.

Methodology: 20 patients referred to PET-CT Unit of the Faculty of Medicine, UNAM, on suspicion of ischemic heart disease. We made them 13N – ammonia; rest - stress myocardial perfusion study using adenosine, and simple tomography study for the identification and quantification of coronary calcium. Classifying patients into low, intermediate and high risk and very high risk. The perfusion was evaluated by two experts in cardiovascular imaging and nuclear cardiology, classifying them in mild, moderate and severe ischemia, as well as territories of the coronary arteries.

Results: Average age was 61.3 years ± 8.8 years, 52% women, 50% diagnosis of hypertension, 35% high cholesterol, 15% diabetes mellitus and 15% smokers. 70% were classified as low-risk by calcium score, half of them presented abnormalities on myocardial perfusion, of whom 57% were moderate to severe ischemia. 15% qualify at intermediate risk of which 1/3 present corresponding moderate to severe ischemia perfusion, 10% was considered high risk by calcium score and half of these were for severe ischemia. Finally 10% was classified at high risk and half of them with severe ischemia. Artery calcium score average was 387 U. In anterior descending, 139 U circumflex and 153 U in right coronary artery, with abnormalities of myocardial perfusion in territory of anterior descending by 29%, in territory of circumflex 47% and right coronary artery 23.53%. The Pearson’s correlation coefficient between these values was r=0.98, however the value of P was 0.196.

Conclusion: The total calcium score already has a well described prognostic value. However, the high correlation between the calcium score from each of the coronary arteries and perfusion defects of their territories proposed that it could be used as a predictor of ischemia blood territory, even with a low total score calcium. The PET CT allows calcium score to be used as a tool that increases the certainty of diagnosis with 13N-ammonia perfusion.
Role of Rest GMPS in Patients with Ischemic and Non Ischemic Dilated Cardiomyopathy; Differences in Perfusion and Wall Thickening

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Background: Dilated Cardiomyopathy (DCM) is a common pathology, and its proper management requires differentiation of its ischemic cause from nonischemic etiology. Objective: To evaluate rest gated myocardial perfusion scintigraphy (GMPS) in patients with ischemic and nonischemic DCM, categorized on the basis of coronary angiography, and to compare perfusion status and wall thickening between them.

Methodology: Descriptive case series were used as study design. This study was conducted at Nuclear Cardiology department of Punjab Institute of Nuclear Medicine (PINUM), Faisalabad over a period of two years from 01-01-2013 to 30-12-2014. Resting GMPS was performed in 107 known patients of DCM (aged 17 to 71 years with a mean age of 49.14 ± 11.9 years, 87 Male and 20 Female) by injecting 20 mCi of 99mTc-MIBI. Patients were subdivided into ischemic (n=77) and nonischemic subgroup (n=30) by using the coronary angiography results. Summed perfusion score (SPS), summed thickening score (STS) and extent of perfusion abnormality (EPA) were calculated by using twenty segment model. Results of GMPS were compared between ischemic DCM and non ischemic DCM by using independent samples t-test. P-value of <0.05 was taken as statistically significant.

Results: SPS and EPA are significantly higher in ischemic than non ischemic sub groups (27.19 ± 10.78 Vs 7.91 ± 5.09 P<0.001, and 7.62 ± 1.99 vs 4.30 ± 1.68 P<0.001 respectively). STS was significantly higher in non ischemic group than ischemic group of DCM patients (34.14 ± 7.21 vs 24.21 ± 7.87 P<0.001).

Conclusion: Our study shows that there are statistically significant differences in the perfusion (summed perfusion score and extent of perfusion abnormalities) and wall thickening (summed thickening score) between ischemic and non ischemic DCM groups, calculated by using rest gated myocardial perfusion scintigraphy. Combined evaluation of the perfusion and wall thickening on rest gated myocardial perfusion scintigraphy might be helpful in identifying ischemic and nonischemic etiology of DCM.
Prevalence of Coronary Artery Disease in Patients Having Essential Hypertension With or Without Diabetes Mellitus Detected by Myocardial Perfusion Scintigraphy

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Background: Aim of this retrospective study was to find the prevalence of coronary artery disease (CAD) in hypertensive patients with or without diabetes mellitus.

Methodology: Data of patients having essential hypertension (n=931) referred to PINUM for stress/rest myocardial perfusion scintigraphy (MPS) was analyzed. This data was divided into two groups. HDm group contains data of patients having hypertension with diabetes mellitus (n=456, 48.98% of total population, M:F=245:211). While data of patients having hypertension without diabetes mellitus was placed in H group (n=475, 51.02% of total population, M:F=254:221). The mean age was 52.4 + 10.2 years in HDm group and 48.7 + 10.9 years in H group. Duration of hypertension was 5.2 + 5.0 years in HDm group and 5.6 + 5.5 years in H group. Duration of diabetes mellitus was 7.0 + 5.8 years in HDm group. Each group was divided into subgroups based on gender, clinical presentation and age. Patients with perfusion defects on MPS were considered to have CAD. Prevalence of CAD in HDm and H groups was statistically compared using q2 (Chi-square) test.

Results: Prevalence of CAD is higher in HDm group than H group subjects (47.8% vs. 30.1%; p<0.001). Prevalence of CAD is higher in males than females in HDm (53.9 % vs. 40.8%) and H groups (39.4% vs. 19.5%) respectively. The difference of prevalence of CAD in HDm and H groups is more marked in females (40.8% vs. 19.5%; p<0.001) than males (53.9 % vs. 39.4%; p=0.001). Prevalence of CAD in patients with typical presentation is not statistically significant in HDm and H groups (72.3% vs. 68.4%; p=0.645), while in subjects with atypical presentation prevalence is significantly higher in HDm group than H group (40.8% vs. 26.8%; p<0.001). Considering males and females together, prevalence of CAD increases with increasing age in both HDm (age<36 years; 25.0%, age 36-50 years; 44.8%, age 51-65 years; 49.5%, age>65 years; 64.3%). and H groups (age <36 years; 13.2%, age 36-50 years; 25.7%, age 51-65 years; 40.28%, age>65 years; 45.5%).

Conclusion: Prevalence of CAD is higher in patients having essential hypertension with diabetes mellitus than those patients having essential hypertension without diabetes mellitus. Prevalence of CAD is higher in males than in females in both groups. Prevalence is almost similar in patients with typical presentation in both groups. While in patients with atypical presentation, prevalence of CAD is higher in patients having essential hypertension with diabetes mellitus. Prevalence of CAD increases with increasing age in both groups. However in females, this increase in prevalence with increasing age is markedly slower till the age of 65 years, as compared with males. After the age of 65 years, prevalence in females approaches to males.
Cardiac Viability Scintigraphy using Sublingual Nitrate: Our Experience at Ginum Hospital

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Background: The Viability scan is used to determine the extent of viable myocardial tissue. It is mostly used for patients who have had previous heart attacks, and where a decision needs to be made as to whether revascularization surgery will provide significant benefit or not. After a heart attack (myocardial infarction), some of the heart muscle may be permanently damaged or scarred. Once this occurs, the area affected will cease to function properly. Other parts of the heart may be injured, but not permanently scarred. These areas are usually hibernating which means that these damaged areas of the heart may still be viable, but may not have completely recovered and may not be detectable through traditional imaging studies, such as an echocardiogram etc. It is vital to identify these hibernating areas because restoring blood flow to such territories of the heart may restore proper function and prevent permanent damage from occurring.

Aim & Objectives: This study is aimed at determining the cardiac viability in our patients when we perform nitroglycerine augmented viability scintigraphy. These patients will also be followed up clinically for evaluating their outcome and disease prognosis.

Material & Methods: It is a prospective study enrolling total of 30 diagnosed adult patients with myocardial infarction, without any bias and gender discrimination, referred to us for viability scan prior to interventional procedure. Semi quantitative visual analysis and interpretation of the scans with scoring of (0-4) will be performed by two consultant nuclear physicians and cardiac segments with score of 3 will be of concern in this study. Nitroglycerine will not be used if the patient’s resting blood pressure is found to be low or if there is a history of previous intolerance to such medications. Informed consent will be taken prior to the conduction of study.
Assessment of Small Hearts for Perfusion Defects in Comparison with General Population Using Myocardial Perfusion Scintigraphy

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Background: Myocardial perfusion scintigraphy (MPS) is a sensitive non-invasive imaging modality to assess myocardium for perfusion defects in known or suspected cases of coronary artery diseases (CAD). Its sensitivity may get compromised in certain patients like in those with small hearts.

Objective: The aim of this study was to assess small hearts for perfusion defects and compare results with general population.

Methodology: A total of 1000 MPS (combined set of rest + stress) images acquired by dual head SPECT/CT Hawkeye gamma camera were retrospectively analyzed and categorized into two groups as general population i.e. ESVs > 15ml and subjects with small hearts i.e. ESVs ≤ 15ml. Each group was further categorized as normal, reversible perfusion defect and fixed perfusion defects. Cases of dilated cardiomyopathy / post nitrate-rest studies were excluded from the study.

Results: Out of total 1000 patients, 350 (35%) met criteria for small hearts and 580 (58%) for general population while 70 (7%) patients were excluded from the study. Irrespective of the risk factors, in the category of patients with small hearts, 88.6% (310 patients) showed normal perfusion and 11.4% (40 patients) showed reversible ischemic defects while no patient showed fixed perfusion defect. In the category of general population, 41% (240 patients) showed normal perfusion, 31% (180 patients) showed reversible ischemic defects and 28% (160 patients) showed fixed perfusion defects.

Conclusion: Number of perfusion defects differs to a significant level in both categories. Low percentage of perfusion defects in small hearts may be because scintillation detectors are not able to pick small perfusion defects in small hearts due to inherent low spatial resolution. Secondly, total phase analysis (combined full cycle systole/diastole images) of MPS images is usually done, which may hinder diagnosis of small perfusion defects in patient with small hearts. We believe this problem may resolve with the use of solid state detectors with high spatial resolution and may also be overcome by single diastolic phase analysis of MPS images.
Collateral Circulation in the Patients of Myocardial Infarction

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An ischemic heart disease patient was selected, who underwent pre and post Angiography thallium scans. Angiography revealed two vessels CAD. After Angiography and thallium scans, patient continuously remained on oral treatment and did not undergo Angioplasty. Either of pre and post Angiography scans revealed similar conclusion with a dramatic change in the exercise tolerance test, METS, predicted heart rate achieved. Discussion leads towards the role of collateral circulation. Collaterals are an alternate source of blood supply to myocardium jeopardized by ischemia. Well developed collateral in patients with CAD mitigate myocardial infarcts and improves QOL and survival. Therapeutic promotion of collateral growth is valuable treatment strategy.
Meaning of Symmetrical, Inverted and Deep T Waves in Patients Referred to Gated-SPECT: Functional and Structural Value of the Method

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Background: The presence of inverted and symmetrical T waves in a baseline ECG in the context of a patient with chest pain suggests myocardial ischemia constituting a sign of high risk, in particular when configuring the Wellens syndrome (WS). The clinical and electrocardiographic criteria of WS are: 1) Biphasic or inverted, deep T waves in precordial leads; 2) Normal or minimally elevated cardiac enzymes; 3) ST depression <1 mm; 4) Preserved progression of R waves in precordial leads; 5) Absence of pathological Q waves; and 6) Anginal chest pain. Nevertheless, this sign is nonspecific and may be associated with other diseases, especially hypertrophic cardiomyopathy (HM). In general, this condition has a benign clinical course, but since the ECG abnormalities can simulate the existence of coronary heart disease, imaging tests are of clinical relevance. We describe the results of myocardial perfusion studies (MPS) in a group of patients with this particular electrocardiographic finding.

Methodology: We analyzed consecutive patients referred for investigation of myocardial ischemia by MPS between January 2014 and July 2015, who presented symmetrical inverted and deep T waves in precordial baseline ECG and were clinically stable. In all cases, a MPS was performed (99mTc-MIBI Gated-SPECT, 16 frames/cycle) using a 2-day protocol with dipyridamole (0.56 mg/Kg). Myocardial perfusion scores, left ventricular ejection fraction (LVEF) and peak filling rate (PFR) were analyzed at rest and post-stress.

Results: A total of 8 patients presented the mentioned features at baseline ECG (5 women, ages 22 to 81 years, mean 64.62 ± 17.8 years). Three patients had a history of angina, while others had varied symptoms that motivated the consultation. One had revascularization and none had previous myocardial infarction. Four patients had a SSS >3 and <10. The appearance of the myocardium was of HM in 6 cases, with suspicion of apical type in 3 and asymmetrical in the others, all confirmed by two-dimensional echocardiography. Rest and post-stress LVEF was 58.26±12 and 57.25±13.6 respectively (p=ns). The PFR in rest conditions was 2.31±1.03 EVD/s, for a lower normal limit of 2.35 EVD/s; only 3 patients exhibited a normal value, one of whom had a myocardial bridge in angiographic study.

Conclusion: While the presence of inverted and deep T waves was not common in patients referred for MPS, most of them (75%) had unsuspected HM either of asymmetrical or apical type, with mild or no ischemic component. The method also showed structural value, allowing identification of different variants of HM. The analysis of diastolic function (PFR) may be of additional interest to characterize in these patients, as the systolic phase is usually preserved.
Abstract ID: 205

**Appropriate Use Criteria for Stress Myocardial Perfusion Imaging in a Tertiary Level Hospital in Panama: A Pilot Study**

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**Background:** Cardiovascular diseases are the first cause of death in Panama, followed by oncological causes. There has been an increasing need for non-invasive cardiologic imaging techniques that allow clinicians to stratify the cardiovascular risk of their patients. Objective: We sought to assess the appropriateness use criteria for cardiac stress myocardial perfusion imaging (MPI) at Santo Tomas Hospital, which is a government tertiary health care center that provides clinical services to all patients regardless of insurance or social security status.

**Methodology:** We conducted a descriptive retrospective pilot study and included 61 patients referred to the Nuclear Medicine Unit for stress MPI between June 2015 and April 2016. These were all referred by cardiologists. To assess the appropriateness of MPI referrals, we used the 2013 Multimodality Appropriate Use Criteria for the Detection and Risk Assessment of Stable Ischemic Heart Disease. Additionally, we described the sample distribution according to gender, age, stress test, MPI results and cardiovascular risks factors.

**Results:** Out of the 61 included patients, 39 (63.9%) were female and 22 (36.1%) were male. The average age of our sample is 61 + 10.3 years and the age range 41 to 82 years. Appropriate use referrals were seen in 43 (70.5%) patients, 5 (8.2%) of referrals may be appropriate and rare appropriate MPI tests were referred in 8 patients (13.1%). Five (8.2%) of our patients’ appropriateness use criteria could not be determined because we lack the necessary information. We performed pharmacological stress in 49.2% of the patients and exercise stress MPI in 50.8%. Thirty one (50.8%) radionuclide stress tests were abnormal, 26 (42.6%) were normal and 4 (6.6%) studies were limited due to image artifacts. The most frequent cardiovascular risk factor was hypertension (65.6% of patients), followed by dyslipidemia (39.3%), obesity (28.2%), diabetes mellitus (16.4%); 16.4% had previously known ischemic heart disease and 11.5% were smokers.

**Conclusions:** The appropriate and the rare appropriate MPI rates at our institution are similar to data previously published in other centers.
Phase Analysis to Measure Left Ventricular Dyssynchrony by Gated-SPECT Myocardial Perfusion Imaging Showed by Two Different Software

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Background: Phase analysis by Gated-SPECT myocardial perfusion imaging (G-MPI) is a new tool to measure left ventricular dyssynchrony in patients with or without cardiovascular disease or heart failure. It is predicted to have different important clinical applications in the near future. For its determination, it has been introduced as a new tool in two of the main software used in nuclear cardiology: Emory Cardiac Toolbox® (ECTb) and Quantitative Gated SPECT - Cedars-Sinai® (QGS C-S). Because a lot of centers use only one of them, the aim of this work is to verify whether there is difference between using one or the other.

Methodology: An observational and retrospective study was designed. It included patients with totally normal G-MPI and Phase analysis and who were able to be performed in post-stress and rest tests. The tests were acquired on a Symbia T- Siemens® machine and were processed with ECTb or with QGS C-S. Within this two groups, the phase parameters obtained in common by the two software (phase standard deviation - and the histogram bandwidth) were obtained post-stress and rest tests. Assessment of the difference between these groups was performed using nonparametric test for independent samples (Mann-Whitney) after analyzing the distribution of data between the two groups with the Kolmogorov-Smirnov test. The significance level (p) was 0.05 and the software used for this analysis was SPSS IBM V.21®.

Results: 193 patients (104 men and 89 women) with mean age of 64 ± years (24-89) were included. 61/193 patients were processed with QGS C-S and 132/193 with ECTb. In post-stress tests, the overall mean of the phase standard deviation was 6 ± 3.7 and the median was 5 with interquartile range (IR): 3.6. The overall mean of histogram bandwidth was 22.7 ± 10 and the median was 18 with IR: 11.5. In rest tests, the overall mean of the phase standard deviation was 5.76 ± 4.82 and the median was 4.5 with IR: 3.1. The overall mean of histogram bandwidth was 21.67 ± 14.06 and the median was 18 with IR: 12. Between the data obtained from both software were found significant differences in phase standard deviation in both the post-stress (p=0.001) and post-rest tests (p=0.019) and no significant differences were found in histogram bandwidth in the post-stress (p= 0.31) and post-rest tests (p= 0.18).

Conclusion: The determination of phase analysis by Gated-SPECT is feasible by two of the most used software available: ECTb and QGS C-S. However, one of the parameters (phase standard deviation) showed significant difference between the two groups in post-stress and post-rest tests, while measuring histogram bandwidth showed no difference between the two groups. Therefore, it is recommended that normal values of phase analysis have to be obtained and used for each specific software separately.

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Background: The Choosing Wisely initiative by the ABIM foundation attempts to recommend to physicians and patients its purpose through 5 items at the time of performing myocardial perfusion imaging when using methods to reduce radiation exposure with clinical benefit without losing accuracy. Aim: To validate our practice in Costa Rica with myocardial perfusion imaging low dose reduction in daily practice, with CZT gamma camera.

Methodology: Five myocardial perfusion studies were performed to validate image and quantification parameters when the Nuclear Medicine Department incorporated new CZT technology during January 2014. All individuals had low cardiovascular risk assessment with 2 or less risk factors, ≤30 BMI. Images were acquired during supine, rest and stress positioning with numerous CZT detectors with pinhole geometry around the heart. Scans were performed on CZT camera Discovery NM 530c; GE Healthcare. Additionally, acquisition was performed in Ecam Siemens gamma camera the same day in similar conditions to compare functional and morphological parameters. Study Protocol: In 5 patients, a 1-day 99mTc-sestamibi rest/Bruce protocol treadmill exercise imaging protocol was performed. Rest and stress tests were performed after administration of standard dose of 185 MBq (5 mCi) and 555 MBq (15 mCi) respectively, followed by image acquisition at 60 minutes after rest and 15 minutes after stress. A low dose cardiac phantom was also acquired.

Results: Images were assessed by visual and statistical analysis. No significant differences were found between medians of morphological and functional parameters with CZT acquisitions vs NaI, and between cardiac phantom and controls. (P CI:95%, P= 0.5)

Conclusion: Low dose reduction in CZT technology can be used to reduce radiation exposure with clinical benefits without compromising accuracy.
Experience in the Use of Myocardial Perfusion Imaging in the Military Hospital Dr. Carlos Arvelo from July 2014 - June 2016

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Background: The purpose of this study was to describe the experience in the use of cardiac SPECT for detection of coronary artery disease in patients with suspected or known diagnosis, tests using exercise and myocardial perfusion imaging, and comparing the data reported with the literature.

Methodology: We arranged clinical information of 101 consecutive patients presenting to studies of myocardial perfusion at our center in the period July 2014 to June 2016. Each of them was questioned about symptoms possibly related to ischemic heart disease and the presence of cardiovascular risk factors. All patients underwent stress electrocardiography by exercise according to protocols commonly employed. We obtained myocardial perfusion imaging at rest and stress, using gamma-camera dual-head, after injection of the radiopharmaceutical, in this case sestamibi-Tc99m. The interpretation of the images was performed by two independent observers and findings in each case were issued by consensus.

Results: Of the 101 patients, 57 (56.43%) showed myocardial perfusion imaging with abnormal uptake suggestive of coronary artery disease. Most of them possessed as an indication functional assessment of coronary lesions (23.76%). Finally, 44 patients (43.56%) had normal uptake of the radiopharmaceutical.

Conclusion: The experience gained in our hospital shows some disagreements with some researchers, due to higher relative volume of patients with coronary artery disease to guide any revascularization procedures and reveals the utility of cardiac SPECT in clinical context individualization.
Myocardial Perfusion Imaging and Coronary Angiography in the Evaluation of the Functional Significance of Coronary Lesions

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**Background:** Single-photon emission computed tomography (SPECT) can be used as a non-invasive tool for the assessment of coronary perfusion. The objective is to determine the functional significance of coronary lesions in one or more vessels, through myocardial perfusion imaging.

**Methodology:** Among patients with indications for a coronary artery angiography, those with significant lesions in one or several vessels were selected for the study. Within 15 days, cardiac SPECT examinations on exercise conditions and rest afterwards were performed. SPECT data from 22 patients with a low probability of coronary artery disease was used for comparison.

**Results:** Twelve patients aged 55 ± 7.53 years (ten men) were studied. Visual analysis of SPECT revealed signs suggestive of ischemia in ten patients. SPECT detected almost 80% of abnormal vessels reported in the coronary artery angiography. There were 20% false negative results.

**Conclusions:** SPECT detected 80% of significant coronary lesions of major vessels found during coronary artery angiography. Visual analysis of perfusion is highly reliable for diagnosis and it is very useful for guided therapy. Quantitative parameters must be considered only as reference parameters.
Evaluation of the Cardiopulmonary Index and the Relationship with the Severity of Coronary Disease in the Elderly Patients


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Background: To evaluate the cardiopulmonary index (CPI) and the relationship with the severity of coronary disease in elderly patients.

Methodology: A cross sectional study in patients with indication of cardiac SPECT. The protocol for the image acquisition was 2 planar image (static image) 2 minutes prior to the acquisition in stress or rest and 45 minutes after the injection of Mibi-technetium 99m. We used a conventional protocol in rest and stress, using adenosine or ergometer according to the medical indication. The SPECT Camera used was a dual detector camera model Ecam-Siemens. To process the images, we used Cedars and Emory software. To measure the CPI, we obtained the average account for ROIs in the 4 walls of the left ventricle for heart capacity and average accounts for ROIs in the upper lobe and half of both lungs. The ratio of these values form the CPI. A total of 38 elderly patients with coronary disease were evaluated. All the patients gave informed consent and were evaluated by a cardiologist prior to the evaluation of the test. We did a telephone follow up for 18 months to verify cardiac event or death.

Results: Thirty eight patients were included, mostly males (79%), average age 65 years (DE 8.1 years), with average weight of 77.6 kg (DE 16.2 kg) and average size 1.61m (DE 0.29 m). No significant association between ICP and the severity of coronary disease was found. A significant association between the right ventricular capture (RVC) and asynchrony in the phase analysis (p = 0.035) was found. RVC was not associated with the presence and/or development of a cardiac event (p = 0.635) and/or infarction (p = 0.662).

Conclusion: The altered right ventricular uptake is significantly associated with the phase of asynchrony. We need to increase the sample size to determine the cut-off value of cardiopulmonary index in determining the severity of coronary disease.
### II. Member States experience with other imaging modalities in cardiology (MRI, CT, echocardiography)

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Echocardiographic evaluation of hypertransfused children with β thalassemia Intermedia using standard and Tissue Doppler methods
Determinants of Carotid Intima Media Thickening in a Group of Adults in Yaounde

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Background: The aim of this study was to determine the relationship between conventional cardiovascular risk factors and carotid intima-media thickness (CIMT) in a group of adults in Yaounde.

Methodology: This was an analytical cross-sectional study conducted from January to July 2015 in the Cardiology Unit of the Yaounde General Hospital (HGY), the LAMAT Medical Centre (LMC) and the Yaounde Gyneco-Obstetrical and and Pediatric Hospital (YHGOP). We recruited 128 patients with at least one major cardiovascular risk factor, gathered according to their level of cardiovascular risk. The variables of interest were clinical (age, sex, hypertension, diabetes, dyslipidemia, smoking), anthropometric (weight, height, BMI) and ultrasonographic (measure CIMT). Statistical analysis was done using non parametric tests: Pearson test for proportions comparison and ANOVA for averages comparison. The significance level was set at p < 0.05.

Results: Males accounted for 61.7% (79/128) of the subjects (sex ratio M / F = 1.6). The mean age was 49.8 ± 8.8 years [29 years to 70 years]. There was an average of 3 cardiovascular risk factors per subject. Hypertension was the most frequent risk factor (63.3%); the cardiovascular risk was moderate or high for 35.2% and 7.8% of patients respectively. The average CIMT was 0.6 ± 0.26 mm and it increased with age (p = 0.03). The value of CIMT was on average higher among women than men (p = 0.000). The CIMT was higher in the group of subjects with high cardiovascular risk (p = 0.004); it was increasing with the number of cardiovascular risk factors per subject.

Conclusion: The carotid intima-media thickness increases with age, female gender and the cumulated cardiovascular risk factor. A comparative study with logistic regression is recommended to confirm these results and determine the impact of each conventional cardiovascular risk factor on CIMT.
Analysis of Imaging Modalities Used for Coronary Artery Disease in Sri Lanka and Identification of Challenges

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Background: Diagnosis and management of coronary artery disease (CAD) is a major challenge to health care in Sri Lanka as in many other countries. Coronary artery disease accounts for 40-45% adult deaths in Sri Lanka and incidence appears to be rising. Until recently, the main diagnostic technique for CAD was invasive coronary angiography (CA). Nowadays, cardiologists prefer to perform non invasive modalities such as echocardiography, cardiac CT, myocardial perfusion SPECT (MPS), and cardiac MRI. In this study we critically evaluate current practice of these imaging modalities in Sri Lanka.

Methodology: The study period was from 01-01-2015 to 30-12-2015. Data from all patients referred to and registered at the Ischemic Heart Disease Unit of the National Hospital of Sri Lanka was obtained for the study. Details of patients’ imaging investigations namely echocardiography, computed tomography, MPS, cardiac MRI and coronary angiography were obtained from hospital database. Age, sex, reason for each study, and clinical benefits gained were also recorded.

Results: There were 9569 patients registered at the Ischemic Heart Clinic with CAD. 97% underwent echocardiography at least once during risk stratification process. Coronary angiography was performed in 44% and some also underwent interventional procedure such as stenting. CT was done in approximately 20%, sometimes in private facilities. MRI was offered to patients who could afford it (6%) as they were done in private hospitals. MPS is performed in one government hospital and in one private hospital. Approximately 3.8% underwent MPS during the study period.

Conclusion: It is evident that the most commonly used modality was echocardiography as it is the cheapest, most widely available modality. It is used for basic diagnosis and risk stratification. Depending on the findings, coronary angiography was the following most used modality in patients with high risk. Although it is invasive it was highly used because it is performed by cardiologists themselves and some time is associated with therapeutic intervention. This modality was widely available for free for patients in major government hospitals. Cardiac MRI is not widely performed for evaluation of CAD or ischemic heart disease due to high cost and limited access. MPS is about 3 times more expensive compared to cardiac MRI limiting its use. Some cardiologists were not fully convinced about usefulness and cost effectiveness of these two modalities. These are the major challenges faced by country’s healthcare system. In developed countries MPS is widely utilized to diagnose CAD and estimate the risk of adverse cardiovascular outcomes. Thereby it is possible to reserve invasive modalities for patients with higher risk and optimize the risk-benefit ratio for the patient. In developed world, the use of MPS to select patients needing CA is proven as a safe and cost effective strategy. However our results show that this practice is quite different in Sri Lanka and there is a significant underutilization of radionuclide cardiac imaging tests and MRI. This can be mainly attributed to lack of financial resources and facilities.
The Heart Murmor Which Saved the Life: Giant Left Atrium Myxoma

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Background: We present a case of a 45 year old female who was scheduled for a medical examination because of breathlessness and rapid fatigue. Further investigation discovered that the patient had a weight loss of 10 kg within the last 6 months, she often felt palpitations and bloating in the stomach. The symptoms were present for six months during which the patient went to several medical examinations in different institutions of health and was diagnosed with COPD - a (chronic obstructive pulmonary disease) and anemia. After taking bronchodilators and iron supplements, which were prescribed from different doctors, she didn’t feel any better and was afterwards diagnosed with anxiety - depressive syndrome.

Methodology: During the physical examination in our clinic systolic murmur was found with the point of maximal intensity over the apex of the heart. This heart murmur was not found until then and it was a indication for us to do a transthoracic echocardiography (TTE). Blood pressure (120/80 mmHg), heart rate (62/min) and ECG of the patient were normal. Echocardiography revealed a gigantic tumor, with dimensions of 67 x 53 mm, that took up almost the entirely left atrium and partly protruded into the left ventricle. Tumor mass followed the kinetics of the left ventricle and gave the impression that it was connected with a thin stem to the interatrial septum. Dimensions of the left atrium were slightly increased (LAD 4.8 cm) with the presence of severe mitral regurgitation, moderate tricuspid insufficiency, pulmonary hypertension and a small pericardial effusion.

Results: An emergency surgery was performed. The tumor was removed entirely, with dimensions of 7.0 x 5.5 x 4.0 cm, connected with a thin stem to the interatrial septum. Histopathologic analysis confirmed a myxoma. Postoperative the patient had episodes of atrial fibrillation that were successfully treated with cardioversion after which the patient was in a permanent sinus rhythm without need for a pace maker and without any symptoms.

Conclusion: This case shows a patient who was misdiagnosed only due lack of basic methods of physical examination, in this case, auscultation of the heart. Auscultation of the heart is a very important part of the physical examination that can not be left out. Each newly discovered heart murmur should undergo a ultrasound of the heart in order to timely detect difficult diagnosis. In this case we want to emphasize the importance of basic physical examination and ultrasound of the heart as a primary method of testing the origin of any heart murmur. The importance of this case lies in the fact that a myxoma tends to embolic incidents and sudden cardiac death and as such should be promptly detected and removed. This case is also significant because the gigant tumor mass did not make any embolic process or lead to sudden cardiac death, which is very rare for a myxoma with such large dimensions.
Biventricular Ventricular Non-Compaction Cardiomyopathy as Cause of Irreversible Heart Failure in Male Teenager

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Background: Non-compaction cardiomyopathy (NCC) is a primary genetic disease caused by the arrest of normal early embryogenesis of the endocardium and myocardium. It is characterized by the presence of an extensive non-compacted myocardial layer lining the cavity of the left ventricle (LV) and rarely right ventricle, depending on the non-compacted severity, the cardiomyopathy could remain asymptomatic for a large number of years. Cardiac magnetic resonance imaging (cMRI) allows morphological and functional evaluation, as well as myocardial characterization. The fibrosis detected by delay enhancement is considering a bad prognosis factor; in non-compaction cardiomyopathy increase cardiac failure, thromboembolism, malignant arrhythmias, and sudden death. In our patient non-compaction cardiomyopathy, left ventricular dysfunction and myocardial fibrosis take him to irreversible heart failure, requiring left ventricular assistance before heart transplantation.

Case Report: A 13-year-old male without a medical history. He initially manifested dyspnoea on moderate effort, chest pain and palpitations. His deterioration progressed up to class IV of New York Heart Association that was the reason for admission. Transthoracic echocardiogram: non-compaction cardiomyopathy. Catheterization: Evidence of pulmonary arterial hypertension. Magnetic resonance: biventricular non-compaction cardiomyopathy, Left Ventricular Ejection Fraction (LVEF) 24%, Right Ventricular Ejection Fraction (RVEF) 40%, severe mitral regurgitation, late linear enhancement myocardium in the anterior, anteroseptal and inferoseptal walls and right ventricle free wall, late linear enhancement myocardium in the non-compaction zone, the anterolateral and inferolateral walls. Instead medical treatment the patient had pulmonary edema, with imaging findings and irreversible heart failure the ventricular assistance therapy was initiated, two weeks later a new heart catheterization evidence lower pulmonary arterial pressure and he was enrolled to the heart transplantation list. Discussion: The non-compaction cardiomyopathy (NCC) increase risk for myocardial fibrosis, causing heart failure, arrhythmias and sudden death, and this finding can be discovered by cMRI in different cardiomyopathies. At the end cMRI can follow ventricular function and characterize myocardium, to implement preventive treatment as implantable cardiac defibrillator (ICD), or accelerate the enrolment to heart transplantation list. In our patient we found evidence of non-compaction in both ventricles, plus the fibrosis presence, which is an aggravating factor for a compromised prognosis.

Conclusion: cMRI techniques play an important role in the diagnosis and the accuracy of the cardiomyopathies. Late enhancement technique assesses the myocardial fibrosis and it is a remarkable prognostic factor. In this case report, we found evidence of non-compaction in both ventricles, plus the fibrosis presence, which is an aggravating factor for a compromised prognosis.
Non-contrast Low Frequency Transthoracic Echocardiography in Detecting Chronic Occlusions of the Left Anterior Descending and Right Coronary Arteries

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Background: The purpose of the study was to detect of the left anterior descending coronary artery (LAD) and the right coronary artery (RCA) chronic occlusions using low-frequency harmonic transthoracic echocardiography (TTE).

Methodology: TTE was used to assess blood velocity patterns in the distal segment of the LAD (dLAD), the LAD septal perforator (SEP) and in the right posterior descending artery (PDA), the RCA posterior septal perforator (pSEP) in 173 consecutive patients (mean age 52±10 years; 149 men) who underwent coronary angiography (CA) for investigation of angina. Second tissue harmonic was used and Doppler velocity patterns were obtained without contrast enhancement using ultrasound diagnostic systems Vivid 7 and Vivid 9 GE and a 1.7-3.5 MHz narrow-band sector transducer within 1 week before CA. We defined retrograde dLAD flow or retrograde SEP flow as a Doppler marker of the LAD occlusion and retrograde PDA flow or retrograde pSEP flow as a Doppler marker of the RCA occlusion.

Results: Doppler velocity patterns for the dLAD and PDA were obtained in 92% (159 patients) and 90% (156 patients) of cases, respectively. Retrograde flow by TTE was detected in 23 (dLAD – 10; SEP – 2; both – 11) of 25 patients with occluded LAD, and antegrade flow was detected in 131 (dLAD) of 134 patients without LAD occlusion. The sensitivity and specificity of retrograde flow for identification of occluded LAD by TTE in dLAD only were 84% and 98%, respectively, and those in both dLAD and SEP - 92% and 98%, respectively. Retrograde flow by TTE was detected in 38 (PDA – 16; pSEP – 5; both - 17) of 42 patients with occluded RCA, and antegrade flow was detected in 109 (PDA) of 114 patients without RCA occlusion. The sensitivity and specificity of retrograde flow for identification of occluded RCA by TTE in PDA only were 79% and 96%, respectively, and those in both PDA and pSEP - 90% and 96%, respectively.

Conclusion: Thus, non-contrast low-frequency harmonic TTE with assessing direction of coronary flow in epicardial (dLAD and PDA) and intramyocardial (SEP and pSEP) collaterals is a sensitive and highly specific noninvasive method for detection of the LAD and RCA occlusions.
Abstract ID: 45

Accuracy of Echocardiography and Nuclear Myocardial Perfusion Scintigraphy (MPS) in Assessing Cardiac Function in Comparison with Cardiac CT

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Background: Cardiovascular diseases are a big burden on healthcare systems around the world especially the coronary artery diseases (CAD). This manifest as deterioration in cardiac function reflected in the value of left ventricular ejection fraction (LVEF). Therefore, the need to look for efficient imaging technique is essential. Aim: This study aimed to evaluate the accuracy of echocardiography and nuclear myocardial perfusion scintigraphy (MPS) in assessing cardiac function in comparison with cardiac CT.

Methodology: LVEF values of 47 patients who underwent cardiac CT, MPS and echocardiography were collected. Values of MPS and echocardiography are compared to LVEF values of cardiac CT as a standard in this study and correlation was observed.

Results: The mean values of LVEFs were 57.6% ± 14% for echocardiography, 61.1% ± 16% for NM and 60% ± 15% for cardiac CT. Our results showed moderate to high correlation between cardiac CT with MPS (r = 0.756) and with echocardiography (r = 0.768).

Conclusion: MPS and echocardiography agreed well with cardiac CT in LV assessment. Keywords: Ejection fraction, MDCT, MPS, Echocardiography.
Utility of Chest X-ray in Quantifying Pulmonary to Systemic Shunt (Qp:Qs) Ratio Among Patients with Acyanotic Congenital Heart Disease Using Cardiac Magnetic Resonance Imaging as Reference Standard

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**Background:** Non-invasive assessment of cardiac shunt by quantifying the pulmonary-to-systemic blood flow ratio (Qp:Qs) may be of value preoperatively to determine the need for surgery and postoperatively to assess the outcome. Hemodynamic study is not as readily available as chest x-rays. To overcome these limitations, a study was conducted to correlate the chest x-ray measurement using aortic knob and main pulmonary artery segment diameters with cardiac magnetic resonance imaging as a reference standard. Objective: To determine the utility of chest x-ray in quantifying systemic to pulmonary (Qp:Qs) ratio in screening patients with congenital heart disease as compared to systemic to pulmonary (Qp:Qs) ratio of cardiac magnetic resonance imaging.

**Methodology:** PA and lateral chest x-rays will be collected and each roentgenograph must fulfill the following requirements before being used in this study 1. Proper positioning 2. Proper exposure technique enabling measurements of the aortic arch and the main pulmonary artery segments 3. At the diaphragm level of at least 9th posterior rib. The measured systemic to pulmonary shunt (Qp:Qs) ratio by chest x-ray will be compared with the systemic to pulmonary shunt (Qp:Qs) ratio by cardiac magnetic resonance imaging by cine contrast velocity flow maps.

**Results:** Of the 47 subjects included in the study, 17 (36.1%) were diagnosed to have congenital heart disease and the rest have valvular heart disease. By comparing the pulmonic and aortic measurements by chest x-ray and cardiac magnetic resonance imaging it was found out that the p value is not significant, however a good trend was observed thus there is a good correlation between cardiac MRI and chest x-ray with a mean difference of 0.26.

**Conclusion:** This research concluded that chest x-ray is highly sensitive but not specific in measuring Qp:Qs among patients with congenital heart disease, thus chest x-ray can only be a screening tool but not a diagnostic modality. The operator expertise is a crucial determinant in both modalities in order to arrive at accurate measurements.
Quantitative and Qualitative Evaluation of EF by 99mTc-MIBI and Echo: Is There Any Correlation Between These Two Modalities?

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Background: Accurate estimation of LVEF has great significance in cardiac disease. Echo is routinely used modality for this purpose, so we choose this technique for comparison with MIBI GSPECT. Aims: To assess quantitative and qualitative correlation between GSPECT and echo in the evaluation of left ventricular ejection fraction (LVEF).

Methodology: 103 patients, 60 male and 43 female, age ranges from 30 -68 yrs. All patients have been referred to us by super-specialty cardiac hospital. where all patients underwent echo evaluation for LVEF. For gamma imaging 20mCi 99mTc-MIBI injected and 44 minutes post injection gated SPECT imaging done with GE dual head gamma camera infinia model and QGS software used for this study. For hepatobiliary excretion fatty meal given to all patients, which reduce the inferior wall overlapping.

Results: There was a significant correlation between two modality (Echo & SPECT) in LVSV, size and shape, Pearson’s correlation coefficient (PCC) was 0.92 but in EF PCC was only 0.81. there was a significant difference in LVEF.

Conclusion: Both methods correlate well in size, shape and LVSV, but LVEF by GSPECT shows significantly more than in echo. Additional studies are needed as to why this over estimation occurs. Keywords: echo, GSPECT, LVEF, Pearson’s correlation coefficient.
Abstract ID: 61

Diagnostic Performance of Combined Noninvasive Coronary Angiography and Myocardial Perfusion Imaging Using 320 - MDCT

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Background: Multi-coronary angiography (CTA) is a robust method for the non-invasive diagnosis of coronary artery disease (CAD). However, in its current form, CTA is limited in its prediction of myocardial ischemia. The purpose of our study was to test whether stress computed tomography myocardial perfusion imaging (CTP), when added to CTA, can predict perfusion abnormalities caused by obstructive atherosclerosis.

Methodology: We conducted a prospective study to evaluate the accuracy of integrated CTA-CTP, using 320 - MDCT. 100 patients were included, aged between 23 and 74 years old. The protocol was performed as follows: Rest CT: contrast enhanced scan using prospective triggering. Stress CT: contrast enhanced scan during dipyridamole infusion. CTA was evaluated for stenosis. CTP images were analyzed for the transmural differences in perfusion using the transmural perfusion ratio (TPR) and detector computed tomography the 17 segments model.

Results: The protocol was successfully completed for 100 patients, with an average radiation dose of 14 mSv. The sensitivity, specificity, positive predictive value and negative predictive value of CTA and CTP to detect obstructive atherosclerosis causing perfusion abnormalities using quantitative angiography and SPECT, as gold standards, was 97%, 57%, 69%, 95% and 94%, 71%, 69%, 95%, respectively. CTP can identify stress myocardial perfusion defects and provide information on coronary stenosis.

Conclusion: The combination of CTA and CTP can detect atherosclerosis causing perfusion abnormalities when compared with quantitative coronary angiography and SPECT. Keywords: CTA, Perfusion, Dipyridamole, CTP
Abstract ID: 62

**Combined Cardiac CT and MRI for the Comprehensive Workup of Hemodynamically Relevant Coronary Stenoses**

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**Background:** The purpose of our study was to prospectively evaluate the accuracy of a comprehensive assessment of coronary artery disease (CAD) with prospectively ECG-gated coronary CT angiography (CTA) and perfusion–cardiac MRI for the detection of hemodynamically relevant coronary stenosis.

**Methodology:** One hundred consecutive patients were enrolled and cardiac MRI at 1.5 T and 320-row MDCT were all performed within a median time interval of 7 days. Detection of hemodynamically relevant stenoses by the combination of coronary CTA plus cardiac MRI was compared with the combination of coronary angiography (CA) plus SPECT, the latter serving as the standard of reference.

**Results:** CA identified stenoses in 43 cases. Cardiac MRI revealed perfusion defects in 41 patients. Image quality of coronary CTA was diagnostic; Coronary CTA revealed stenoses greater than 50% in 31 coronary arteries. Sensitivity, specificity, negative and positive predictive value, and accuracy of coronary CTA and perfusion–cardiac MRI versus CA and SPECT were calculated for the detection of hemodynamically relevant stenoses.

**Conclusion:** The combination of coronary CTA and perfusion–cardiac MRI shows diagnostic performance comparable to that of CA and SPECT.
The Spectrum and Distribution of Imaging Findings at Coronary Computed Tomography Angiogram in Patients Suspected to Have Coronary Artery Disease

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Background: Coronary CT angiography (CCTA) has in the recent past evolved rapidly due to the development of sophisticated Multidetector row CT. Likewise, the prevalence and incidence of coronary artery disease is rising worldwide with a steep rise being experienced in sub-Saharan Africa likely due to rapidly changing trends in urbanization and lifestyle. The cardinal indication for coronary CTA is in the evaluation of suspected or known coronary artery disease. Other applications are in the assessment and follow up for by-pass grafts and coronary stents and also in suspect anomalous circulatory patterns. The study was set to determine the spectrum, pattern and distribution of imaging findings at coronary CTA as detected by a 320 row MDCT.

Methodology: A cross-sectional study was carried out at an imaging facility within Nairobi city in Kenya. Study subjects were patients referred for coronary CTA and imaged within a period of 6 months from August 2013 to January 2014. Consecutive patients who fulfilled the inclusion criteria and gave written and verbal consent were recruited into the study. A two-part data collection form was used to manually record relevant information which included socio-demographics, clinical and imaging findings. All the recruited subjects underwent a low dose calcium scan and a standard coronary CTA. Statistical package for social sciences was used for data analysis employing relevant statistical tests. Results were presented on tables, charts and graphs and discussed accordingly.

Results: In the period of 6 months, 38 out of a total of 42 scanned patients were recruited. Age distribution was wide ranging from 21 to 89 years. Chest pain accounted for the most common indication for imaging at 63.2%. Hypertension and diabetes mellitus type II were the commonest co-morbidity states of individuals undergoing CCTA. Atherosclerotic plaques lesions were the most commonly encountered abnormality accounting for 93.1%. Total calcium scores (Agatson) ranged from 0 and 242. Calcified plaques tended to be located on the left anterior descending while the non-calcified plaques in the right coronary artery.

Conclusion: The study demonstrated the common occurrence of coronary atherosclerotic plaques in individuals older than 55 years. It also demonstrated the wide spectrum of luminal narrowing effect the plaques had on the vessels ranging from none to severe stenosis. The study also shows the paucity of calcified plaques in the imaged population with the highest calcium score being Agatson score of 242 thus highlighting the likely insignificance of coronary calcium scan in this setting.
Abstract ID: 111

**Inventory of Fixtures in Cardiovascular Imaging in Togo**

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**Background:** Cardiovascular imaging due to technological advances in recent years has experienced a very important development. New tools are now available for the diagnostic management and prognosis of patients. Thus heart CT and magnetic resonance imaging (MRI) take place nearby ultrasound, nuclear medicine techniques (positron emission tomography and single photon emission computed tomography) and coronary angiography for taking care of patients. These tremendous technological advances can help physicians improve the care of patients [1]. However, in Togo, many of these techniques are not available. The cardiovascular exploration imaging comes down to chest X-ray and ultrasound. That is why we undertook this work with the overall objective to evaluate cardiovascular exploration means available in Togo and specifically to determine the different cardiac imaging exploration techniques in Togo and different diagnosed pathologies.

**Methodology:** We have identified the various health facilities available equipped with a scanner dedicated to cardiovascular exploration. We chose to identify different indications and results of ultrasound performed at CAMPUS Hospital. It is the only public center for making these explorations. We included in our study all examinations in cardiology department of the University Hospital Campus since the installation of the system. This service only carries out heart scans. We conducted by manual counting using the records of the service which allowed us to determine the number of examinations, sex of patients, indications and results of examinations performed.

**Results:** Twelve health facilities offer echocardiography including six also offering a vascular ultrasound. These twelve centers were all in the municipality of Lomé. CHU campus A total of 497 examinations were made since the installation of the ultrasound in the cardiology department; 229 male patients, 268 female patients. Indications High blood pressure was the main indication for completing ultrasound (25.75%) (Table I). Pathologies 9.7% (n=48) of exams were normal against 90.3% (n=449) which were pathological.

**Conclusion:** Cardiovascular Imaging in Togo relies heavily on ultrasound, as the other techniques are unavailable. This of course does not allow for a thorough investigation of cardiovascular disease.
II. MEMBER STATES EXPERIENCE WITH OTHER IMAGING MODALITIES IN CARDIOLOGY (MRI, CT, ECHOCARDIOGRAPHY)
INTERNATIONAL CONFERENCE ON INTEGRATED MEDICAL IMAGING IN CARDIOVASCULAR DISEASES (IMIC 2016)

Abstract ID: 113

Association of Aortic Arch Calcification on Chest Radiography and Coronary Calcium Score in Detecting Coronary Artery Disease Among Filipino Seafarers

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Background: Atherosclerotic cardiovascular disease is the leading cause of mortality and morbidity worldwide. Recent studies have shown that coronary calcium score is a good marker of vascular injury that correlates closely with the overall atherosclerotic burden (1). Thoracic aortic calcification has been associated with coronary artery disease. In a study of Iribarren et al (2), aortic arch calcification, as determined by chest radiographs, was a significant predictor of cardiovascular outcomes, including heart disease and ischemic stroke. Chest radiograph is the commonly used routine physical examination and can detect presence of calcification in the aortic arch. Studies on the relationship between aortic arch calcification and coronary calcium score are scarce. Objective: To determine the association of aortic arch calcification (AAC) and coronary calcium score (CCS) in detecting coronary artery disease among Filipino seafarers.

Methodology: This is a cross-sectional study of Filipino seafarers who are suspected to have coronary artery disease. All subjects underwent both chest x-ray and coronary calcium score to assess for both aortic arch and coronary calcification. The extent of aortic arch calcification on chest radiograph was divided into four grades (0-3). The coronary arterial calcification was determined by calcium score and was measured using a 160 multi-slice CT scan. The radiologist, who reviewed both chest radiograph and coronary calcium score, was blinded with the clinical data and the results of both imaging modalities.

Results: A total of 19 subjects (mean age 51.1 years, 52.6% female) were included in the study. The results showed significant association between AAC and CCS with p-value of 0.03. Significantly more proportion of subjects with AAC of >0 who had calcium score of >0 also. Of those with AAC of 1&2, 4 (66.7%) had a calcium score of >0. All subjects with AAC of 3 had a calcium score of >0.

Conclusion: The presence of aortic arch calcification (AAC) detected on chest radiograph showed significant association with coronary calcium score. AAC is an independent predictor of CCS. AAC on chest radiograph may be used as an independent variable to detect coronary artery disease.
Usefulness of Aortic Arch Calcification on Chest Radiograph in Detecting Coronary Artery Disease Among Filipino Seafarers

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Background: Atherosclerotic cardiovascular disease is the leading cause of mortality and morbidity worldwide. Studies in the coronary arteries demonstrate an association between calcification and cardiovascular events, in particular myocardial infarction (1). Similar relationships between calcification and cardiovascular events have been demonstrated in other vascular beds, such as the aortic arch and the thoracic aorta (2). Chest radiograph is the commonly used routine physical examination and can detect presence of calcification in the aortic arch. Objective: To determine the correlation of aortic arch calcification (AAC) seen on chest radiograph and coronary artery stenosis measured on CT coronary angiogram in detecting coronary artery disease among Filipino seafarers.

Methodology: This is a cross-sectional study of Filipino seafarers who are suspected to have coronary artery disease. All subjects underwent both chest x-ray and CT coronary angiogram to assess for aortic arch calcification and coronary artery stenosis, respectively. The extent of aortic arch calcification on chest radiograph was divided into four grades (0-3). The CT coronary angiography was determined using a 160 multi-slice CT scan. The radiologist, who reviewed both the chest radiograph and CT coronary angiogram, was blinded with the clinical data and the results of both imaging modalities.

Results: A total of 44 subjects (mean age 51.9 years, 81.8% male) were included in the study. The results showed significant correlation between AAC by chest radiograph and coronary artery stenosis by CT coronary angiogram with p value of 0.03. The risk of patients with aortic arch calcification for coronary artery stenosis was almost 2x (RR: 1.7 95% CI: 0.94 -3.1) higher than those without aortic arch calcification.

Conclusion: The presence of aortic arch calcification (AAC) detected on chest radiograph showed significant correlation with the presence of coronary artery stenosis on CT coronary angiography. AAC on chest radiograph may be used as an independent variable to detect coronary artery disease.
Utility of Cardiac Computed Tomography in Evaluation of Anomalous Pulmonary Venous Connection

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Background: Compare the correlation between the echocardiogram and cardiac CT in the diagnosis of anomalous pulmonary venous connection, and the accuracy in the diagnosis of connection of the pulmonary venous.

Methodology: 66 patients were studied from February 2011 to June 2013 August. Echocardiogram were performed as initial approach and supplemented with cardiac CT and were compared in the diagnosis and the site pulmonary venous connection.

Results: Echocardiography and cardiac CT had a concordance of 60% (39 cases). Of which 14 patients were reported healthy, 19 reported with total anomalous venous connection, 4 partial anomalous venous connection. 40% of cases where there was no agreement: 16 cases (64%), the echocardiography reported healthy patient and reported that cardiac CT partial anomalous pulmonary venous connection, and 2 cases with mixed total anomalous pulmonary venous connection.

Conclusion: Echocardiography and CT are consistent when it comes to total anomalous pulmonary venous connection. If total anomalous pulmonary venous connection is diagnosed by echocardiography is not necessary to request additional studies. Cardiac CT was useful in evaluating the partial pulmonary anomalous venous connection. CT is more useful than echocardiography in the evaluation of extracardiac structures.
Cardiac Magnetic Resonance and Multidetector Computed Tomography as Useful Tools for Evaluating Coronary Arteries in the Long Term Follow-up of Kawasaki Disease in Mexican Children


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Background: Kawasaki Disease (KD) is an acute febrile illness characterized by systemic vasculitis of unknown etiology. Coronary artery aneurysms (CAA) is one of the most important aspects of this disease. Some patients with KD develop giant coronary aneurysms (Z score > 10) and coronary stenosis, leading to ischemic heart disease. Cardiac Magnetic Resonance (CMR) can evaluate ventricular function, anatomic characteristics and the presence of infarction with gadolinium late enhancement. The multidetector cardiac computed tomography (MDCT) is useful tool for evaluating coronary arteries at all segments of the vessel including distal segments, giant aneurysms, thrombus, occlusion, calcifications. The CMR and MDCT have little intra and inter-observer variation, where the patient receives very low radiation with the actual acquiring protocol. Objective: To demonstrate the useful of CMR and MDCT for evaluating coronary arteries and ischemic zones in the long term follow up of Kawasaki disease in Mexican children.

Methodology: We retrospectively included 33 consecutive patients with KD. Patients were obtained from the cardiac CT department database from a single tertiary referral center from February 2011 to February 2015. Studies were performed with a 256slice Dual- Source Computed Tomography scanner with either ECG-gated or non ECG-gated high pitch protocols. CMR was performed with a 1.5T Avanto Magnetom Siemens Germany, with perfusion protocol and late enhancement gadolinium sequences. Coronary segments where divided according to Z-score as follows: no aneurysm <2.5, small ≥2.5 to <5, large ≥5 to <10 and giant ≥10. The higher Z score of each coronary artery was used for the analysis.

Results: Of the 33 patients 22 (66.7 %) were males, mean age 6 ± 3.2 years. Twenty-two patients had a total of 57 coronary aneurysms distributed as follow (table 1). The breakdown by vessel was: RCA 18/33 (54.5%), LM 15 (45.5%), AD 14 (42.4%) and Cx 10 (30%). Fourteen patients had a total of 28 giant aneurysms, 3 vessels affection was present in 5 patients, 2 vessels in 4 and one vessel in 5, respectively. CMR was performed in 15 patients, myocardial infarction was observed in 3 patients with inferior, inferolateral and inferoseptal localizations. Two of these 3 patients had giant aneurysms.

Conclusion: MDCT and CMR are excellent and safety complementary tools for the evaluation of cardiac findings in infants with Kawasaki disease.
Predictors of Coronary Artery Disease (CAD) in the Mexican population: Study with Coronary Computed Tomographic Angiography


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Background: Coronary artery disease (CAD) is the leading cause of death in the Mexican population, in both men and women. Traditionally used risk scales have been developed in other populations. Objective: to determine the risk factors related to CAD in Mexicans.

Methodology: A retrospective multicenter study was performed. We included patients referred for Coronary Computed Tomographic Angiography in Mexico City and Chihuahua. The presence of traditional risk factors was evaluated by a simple questionnaire. Obstructive coronary lesions (OCL) were defined as stenosis >50%. Multivariate analysis was performed using logistic regression to assess risk.

Results: A total of 773 patients were included, age 61±11 years, 55% male, 74% symptomatic, 20% were smokers, 18% with peripheral vascular disease, 64% had hypertension, 25% diabetes, 45% dyslipidemia, 14% with previous infarction (9% after PTCA, 4% with prior CABG). Median presence of coronary calcium 170UA (0,116). OCL prevalence was 30.5% (lesions >70%: 18.5%), with the following distribution: LM:2.8%, LAD:22.5%, LCx:15%, RCA:17.6%. LVEF <55 % was demonstrated in 15%. Independent predictors of OCL are: calcium score (OR: 1.006, IC95%: 1.004-1.007, p<0.0001), male gender (OR: 2.14, IC95%: 1.2-3.6, p=0.006), age >60 years (OR: 1.89, IC95%: 1.1-3.3, p=0.02), dyslipidemia (OR: 1.79, IC95%: 1.1-3, p=0.02) and LVEF >55% (OR: 0.44, IC95%: 0.2-0.9, p=0.03). Calcium score presents an area under the curve of 0.89 for detecting OCL.

Conclusion: In Mexican Population, the best predictors of OCL are the presence of coronary calcium, male gender, age >60 years and dyslipidemia. LVEF >55% is the protective factor of OCL. These are adjusted to the presence of symptoms or other traditional risk factors.
Prognostic Value of Parameters Measured by CMR for Predicting Events Associated with Arrhythmias in Hypertrophic Cardiomyopathy


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Background: Hypertrophic cardiomyopathy (HCM) is characterized by loss of mural architecture that favors the development of malignant ventricular arrhythmias. Cardiac magnetic resonance (CMR) is a tool that has proven useful in the assessment of various heart diseases, and quantification of late gadolinium enhancement has been linked to malignant arrhythmias in this population. However, it is unclear the role of other parameters evaluated by CMR in predicting these events. Objective: To assess the prognosis of the different parameters measured by CMR in predicting events associated with arrhythmias in patients with HCM.

Methodology: Cohort study was performed between August 2007 and November 2015, including patients with echocardiographic diagnosis of HCM. These patients were evaluated by CMR Magneton Avanto 1.5T team (Siemens, Erlangen, Germany). Follow up for at least 12 months was performed in search of a major adverse cardiovascular events (MACE) - death from any cause, aborted sudden death, VT in Holter, appropriate ICD discharges, abnormal pressure response during stress test, unexplained syncope.

Results: A total of 106 patients were included with ages of 41±21 years, 4.6±2.5 (of 16) hypertrophied segments, maximum thickness of 23.6±6.9 mm, and mass of 83 (63,112 ) g/m2BSA. Patients with events showed a significantly higher number of hypertrophic segments, higher maximum thickness, increased end-systolic volume and phenotype of septal and anterior hypertrophy (see table). Late gadolinium enhancement trended higher proportion of events. The septal-anterior phenotype is the only independent predictor with HR=3.6, IC95% 1.2, 10.2, p=0.01. The traditional parameters of echocardiogram showed no prediction of events.

Conclusion: In patients with HCM, the phenotype of septal and anterior hypertrophy proved to predict events associated with arrhythmias independently. The apical phenotype showed a good prognosis.
Cardiac Magnetic Resonance (CMR) in Pediatric Hypertrophic Cardiomyopathy


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Background: Hypertrophic Cardiomyopathy (HCM) is defined as the presence of non-dilated hypertrophic left ventricles, without an underlying cause. This is one of the main causes of cardiomyopathy in pediatric population. The evaluation by cardiac magnetic resonance (CMR) and the quantification of the late gadolinium enhancement (LGE) has shown great utility in certain population groups; however, the evidence in pediatric population is limited. Objective: To evaluate the CMR and LGE in the diagnostic and prognostic of HCM in pediatric population.

Methodology: Case series performed in the National Cardiology Institute of Mexico City between August 2007 and November 2015. We included patients younger than 18 years with CMH by echocardiogram, which were evaluated with CMR in a Magneton Avanto 1.5T (Siemens, Erlagen, Germany) equipment.

Results: A total of 17 patients were included, with a mean age of 10.3 ± 4.8 years (the younger with 6 months and the older with 16 years), 10 males, with 1.2 ± 0.5 m2SC. The measure of the L.V. with hypertrophy was 4 ± 2, maximum thickness of 26 ± 10 mm, mass of 85 ± 33 g/m2SC, and phenotypes predominantly septal and inferior (14/17), only one case presented apical hypertrophy. The mean of LGE was 13.4 ± 9.8% of the L.V. mass, 3/17 presented LGE in >20%, and in only one was absent. Echocardiogram shows a left outflow tract gradient (LOT) of 71 ± 40 mmHg with (LLOT) obstruction in 10/17 cases, 6/16 presented mitral regurgitation from moderate to severe. Among other findings, 1 patient presented Noonan Syndrome, 1 patient presented apical aneurysm, and 3 showed right ventricle hypertrophy with right outflow tract obstruction. Two patients were brothers. 3 patients had Implantable Automatic Defibrillator, 2 had Morrow myomectomy, 3 had alcohol septal ablation. 1 was reported dead in the younger case (6 months), whom presented >20% of LGE.

Conclusion: In our case series, CMH presented a more aggressive behavior in the pediatric population than reported in the adult literature. Thus, a more thorough integral evaluation is needed, including CMR in the initial diagnosis process.
Coronary Calcium Role as a Death Predictor in Valvular Heart Surgery


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Background: Valvular disease is major cause of cardiac surgery worldwide; coexistence with coronary artery disease (CAD) is one of the main factors of perioperative mortality. Coronary calcium (CC) has a close relationship with CAD, however its role in death prediction is not well defined. The aim of this study is to determine the prognostic value of CC in predicting perioperative mortality in valvular heart surgery.

Methodology: A prospective study included 220 consecutive patients from January 2012 to December 2015 with severe valvular disease and surgery candidates. We performed CC quantification in Sensation Somaton equipment with 256 slices (Siemens, Germany). The quantification of coronary calcium was carried out in Agastston units.

Results: The mean age was 54±11 years, 43% male, with 4.5±2.3 EuroScore points. The prevalence of CAD risk factors was low (diabetes 13%, hypertension 28%, dyslipidemia 14%). Of the total population, 37% underwent aortic valve replacement, 30% mitral replacement and the rest had more complex surgeries (multiple valves, aortic surgery, coronary revascularization). The average CC was 27UA on survivors and 300UA in deaths. 16 deaths occurred (7%), independent predictors were: invasive mechanical ventilation days (OR:1.9, IC95%: 1.3, 2.8, p<0.05), additive EuroScore (OR:1.9, IC95%: 1.2, 3.1, p<0.05) and CC (OR:1.004, IC95%: 1.001, 1.007, p<0.05), adjusted to obstructive lesions, bomb time, age, left ventricular ejection fraction (LVEF) and pulmonary artery systolic pressure (PASP).

Conclusions: CC presence was associated with mortality prediction in patients with severe valvular heart disease that undergo cardiac surgery.
Burden of Atheroesclerosis Assessed with Computed Tomography in Patientes with Aortic and Mitral Valve Disease


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Background: Valvular heart disease is one of the major causes of cardiovascular morbidity and mortality worldwide and mainly affects aortic and mitral valves. The coexistence of these entities with coronary atherosclerosis is common, and the symptoms of both overlap. It is imperative to assess the presence of coronary artery disease (CAD) in these patients. Traditionally, CAD is evaluated with perfusion tests or invasive coronary angiography. Computed coronary tomography angiography (CCTA) has emerged as a feasible and practical option. The aim of this research is to evaluate the CT findings related to atherosclerosis in a population with aortic and mitral valve disease.

Methodology: A prospective study included 147 consecutive patients from January 2012 to December 2015 with aortic or mitral valve disease. Coronary calcium (CC) quantification and CCTA was performed ATC in a 256 slice Somaton Sensation equipment (Siemens, Germany). Obstructive coronary lesion (OCL) was defined with >50% of stenosis.

Results: A total of 81 aortic and 66 mitral valve patients were included. The mean age was 53±10 years, female were predominant in mitral valve group (76 vs 47%, p < 0.05). Cardiovascular risk factors were more frequent in the aortic group (diabetes 20 vs 9%, p = 0.07; hypertension 35 vs 15%, p < 0.05). Left ventricular ejection fraction (LVEF) and age were not different between both groups. The coronary calcium average was 44UA in the aortic and 13UA in the mitral group, p< 0.05; 89% of these presented 0UA (vs 68 % of aortic (p < 0.05). In table 1 the distribution of CAD is presented. OCL was observed in 7% of mitral and 10% of aortic groups. For the mitral group, male gender is associated with high risk OCL (OR= 16.3, 95% CI 1.6, 159, p<0.05). The CC <60UA in aortic and <30UA in mitral, excludes OCL with a negative predictive value (NPV) of 96 and 98 %, respectively.

Conclusions: In our population, CAD has low prevalence, mainly in the mitral valve group. An initial approach of quantification of CC is recommended, and decide to proceed with CCTA only in aortic >60UA, and mitral with >30uA, especially if they are male.
Cancer Patient Management in Neurological Clinic by Using US and MRI Imaging of Cardiovascular System

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Background: The matching of US, MRI or CT data of cardiovascular system gets the special role in delivering personalized care of cancer patient.

Methodology: Since 2010, seven patients (male:female – 2:5) with complex oncological, neurological and cardiac pathology were admitted in clinic. One of them had severe pain syndrome due to brain metastasis near the VII nerve treated by narcotic analgesia and underwent setting of pacemaker for concomitant diagnosis as myocardial dystrophy of complex genesis, transient AV block III stage in syncope. Transthoracic echocardiography in 2D with 3D reconstruction was applied used Philips SONOS 5500 ultrasound machine with 1-5 MHz probes. MRI investigation with Gadolinium enhance was executed.

Results: The heart tumor was found in one of the patients. Ventricular wall is composed of normal myocardium (anterior wall and antero-lateral segments of left ventricle and anterior wall of right ventricle) and tissue with higher density, abnormal structure, postero-lateral spreading and intracavitary growth with extremely decreased right ventricle volume. Echo signs of tumor capsule or extracardiac growth were not found. MRI data: large intramural masses in area of intraventricular septum, posterior wall of both ventricles with abnormal shape and small volume of right ventricle cavity were revealed. These data corresponded the data of US-investigation and clearly have shown the tumor of myocardium with intramural and intracavitary growth, which could not be operated by open-heart techniques. Other six patients had signs of chronic cardiovascular disease (CVD) and the effective treatment of CVD was conducted early due to early diagnosis.

Conclusion: Medical imaging technologies offer precise, three-dimensional views of anatomical and physiological function. Combined US, MRI imaging for cancer patients with complex pathology is useful diagnostic option for heart tumor. Imaging technology plays principal role in detecting CVD diseases early, that revealed to start effective treatment early due to early and precise disease diagnosis.
MRI and Cardiac US Utilities in Patients with Pharmacoresistant Epilepsy and Acute Myocardial Infarction

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Background: Investigation of intracardiac hemodynamics and myocardial perfusion by using combined myocardial imaging (cardiac ultrasound and MRI) in patients with pharmacoresistant epilepsy and acute myocardial infarction was aimed.

Methodology: Twelve patients with pharmacoresistant epilepsy and acute myocardial infarction underwent coronary angiography (CA) directly after hospital admission. All patients were treated with anticoagulants, antiplatelet agents, morphine and nitrates since first medical contact. There is no diabetes mellitus or acute inflammatory disease. Transthoracic ultrasound in emergency care unit was performed after coronary reperfusion for estimation of chamber size, function and myocardial deformation, as well as cardiac valve competence. MRI with Gadolinium enhancement was used for estimation size and volume of damaged myocardium and myocardial edema at 5-7 days after CA. Blood samples for troponins were collected.

Results: Patients with no-reflow phenomena had depressed left ventricle pump function early after endovascular coronary reperfusion (LVEF<45%). Post CA depressed LVEF was correlated with MRI signs of myocardial edema (Pearson, r=0.44, p=0.01), but not with TIMI flow (p=0.4) in all patients. MRI volume of impaired but not scarred myocardium in the bed of infarct-related coronary artery was significantly large in patients with CA no-reflow phenomena (HR 4.3, p<0.001).

Conclusions: MRI data may be used for estimation of acute coronary syndrome prognosis and personalization of treatment. Combined cardiac ultrasound and MRI cardiac imaging can prove a substrate for no-reflow phenomena and drug resistance in patients with pharmacoresistant epilepsy early after invasive treatment of acute myocardial infarction.
Role and Place of Myocardial Perfusion Scintigraphy in Nuclear Medicine at Yalgado Ouedraogo Teaching Hospital After Four Years

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Background: The nuclear medicine opened these doors in January 2012 in Yalgado Ouédraogo Teaching Hospital (CHU-YO). The different exams achieved are: nuclear cardiology exams (e.g. myocardial perfusion scintigraphy), bone, thyroid, lung and renal scans. The myocardial perfusion scintigraphy is performing in the case of the balance of the cardiac pathologies. They concern the tests of effort coupled to the study of perfusion and function of myocardium. After four years of working, we intend to determine the role and place of the myocardial perfusion scintigraphy in the exams achieved at the Nuclear Medicine Department at CHU-YO.

Methodology: The patients must not be on an empty stomach. However, they must not take tea, coffee, or chocolate the morning of the exam. The anti-ischemic or anti-hypertension medications will be suspended according to the exam indication. The Sestamibi (Cardiolite) is the product marked in the Technetium 99m that is injected to the patient. At rest, 370 to 555 MBq (10-15 mCi) is injected to the patient and after stress, 740-1110 MBq (20-30 mCi) is injected to the patient according to the weight. The acquisition makes itself in two distinct sequences. The first acquisition is made to rest, 60 minutes after the first injection of radiotracer. The second acquisition is made between 40 to 60 minutes after stress. Between the two sequences of acquisition, there is 4 hours. The acquisition with effort and the acquisition with rest take place in the same way. The patient is the most often in ventral decubitus on the table of exam, the superior members folded above the head.

Results: The myocardial perfusion scintigraphy represents 12.8% of the exams achieved over four years. This includes 123 patients with an average age of 52.89 years. Men represented 61.8% of patients receiving myocardial perfusion scintigraphy. The percentage of the myocardial perfusion scintigraphy decreased from 16.43% in 2012 to 7.79% 2015. The indications for exams are most frequently ischemia (37.80%), thoracic pain (31.50%), coronary deficiency or syndrome (15.75%) and infarctus (4.72%).

Conclusion: The integration of the myocardial scintigraphy in the evaluation of the cardiac pathologies could contribute to improved patient care and to a precocious diagnosis of ischemia for the asymptomatic patient. Unfortunately, the number of referred patients for myocardial scintigraphy decreased. Key Words: myocardial scintigraphy, cardiac pathologies, ischemia.
Case Report of Utility of Imaging on Coronary Disease in Nicaragua

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Objective: To evaluate the utility of imaging on coronary disease. Case: This presents a clinical case of a male patient around 60 years old who has morbid obesity, arterial hypertension, diabetes and coronary disease. In 1996, he had a cardiac revascularization surgery. He now presents with peripheral arterial disease treated percutaneously, meriting a stent in the right femoral artery. During 2008, he had right carotid endarterectomy. It was diagnosed by an echocardiogram as a carrier of valvular, ischemic and hypertensive heart disease. He had diverse imaging for the proper approach to the pathologies. Currently, he is under medical treatment and his evolution has been satisfactory.
Experience in Implementing Nuclear Cardiology Studies at the Santa Cruz Hospital Caja Petrolera de Salud

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Santa Cruz is one of the largest cities in Bolivia with a population over 2.5 million. For 5 years, the Nuclear Medicine Service at CPS was the only functional public hospital in the city, where there is additionally just a single private clinic.

The Nuclear Medicine Service at CPS has been in operating since 2005. However, since 2010, there has been an increase from 30 monthly studies to 100 (current number of studies performed). Of these, 30% are nuclear cardiology studies: myocardial perfusion, viability and radioisotope ventriculography.

Location: the infrastructure is especially dedicated to the Nuclear Medicine Service; there are 2 rooms for Radioiodine Therapy. It is one of the only 2 institutions in the country which provides diagnostic treatments.

Instrumentation: A SPECT gamma camera, G. E. Millenium MPR, with all the requirements to operate a gamma camera SPECT-CT in 2017.

Personnel: 1 Nuclear Medicine physician, 2 technologists in radiology with Nuclear Medicine training and a cardiologist who performs nuclear stress tests.

Operation: the Nuclear Medicine Service provides assistance in patient care and will eventually become a teaching service, able to accommodate rotating technicians in radiology. Our population has a high prevalence of Chagas Disease therefore we must perform diagnostic studies for coronary diseases carefully, as it is known, following our studies, that the probability of the latter in this group of patients was relatively low (18%). Amongst other risk factors for coronary diseases, our population has high hypertension and diabetes, often poorly controlled, especially those coming from the provinces. Amongst the strengths of CPS' Cardiology services is that it is one of the most complete in the city, offering high quality diagnostic and treatment services.
Estimation of Effective Radiation Dose in Pediatric Patients with Heart Congenital Disease in CT Angiography

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Background: The objective of this study was to report the frequency of heart congenital disease found among children assessed with CT angiography and estimate the radiation dose in these studies using the dose indicator Dose Length Product (DLP).

Methodology: A cross sectional study was performed including 300 children with indication of cardiac and great vessels Multidetector Computed Tomography (MDCT). All the patients were younger than 5 years old. Once referred, they were sedated to decrease movement during the injection of contrast and to eliminate artefacts due to movement. Every child was injected with 2ml/Kg of non-ionic contrast media through arm or dorsal foot veins using a flow of 1-2 mL/s. Scan using an a multidetector tomography Aquilion 64 (Toshiba, Japan) and a Vitrea workstation was initiated after a delay time of 15 - 20 seconds. Factor of exposure peaks used were 80, 100 and 120 kilovoltage peak, dose modulation and rotation time at 0.35 sec. In few cases it was necessary to scan twice and scan the superior abdomen. To estimate the dose we obtained the dose indicator DLP and multiplied it with the factor K for chest depending on the age of the patient.

Results: Among the 300 children included in the study, 191 were found with complex cardiac abnormalities (38.4 %); 44 (8.8 %) with aortic arc hypoplasia; 42 (8.4 %) with aortic arc to the right. Unique ventricle was found in 36 patients (7.2 %) and ductus were found in 27 children (5.4 %). Good quality images were obtained using low doses of radiation; median for 80 kVp was 9 mSv and for 100 and 120 kVp was 13 mSv.

Conclusion: Low radiation exposition achieved good quality images and consequently accurate diagnosis of cardiac abnormalities among children. A kVp as low as 80 can be used to reduce and optimize the dose in pediatric patients who require a MDTC.
Correlation of Calcium Scoring with Severity of Stenosis on CT Coronary Angiography.

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**Background:** While many studies have correlated age specific calcium scores along with other risk factors and severity of stenosis on conventional angiographies, there is paucity of studies evaluating the independent significance of calcium scoring per se in predicting severity of coronary disease. 

**Purpose:** To investigate the correlation between CT coronary calcium scoring and severity of stenosis on CT coronary angiography in Asian population.

**Methodology:** A prospective study of 141 consecutive male and female patients, ranging from 40-82 years in age, referred to our department for CT coronary calcium scoring (CTCCS) followed by CT coronary angiography (CTCA) was conducted using Siemens’ Somatom Definition, dual source 64 slice scanner. Consent was acquired from all participants. Associations between total calcium score and severity of stenosis on CTCA as well as individual vessels viz. left main (LMCA), left anterior descending (LAD), left circumflex (LCX) and right coronary (RCA) arteries was determined. Stenosis in a good sized branch of latter three were also included in the sample.

**Results:** A scatter plot was formed between total calcium scores and percentage of stenosis. No linear correlation was found between these two variables. Further on evaluation of individual vessels viz. LMCA, LAD, LCX and RCA and only presence or absence (0%) of stenosis, these individual vessels showed statistically significant variation of calcium between presence of stenosis: calcium scores of 62 (0-438), 42.1 (0-274.3), 46.1 (0-357), 1.1 (0-93.3) and in absence of stenosis 0.2 (0-215), 0 (0-160.8), 0 (0-486.6), 0 (0-59.6) in these vessels respectively (p<0.001). Also male gender and higher age had significant correlation to higher calcium scores (p<0.001).

**Conclusion:** While magnitude of calcium scoring alone is a significant predictor of presence or absence of coronary artery disease and hence it absence of calcium implies low probability of disease. However it does not seem to correlate linearly with severity of stenosis. Thus calcium score alone cannot be used alone to predict severity of stenosis. CT coronary angiography is essential in quantifying coronary stenosis to predict, which is the most common indication for referral to us in our practice. Yield of calcium scoring of individual arteries need larger data analysis.
Correlation of Coronary CT Calcium Scoring with Technetium Labelled Sestamibi Scan in Prediction of Future Cardiac Events

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Background: Coronary calcium is a marker for atherosclerosis. The presence and amount of calcium detected in a coronary artery by the CT scan, indicates the presence and amount of atherosclerotic plaque. These calcium deposits appear years before the development of symptomatic heart disease. A calcium score is computed for each of the coronary arteries based upon the volume and density of calcium deposits. This can be referred to as calcified plaque burden. It does not correspond directly to the percentage of narrowing in the artery but does correlate with the severity of underlying coronary atherosclerosis. Single-photon emission computed tomography perfusion scintigraphy (SPECT), using (99m)Tc-sestamibi, in stress and/or rest protocols, has consistently been shown to be an effective modality for identifying myocardial viability and guiding appropriate management. Objective: To establish the correlation of coronary CT calcium scoring with (99m)Tc sestamibi in prediction of future cardiac events.

Methodology: Total of 75 patients at risk of coronary artery disease were investigated in a period of 18 months, they had diabetes and hypertension as major risk factors. CT scan was performed after initial assessment which detected the total calcium score (Agatston) and later all patients underwent (99m) Tc-sestamibi scan for ischemia.

Results: In 75 patients coronary arteries were evaluated with CT scan and (99m) Tc-sestamibi. All patients had some risk factor for major cardiac event. 13 patients had 0 calcium score with minimal identifiable plaque. Out of them, 4 had reversible ischemia on (99m) Tc-sestamibi. 21 patients had calcium score of 101 to 400 with moderate atherosclerotic plaque and mild coronary artery disease. (99m) Tc-sestamibi scan showed ischemia in 15 patients with normal uptake in 5. 6 patients had major myocardial ischemic event in next 1 year, the main vessel being left anterior descending artery. 17 patients had calcium score of more than 400, 15 had 500 to 800. These patients also showed ischemia in perfusion study with development of major ischemia in 14 in next 1 year.

Conclusion: Coronary CT calcium score alone is a good predictor of future cardiac event and when correlated with (99m) Tc-sestamibi a useful tool that can be used in prediction of major cardiac event in high risk population and guides appropriate treatment.
Echocardiographic Evaluation of Hypertransfused Children with β Thalassemia Intermedia Using Standard and Tissue Doppler Methods

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Background: Serious cardiac complication can occur in patients with β thalassemia intermedia (TI). This is the first case control study aimed to evaluate the systolic and diastolic cardiac function in children with TI who are receiving early regular blood transfusion.

Methodology: Thirteen patients with TI with a mean age of 11.7 ± 6 years were compared with eighteen healthy controls with a mean age of 8.8 ± 4 years. Clinical parameters and standard echocardiographic and tissue Doppler imaging (TDI) were compared.

Results: Young TI patients had a significantly increased Z scores for the diameters of the ascending aorta (AscAo) and left pulmonary artery (LPA). Systolic function parameters were similar (P > 0.945). Diastolic function assessment revealed comparable results between the two groups, however the corrected deceleration time of the peak early mitral valve inflow velocity (DTm) was increased in TI patients compared to the controls (P=0.033). Pulmonary vein Doppler velocities showed comparable results except for the peak systolic velocity (Spv) which was higher in the TI cases (P=0.019). None of the patients had evidence of pulmonary hypertension.

Conclusion: Young patients with TI who are receiving early regular blood transfusion have normal systolic and diastolic cardiac function with no evidence of pulmonary hypertension. A statistically significant increase in the diameters of the outflow tracts and in Spv and DTm are most likely attributed to high cardiac output status in TI patients. These findings support the early commencing of regular blood transfusion therapy for TI patients to prevent serious cardiac complications in adult life.
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FDG PET/CT in Detection of Active Disease in Patients with Vasculitis


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**Background:** The aim of this study was to evaluate the usefulness of FDG PET/CT in the detection of active disease in patients with vasculitis.

**Methodology:** FDG PET/CT examination was performed in 10 patients (2 men and 8 women, mean age 52.1±12.8 years) who had different forms of vasculitis in their history, in order to evaluate the activity of the disease. The degree of FDG uptake in the vessels was assessed visually and quantitatively using a maximum standardized uptake value (SUVmax). Findings were classified as positive if SUVmax level in vessels was higher than SUVmax of the liver.

**Results:** FDG PET/CT was positive for active vasculitis in 8 patients (80%). The disease was present in seven women and one man. The mean SUVmax of the active areas was 3.3±1.2. In 30% of patients the disease was present only in one vessel (usually aorta), 10% of patients had active disease in two different vessels and 40% of patients had active disease in three and more vessels. All of those patients who had positive FDG PET/CT findings had fever and different symptoms of disease (usually headache and fatigue).

**Conclusion:** FDG PET/CT can be useful in detecting active vasculitis, since other diagnostic procedures fail to evaluate the disease activity. A calculation of SUVmax on FDG PET/CT scans may give an objective assessment of the level of disease and inflammation.
FDG PET/CT in Detection of Vascular Graft Infection


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Background: The aim of this study was to evaluate the usefulness of FDG PET/CT in the detection of vascular graft infection.

Methodology: FDG PET/CT examination was performed in 15 patients (9 men and 6 women, mean age 66.0±9.5 years) who had a suspicion of vascular graft infection. The degree of FDG uptake in the vessels was assessed visually and quantitatively using a maximum standardized uptake value (SUVmax).

Results: FDG PET/CT was positive for active vascular graft infection in 12 patients (80%). The disease was present in eight men and four women. The mean SUVmax of the active areas was 7.6±2.4. In 40% of the patients, the disease was present in the whole graft including the vascular graft bifurcation (in aortobifemoral bypass), 26% of patients had active disease in two grafted vessels and others had active disease in only one grafted vessel. Forty percent of those patients who had positive FDG PET/CT findings had fever, while sixty percent of patients did not have fever, but had malignancy in their medical history.

Conclusion: The treatment of choice for graft infections is surgical removal; thus an accurate diagnosis is important to avoid unnecessary surgery. FDG PET/CT can be useful in detecting active vascular graft infection, since other diagnostic procedures fail to evaluate disease activity. Calculation of SUVmax on FDG PET/CT scans may give an objective assessment of the level of disease and inflammation.
FDG PET/CT in Endocarditis Evaluation

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**Background:** The aim of this study was to evaluate active disease in patients with suspected endocarditis with FDG PET/CT.

**Methodology:** FDG PET/CT examination was performed in 16 patients (11 men and 5 women, mean age 56.9±17.7) with prolonged fever and symptoms of endocarditis. Most of the patients (75%) had prior artificial valve replacement. Degree of FDG uptake was assessed visually and quantitatively using a maximum standardized uptake value (SUVmax). FDG PET/CT findings were considered positive if FDG uptake was increased above the level in blood vessels of the mediastinum, lung parenchyma, lymph nodes or visceral organs.

**Results:** In 12 patients (93%), various imaging signs of inflammation were noted on FDG PET/CT. Signs that suggested endocarditis were seen in five patients (mean SUVmax of the active areas was 5.8±2.4). In one patient, active vasculitis was found with high FDG uptake in the aorta and its branches (SUVmax 5.0). Eleven patients had different localizations of lymphadenopathy with increased accumulation of the FDG (mean SUVmax 5.9±3.6). Four patients had high FDG accumulation in bones, spleen and lymph nodes, suggesting active granulomatous disease (SUVmax 6.1±1.5).

**Conclusion:** FDG PET/CT detected different signs of infection in patients with suspected endocarditis. However, focally increased FDG metabolism in heart structures was seen in only 42% of patients, in whom the majority did not have antibiotic therapy. Thus, FDG PET/CT has limited role in the detection of active endocarditis in patients on the antibiotic therapy. However, it can be useful in detecting signs of active inflammation which can cause spreading of the inflammatory process into the endocardium.
Abstract ID: 40

Underutilization of MUGA Study at Sarawak General Hospital, Malaysia


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Background: Radionuclide ventriculography or commonly called multigated acquisition (MUGA) study is used to analyse global and regional ventricular function and it is available at most Nuclear Medicine Centre in Malaysia, particularly in Sarawak General Hospital. Sarawak, the largest state in Malaysia, has 2.636 million people (8.5% of Malaysia population) with 26 000 cardiovascular disease reported in a year and Sarawak contributes the highest incidence of breast cancer with 482.9 per 100,000 female population.

Methodology: Study of 9 patients, available from 2012 to 2015, was retrospectively evaluated.

Results: The majority of the patients from Sarawak that undergone MUGA study was female consist of 67% (6 patients) followed by male 33% (3 patients). The number of races included Chinese with 44%, followed by 33% Ibans and 22% Malays. A total number of patients having an ejection fraction of less than 50%, was around 11%, 77.7% with ejection fraction between 50% to 65% and 11% with ejection fraction more than 65%.

Conclusion: Although the number of patients that undergone MUGA study from 2012 until 2015 were too little, compared to the morbidity of the disease and the availability of the service in Sarawak, a more proactive promotion needs to be done in order to fully utilize MUGA study in the future.
Comparison of Inflammatory Atherosclerotic Changes in the Aortic Segments Detected with 18F-FDG PET/CT in Subjects with Insulin Dependent Diabetes Mellitus with the Normal Controls

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Background: Atherosclerosis is a multifactorial disease caused both by genetic and environmental factors. It is a great cause of mortality and morbidity in the world. It is a systemic cardiovascular disease affecting the entire arterial tree marked by inflammation, and plaque formation within arterial walls. FDG-PET/CT has a well established role for the detection of atherosclerotic inflammatory disease and for quantification of this pathology using standardized uptake value (SUV) measurements. Diabetes mellitus (DM) is a well-known and highly important risk factor for atherosclerosis. Our aim was to compare the early inflammatory changes secondary to atherosclerosis in the aortic segments of subjects with DM on insulin with the age-matched controls with no history of DM.

Methodology: 92 subjects who underwent FDG-PET/CT imaging were retrospectively studied. 46 were diabetics on insulin (62±11 years old); 46 were age-matched controls (62±11 years old). SUVmax and SUVmean for four segments of the aorta: ascending aorta, arch of aorta, descending thoracic aorta, and abdominal aorta were measured and compared between the two groups.

Results: Average of the SUV max and SUV mean values were higher in subjects with DM on insulin than the normal control subjects and the difference was statistically significant in all four aortic segments (p<0.05)

Conclusion: In subjects with DM on insulin, inflammatory changes of atherosclerotic disease in the all aortic segments as measured by arterial FDG uptake (SUV max and mean values) were markedly higher compared to that seen in age-matched controls with no DM. The early effects of the atherosclerotic process in the aortic segments as detected and quantified by FDG-PET/CT appear to be more severe in subjects with insulin-dependent DM compared to age-matched controls. Since DM is a well known risk factor for atherosclerosis, severity of its effect can be measured and quantified using FDG-PET.
Role of Myocardial Perfusion Scintigraphy in Evaluation of the Hemodynamic Significance of Borderline Coronary Stenoses

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Background: The hemodynamic significance of borderline stenosis (BLS) is questionable, even in symptomatic patients. Different invasive and noninvasive methods have been developed for helping the management decision. The aim of the study was to visualize the inducible ischemia by myocardial perfusion imaging (MPI) in patients with borderline stenoses, known from coronary angiography and to determine the advantages and limitations of the method.

Methodology: Seventy six patients (49 men, 27 women aged from 45 to 87) with at least one borderline stenosis were examined by MPI after submaximal or symptoms limited stress. The examination was performed on Symbia 2T Siemens SPECT/CT with attenuation correction. Only 7 patients with previous myocardial infarction had also rest MPI. A semi quantitative evaluation was also done by QPS/QGS software with determination of the summed stress score (SSS), or summed differential score (SDS) in patients with documented previous myocardial infarction for appropriate visualization and quantification of the reversible changes. The number of vessel territories with BL stenosis was 126: 7 left main stenoses (LCA), 52 left anterior descendens (LAD), 29 right coronary arteries (RCA), 26 circumflex arteries (rCx) and 12 others. Thirteen vessels with in stent restenosis > 40% were included.

Results: The significant (SSS>3) inducible ischemia was visualized in 21 patients (27.5%): 12 LAD, 2 LCA, 5 RCA and 4 rCx coronary lesions (18%). The smaller vascular territories did not show hypoperfusion changes. In 1 patient with LCA instead of hypoperfusion was documented inducible left ventricular dysfunction. Only 2/13 patients with in stent restenosis had inducible ischemia.

Conclusion: MPI can visualize inducible ischemia in the main vessel territories, including the vessels with in stent restenosis. The main limitation of the examination is the low (symptom limited stress). The presence of previous myocardial infarction is not a limitation factor, in spite of the presence of significant coronary lesion. The quantification of the hypoperfusion by summed stress or by summed differential score participate in the decision making for management of considerable (more than 1/4) part of the patients with borderline stenoses.
Cardiac PET and MRI for Assessment of Myocardial Viability in Patients With Totally Occluded Coronary Arteries

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Background: A purpose of the study was head-to-head comparison the diagnostic value of positron emission tomography (PET) and contrast-enhanced MRI (ceMRI) for detection of myocardial viability in patients with totally occluded coronary arteries (CTOCA).

Methodology: 29 patients with CTOCA were included in the study. All patients underwent PET [82Rb]Cl and [18F]-FDG as well as cardiac ceMRI. In 20 of patients successful CTOCA recanalization was confirmed 12 months after surgery. All of them completed MRI procedure after PCI, an improvement in wall motion at follow-up by at least 1 grade was used as standard for diagnostic accuracy calculation. 3 Tesla MR system was used for ceMRI and cine MRI. Late gadolinium enhancement (LGE) with a T1 IR turbo-FLASH sequence followed a 20 minute time delay after intravenous administration of 0.2 mmol/kg Gadodiamide for the quantification of segmental extent of subendocardial and transmural scar. Quantitative evaluation of the LGE images was performed using the ARGUS software. PET with [82Rb]Cl was performed in static mode 1-1.5 min after intravenous administration of 1500 MBq of tracer. 18F-FDG PET static scanning was performed 60 min after intravenous administration of 370MBq of [18F]-FDG. Myocardial segment was considered as viable if [18F]-FDG uptake was higher to 70% relative to maximal uptake in the referent region or in cases of perfusion/metabolism mismatch or inverted mismatch. Partial viability was determined if [18F]-FDG uptake was higher than 50%, but lower than 69% relative to maximal uptake in the referent region and in cases of perfusion mismatch or inverted mismatch. Nonviable myocardium was diagnosis if [18F]-FDG uptake was less than 50% relative to maximal uptake or in case of perfusion/metabolism match.

Results: High agreement between ceMRI and PET was observed in segments with transmural scar (82.5%). The results of PET and ceMRI were very close for segments with akinesis, rather for segments with hypokinesis (89.9% against 36.4%). Moderately reduced [18F]-FDG uptake (50%-70% relative to maximal uptake) was registered not only in case of subendocardial scar, but also in non-scarred segments (51% against 38%). ROC analysis demonstrated that of scar extension transmurality less than 50% predicts significant improvement in local systolic function with a 80.2% sensitivity, 78% specificity and 79.6% accuracy, whereas that scar volume less than 37.7% has a sensitivity, specificity and accuracy 92.7%, 73.2% and 86.9% respectively. PET [18F]-FDG alone and PET with two tracers ([82Rb]Cl and [18F]-FDG) provide with different information, concerning sensitivity, specificity and accuracy: 81.1% vs 91%, 67.5% vs 75.2%, 65.5% vs 83.3% respectively.

Conclusion: Contrast-enhanced MRI was superior to [18F]-FDG-PET alone in the assessment of myocardial. Diagnostic accuracy and prediction value of ceMRI and perfusion/metabolism PET imaging are very close. Combined evaluation of perfusion, metabolism, structural and functional state of myocardium increases diagnostic accuracy of myocardial viability assessment in patients with CTOCA.
Abstract ID: 95

Comparison in 30 Patients Between Risordan Test and Thallium-201 Chloride Rest Myocardial Scintigraphy in Viability After Myocardial Infarct


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Background: This study aimed to test whether sublingual administration of Nitrate (Risor-dan) could improve the capability of Tc-99m-MIBI to detect viable myocardium by contribution to the baseline examination (Tc-99m-MIBI single) and to compare it with the thallium-201(Tl-201) rest-redistribution protocol.

Metodology:

• The study is a comparison of diagnostic procedures performed over a period of 3 months (first quarter 2016).
• Thirty patients (23 men and 7 women with sex ratio 3.2; mean age 61.63 ± 3.0 years) with previous history of myocardial infarction were included in the study.
• All patients underwent baseline rest, as well as Risordan 99mTc-MIBI myocardial perfusion imaging and rest-redistribution Tl-201 imaging (3 day protocol).
• The data were reconstructed in transaxial slices with iterative algorithm (Astonish) and then reoriented into short, vertical long and horizontal long axis slices.
• Scintigraphic analysis was performed using quantitative perfusion SPECT (QPS), providing the percentage radiotracer uptake and defect severity in a 17-segment model.
• The segments with tracer activity of more than 50% as compared to maximum, or reversibility ≥ 10% were considered as viable.
• The images were interpreted by two independent observers.
• The computer operating software is made on EpiInfo 6.04Dfr and Epidataanalysis V2.2.2.182 (comparison of two samples matched sets).

Results:

• A total of 510 myocardial segments were evaluated by quantitative analysis.
• In the baseline study with 99mTc-MIBI, 357/510 (70%) were viable segments and these were increased to 393/510 (77%) in the Risordan/MIBI study (p=0.001 vs. baseline). A total of 19 (63.33%) out of 30 patients showed an improvement of viable myocardium.
• The concordance for viable and non-viable segments detection between Risordan/MIBI and rest-redistribution Tl-201 imaging was found in 487 out of 510 segments (95.49%). 4% (21/510) of segments that were non-viable on Risordan/MIBI studies were viable on 201 Tl studies, whereas 0.3% (2/510) were non-viable on 201 Tl studies were viable on Risordan/MIBI studies (p <0.001).

Conclusion: Our data suggest that the use of Risordan/MIBI protocol improves detection of viable segments and achieves results very close to those from standard Tl-201 rest-redistribution protocol and therefore might be considered as a potential alternative to the TI201, which is more expensive, less available and irradiating.
Abstract ID: 97

Segmental Impedance Plethysmography: A Low Cost Supplement to Cardiovascular Diagnosis and Monitoring

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Impedance Plethysmography was introduced by JanNyboer in the year 1940 for the assessment of Central and Peripheral Blood Flow (PBF), which was further refined by Kubicek et al. in 1966 for higher accuracy. In this technique electrical impedance of any segment of the body is measured, blood being a moderate conductor of the electricity, changes in blood volume in the body segment produce discernible changes in the impedance. Therefore impedance of the segment (Z), change in the impedance with respect to time (dz/dt) and rate of change of impedance (dz/dt) are adequate to obtain Stroke Volume (SV), Cardiac Output (CO), Systolic Time Index (STI), Left Ventricular Ejection Fraction (LVEF) and PBF with reasonable precision which has been reported by large number of researchers. Electronics Division, BARC developed first model of Impedance Plethysmograph in 1978 and used the same for detection of Peripheral Vascular Occlusive Diseases (PVOD). In this method, BF in the extremities was measured segment wise, e.g. upper thigh, lower thigh, knee, upper calf, lower calf and ankle for lower extremities. From this data Blood Flow Index (BFI) and Differential Pulse Arrival Time (DPAT) was derived at all the locations. Analysis of the same yielded not only approximate location of the Aortic/Arterial Block but also the status of collateral circulation and distal arterial runoff. Comparison of these observations with Aortography yielded a sensitivity of 98% and a specificity of 96%. Similarly Segmental Plethysmography combined with Venus Occlusive Plethysmography increased the detection efficiency of Deep Vein Thrombosis markedly as compared to other non-invasive methods. Advantage of this method is that it could be performed on a patient any number of times for monitoring the therapeutic progress without causing any harm or discomfort to the patient. This technique has undergone several upgradations in past 38 years; from microprocessor based system to PC based Impedance Cardio-Vaso-Graph (ICVG) and now Peripheral Pulse Analyzer (PPA). Our study, with cardiac patients, has shown Segmental Plethysmograph of the chest to be markedly different in various cardiovascular diseases such as Stenosis, Regurgitation of different heart valves and Coronary Artery Disease (CAD) from that of normals. It was also observed that few controls, who recorded abnormal Segmental Plethysmograph, suffered heart attack during fifteen subsequent years. This suggested diagnostic potential of this technique. Peripheral Pulse Analyzer, latest development in the series, in addition to laboratory assessment, has capability of Telemedicine through mobile phone network via Bluetooth connectivity. It also has application software for variability analysis in Heart Rate (HR), SV/PBF and Morphology Index (MI). For variability studies, PBF at wrist level is recorded on the patient in supine and the same is processed to obtain HR, PBF and MI as function of time. The Fourier Transform of the same yields different rhythms responsible for variability. Variability spectra is addition to representing autonomic function is useful for detection of peripheral neuropathy. It is also observed that in patients with CAD, the amplitude of high frequency peak is significantly suppressed. PS: Rest in attachment.
Strategic Trimetazidine-Linked FDG PET Pitfall in Young Patient with Suspected Myocarditis

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Background: The normal heart metabolism is dependent on fatty acids supply and oxygen. In contrast, inflammative myocardium is marked as a glucose-rich area regarding the glucose metabolism mostly. FDG PET was subsequently performed after echocardiography and CMR with late gadolinium enhancement in patients with suspected acute myocarditis.

Methodology: Young patient (24 y.o.) was admitted to a cardiologic hospital due to acute non typical angina, dyspnea and breathlessness. Patient was included in the Acute Coronary Syndrome Program and was treated following guidelines. ECG and cardiac injury blood markers (troponin, MB-CK) were assessed at admission. Blood morphology, as well as plasma biochemistry were analysed simultaneously. Because of non diagnostic results of blood test and persistent ECG abnormalities, patient underwent rest CMR with gadolinium. Multiple local areas of late gadolinium enhancement were revealed. To estimate both perfusion and metabolism, PET FDG was done. The intensity of signal was similar in the different areas of the myocardium with a subtle gradient in the areas of the middle layer of the intraventricular septum, when the pre-scanning medical treatment was verified.

Following the recommendations for treatment of acute coronary syndrome patient was treated by beta blocker, statin, ACE inhibitor, dual antiplatelet agents, and trimetasidine at least one week before PET scanning.

Results: There were imaging issues with trimetasidine treatment. Myocardial edema has been attenuated oxygen supply, and trimetasidine could be easy to switch the metabolism in myocardium from fatty acids to glucose. During PET, the area of normal metabolism was barely distinguished.

Conclusion: FDG PET is a method of choice in the diagnosis of acute myocarditis. Neverthe-less, non appropriately prepared patients could be underestimated and stratified for specific treatment. The PET preparement recommendation for cardiologists and physicians, who recommend PET as a top-level diagnostic procedure, should be developed with cooperation of cardiologic society and available in cardiologic sources.
Does the Burden of Coronary Artery Calcium Lead to Impairment in Myocardial Blood Flow Assessed by 13N-ammonia PET/CT?

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Background: Coronary Computed Tomography Angiography (CCTA) technology has been fused with Positron Emission Tomography (PET) to allow simultaneous evaluation of coronary anatomy and quantitative myocardial blood flows (MBF) in a single scanning session, as a noninvasive technique for the diagnosis of coronary artery disease (CAD). CCTA is a well validated imaging modality for the assessment and quantification of coronary artery calcium (CAC), which is a marker of early atherosclerosis. Nevertheless it is not well established the relationship between CAC burden and its repercussion in MBF in patients with non-obstructive CAD. Objective: The aim of this study was to evaluate the relationship between the CAC burden and the MBF measured by Hybrid PET/CT, in patients with non-obstructive CAD.

Methodology: We evaluated 153 (66% men, mean age 61±10 y.o.) patients without a documented history of CAD. They underwent rest-stress 13N-amonia PET/CT and CAC scoring. Obstructive CAD was defined as the presence of atherosclerotic plaques >50% of the lumen, and was ruled out by CCTA.

Results: We categorized the patients in 3 main groups defined by CAC values of 0, 1-99 and >100UA. Our results showed a lack of correlation between CAC score and rest/stress MBF and coronary flow reserve (CFR). In the per-group analysis, we did not find statistical differences among the MBF at rest (median of 0.73, 0.74, and 0.66, p=0.2), at stress (median of 2.07, 2.17 and 2.06, p=0.69) or in the CFR (mean of 2.7, 2.7 and 2.9, p=0.4) with CAC score groups.

Conclusion: In patients without obstructive CAD the burden of coronary artery calcium did not lead to the impairment in the MBF assessed by 13N-amonia PET/CT.
The SPECT-CT Experience of Myocardial Perfusion Imaging in Diagnosis of Coronary Artery Disease (Non-AC vs AC)

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Background: According to 2014 WHO estimates, non-communicable diseases (NCD) are responsible for nearly 60% of total deaths in Myanmar, where cardiovascular diseases are the third main cause of death. According to Yangon General Hospital statistics, 517 of coronary artery disease (CAD) patients were admitted to the cardiac medical unit in 2012, 607 patients in 2013 and it increased to 957 in 2014. The Department of Nuclear Medicine at Yangon General Hospital has been the only center performing Nuclear Cardiology with 99mTc-Tetrofosmin / Sestamibi (MIBI) with Siemens E.Cam Gamma Camera since 2003. A number of Rest-Stress Myocardial Perfusion Imaging (MPI) has been done and ended up with Coronary angiography and intervention. The new Siemens SPECT-CT (SYMBIA T6) was installed in the department in May 2014. 99mTc-Sestamibi (Rest followed by Treadmill stress and/or Dobutamine stress) MPI studies continue in collaboration with Cardiology department of Yangon General Hospital.

Methodology: Seventy-three patients with known CAD have been studied from January 2015 to January 2016. Two days Rest-Stress 99mTc-MIBI SPECT-CT MPI protocol was used. Among them, 40 patients had Treadmill Modified Bruce protocol and 25 patients had Dobutamine Stress protocol and 8 patients had rest only studies, because of recent and severe Myocardial infarction. Two separate doses of 99mTc-MIBI 740 MBq at rest and peak exercise were injected intravenously. SPECT-CT imaging was performed 30 minutes after tracer injection. Images were processed by Siemens Emory ECTB & Cider-Sinai program and interpretations were made by two senior Nuclear Medicine specialists. Image comparison between Non-AC and AC was done and analyzed. 42 out of 73 patients have undergone cardiac catheterization procedure and intervention.

Results: Among 73 patients, 31 patients had severe fixed defect (prior myocardial infarction) and no more intervention was done. 42 out of 73 patients had reversible perfusion defect on SPECT-CT MPI (with AC) and proceed with invasive procedure (PTCA), 2 patients had normal coronary vessel, 27 patients had single vessel disease and 13 patients had two or more vessel diseases (40/42=95%).

Conclusion: SPECT-CT MPI (with AC) has better diagnostic accuracy than SPECT MPI, because of CT attenuation correction and better localization. Although it has better normalization of the defect, a small number of defects become apparent lesions on AC image, causing the false positive outcome. SPECT-CT MPI plays an important role in the diagnosis and management of coronary artery disease in Myanmar.
Case Report: Sternal Osteomyelitis Diagnosed by 18F-FDG PET-CT in a Patient with Suspected Endocarditis

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Background: The diagnosis of prosthetic valve endocarditis is critical because of therapeutic and prognostic implications, but on the other hand, overdiagnosis of prosthetic heart valve endocarditis can represent significant risk of death, considerable morbidity, unnecessary antimicrobial therapy, and excessive costs. Recent studies showed that 18F-FDG PET-CT can contribute to shorten the hospital stay, prevent clinical complications, reduce the cost of hospitalization and diagnoses other clinical conditions, as a different infection site. We report a case of a male, 46 years, IC Profile B, diabetes, ulcer sacral, stroke sequel, previous myocardial revascularization (multivessel) and mitral biological prosthesis (both in 2004), was hospitalized in our institution, with a clinical history of fever, chills and weight loss. Initial echocardiogram showed vegetation of approximately 10 mm in the mitral prosthesis, significant degree of dysfunction and rupture of the posterior leaflet of the mitral prosthesis. After its diagnosis, a surgery for biological mitral valve replacement was performed. In the late postoperative state, the patient presented dehiscence in sternotomy, positive blood cultures (S. epidermidis, E. faecium) and bacteremia without improvement with broad-spectrum antibiotics. When evaluating the possible sites of infection, the main diagnosis became endocarditis. The first study was transesophageal echocardiography that showed biological mitral valve without signs of dysfunction and intracavitary thrombus. The next step was to request PET-CT with 18F-FDG for research endocarditis on biological mitral valve. Patient underwent 18F-FDG PET-CT and preparation included low-carbohydrate and high-fat diet 24 hours before the exam, for significant suppression of myocardial 18F-FDG uptake. The images were acquired one hour after intravenous administration of 18F-FDG in fasting condition and the level of blood glucose pre-injection of the radiopharmaceutical was 117 mg / dl. The tomographic reconstruction was performed in the axial, sagittal and coronal planes. The study evidenced diffuse and heterogeneous FDG uptake in the sternum (SUVmax: 3.3), with hypermetabolic focal areas in the sternal notch, the most evident in topography of sternal diastasis (at the level of the second rib) measuring 5 mm associated with signs bone resorption (SUV max: 5.0), that was suggestive of inflammatory / infectious process in activity. The CT scan, showed small retrosternal fluid collection measuring 2.7 x 1.4 cm. An abnormal FDG uptake was not observed in the topography of native valves and mitral valve prosthesis. The study was negative for endocarditis and suggestive of osteomyelitis activity in the sternum. After elucidating the diagnosis of osteomyelitis and without new evidence of endocarditis, the chosen treatment was debridement and vacuum dressing. A new antibiotic scheme was also given. The culture of the material (stern fragment) showed growth KPC. Despite an initial clinical improvement, a few days after debridement and new antibiotics, the patient presented with clinical and laboratory worsening. Unfortunately, even with intensive support, as expected for a high risk patient, he passed away. In this case, the findings of 18F-FDG PET-CT did not indicated endocarditis, but revealed sternal osteomyelitis and helped to choose the appropriate treatment.
Case Report: Treatment Guided by 18F-FDG PET-CT in Patient with Infective Endocarditis

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Male, 63 years, dyslipidemia, diabetes and personal history of aneurysm ascending aorta and aortic insufficiency important, corrected with Bentall-De Bono surgery, in 2009. Bentall-De Bono procedure is a technique for the combined treatment of diseases of the aortic valve and the segment of the ascending aorta using a valvulated tube in which the coronary artery ostium were reimplanted. Therefore, it is the procedure of choice for the treatment of aortic valve disease associated with the involvement of the ascending aorta. In 2013, this patient was hospitalized in our institution with clinical history of night fever for two months, with chills and sweating, weight loss, lack of appetite, petechiae on the lower limbs and darkened urine. 5 days ago, the patient’s pain started in the left hemithorax with irradiation to left scapula. Initial evaluation showed positive blood cultures (S. epidermidis) and echocardiogram revealed significant thickening of the mitral-aortic junction and aortic valve prosthesis with filamentary image, 3-15 mm. Patient underwent 18F-FDG PET-CT and preparation included low-carbohydrate and high-fat diet 24 hours before the exam, for significant suppression of myocardial 18F-FDG uptake. Images were acquired one hour after intravenous administration of 18F-FDG in fasting condition and the level of blood glucose pre-injection of the radiopharmaceutical was 114 mg / dl. The tomographic reconstruction was performed in the axial, sagittal and coronal planes. The study evidenced severe uptake of FDG with tubular appearance in the topography of the aortic portion (proximal ascending) of Bentall-De Bono prosthesis (SUV max = 5.8) and moderate focal increased glycolytic metabolism in the transition to the aortic prosthesis (SUV max = 3.8) with slight blurring of adipose surrounding planes. These findings were suggestive of infectious process in activity in valvular and vascular topography. An important associate finding was small focal area of moderate FDG uptake (SUV max = 4.1) in a medial focal area hypoattenuating on spleen, suggesting splenic infarction secondary to septic emboli. The final diagnosis acute endocarditis complicated with abscess periprosthetic. The patient evolved to shock cardiogenic and septic, even with improved antibiotic scheme modified after diagnosis. He underwent emergency surgery for aortic valve replacement and postoperative histopathological confirmed 18F-FDG PET-CT diagnosis. The patient presented clinical improvement to treatment and the tranesophageal echocardiography completed on medical release did not demonstrate vegetations. Nowadays the patient is in functional NYHA class I, asymptomatic, with patent prosthesis without clinical dysfunction while maintained on drug treatment.

Conclusion: Infectious processes related to vascular and valvular prostheses are among the most serious complications and the most difficult to treat. Recent studies have shown that the addition of 18F-FDG PET-CT Modified Duke Criteria increases the sensitivity and specificity of the diagnosis of infection related to vascular and valvular prostheses. In this report, 18F-FDG PET-CT was decisive for the correct therapeutic approach to the patient.
Coronary During Comparing Myocardial Computed Calcium Perfusion Tomography Score in Scintigraphy Low Angiography Dose CT vs Performed Dedicated 64-slices

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Background: The calcification of coronary arteries is a marker of atherosclerosis and has been assessed by calcium score (CS). This study intended to evaluate clinical situations where a combined approach of CS and myocardial perfusion scintigraphy (MPS) is useful for the detection of relevant coronary arterial disease (CAD), providing additional diagnostic and prognostic information. Dedicated Coronary Computed Tomography Angiography (CCTA), provided gold standard CS for this purpose. The objective of this study was to evaluate the accuracy of calcium score with low-dose CT during MPS in hybrid SPECT-CT (Symbia T2) comparative with CCTA.

Methodology: We performed an observational, retrospective, unicentric clinical trial. We analyzed the demographic findings, scintigraphy and computed tomography (SPECT-CT), CS in low dose gated CT and 64-slice CCTA of 27 consecutive patients without CAD, from July to December of 2013, MPS rest and stress associated with CT low dose obtained for attenuation correction in SPECT CT Symbia T2 (Siemens), also performing CS and ACT in 64-slice CT (GE) for anatomical detail and CS. The CT was performed gated with current average 80 mAS and cut 5mm thick for low dose CT. The analysis was performed on the CS software Syngo CaScoring ® with Agatston score. The Pearson’s Correlation co-efficient and Fisher exact test were employed for statistical analysis.

Results: 27 patients (20 men) were analyzed without previous CAD mean age 58 (+/- 12 years) and underwent SPECT-CT for the evaluation of CAD and sequential CCTA with 64-slice for non conclusive MPS or clinical suspicion de DAC. In low dose CS, we observed the following distribution of CS in the coronary arteries for patients: (1) zero CS = 11 (40.7%), (2) 1-10 = 5 (18.5%), (3) 11-100 = 5 (18.5%), (4) 101 – 400 = 3 (11,1%), (5) 401 – 1000 = 2 (7,4%) and (6) >1000 = 1 (3,7%), and for CCTA: (1) zero CS = 9 (33.3%), (2) 1-10 = 2 (7,4%), (3) 11 – 100 = 7 (25,9%), (4) 101-400 = 5 (18,5%), (5) 401-1000 = 2 (7,4%) and (6) >1000 = 2 (7,4%). Statistical analysis for Pearson’s Correlation co-efficient was excellent (r = 0.86) demonstrating optimal correlation between both methods. However, when evaluating the low-dose CT of 11 patients with zero CS, only 9 were confirmed with CCTA (p< 0,001 - IC 95%).

Conclusion: The analysis of the CS with low dose CT during MPS is useful and has good correlation with CCTA 64-slice results. When evaluating zero CS, we have 2 cases of false positive (CS 3 and 83 respectively). We conclude that when the low dose CT demonstrates calcium, it is present in reality, but when the desire is to discard the calcification, low dose CT does not offer the same accuracy.
Abstract ID: 157

**Detection of Early Cardiac Metastases by 18-F/FLT PET/CT in a 16-year old Patient with Osteosarcoma**

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A 16-year-old female was admitted to Hospital Infantil Teleton de Oncologia with a 2-month history of a tumor located in left shoulder, with intense pain and limitation for mobility. She had a partial resection in another center, with report of high grade osteosarcoma, which was corroborated here. She was sent for a cardiac routine basal examination. No cardiovascular symptoms were present. At cardiac physical exam, she was with mild tachycardia and a third sound, no murmurs or other positive findings. The electrocardiogram was normal, in sinus rhythm. No cardiomegaly at x-ray. Echocardiogram reported a huge mass adjacent to septal atria, protruding through tricuspid valve to right ventricle. Another mass in right ventricle was noted and dilation of right ventricle. No ventricle dysfunction was found. Basal LVEF 68%.

She was sent with suspicion of cardiac metastases to Instituto Nacional de Cardiologia Ignacio Chavez, where a cardiac MRI was made, adding diagnosis of right ventricular dysfunction. She underwent a successful cardiac tumor resection, finding two tumor clusters on the location echocardiogram described. She had a satisfactory post-surgical period, and went back to our hospital a week later. Pathology corroborated osteosarcoma metastases. Follow up echocardiogram founded no residual lesion, mild left ventricle systolic and diastolic dysfunction, LVEF 53% and right systolic dysfunction. She started carvedilol, and during hyper-hydration for chemotherapy, furosemide and spironolactone. She was asymptomatic and tolerate well chemotherapy. On later echocardiograms, there were no evident tumors, LVEF improved to 60-65% although left diastolic dysfunction and right systolic dysfunction remained, no cardiovascular symptoms were present.

A follow up 99m TC-MDP SPECT was made, finding a possible mass in left ventricle and a lesion near the basal portion of left ventricle, probably pericardium, with no effusions. Oncology founded it not conclusive and a 18-F/FLT PET/CT was performed. It confirmed tumor activity on primary site and spinal, ovary and heart metastatic lesions. Gamma-PET heart lesion coincided. She was sent for another heart MRI to a specialized cardiac center, reporting normal heart, no residual lesions were seen, with maintained function. She is now on palliative chemotherapy, with no cardiac symptoms. Last echo only showed mild diastolic dysfunction, no tumor was observed.

We suggest that PET scan might detect early cardiac metastases, which are not still evident with echocardiogram or MRI, because functional changes precede the morphological ones. In this case there was less soft tissue involvement which might explain too.
18FDG PET/CT Diagnosis of Solitary Heart Metastases from Malignant Melanoma

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**Background:** Cardiac metastases mostly appear in patients with disseminated tumor disease; solitary metastases to the heart are very rare. Metastatic cardiac involvement is usually diagnosed post-mortem since the clinical picture is dominated by generalized tumor spread. The incidence of cardiac metastases has increased in the last decades since aggressive treatment of localized malignant tumors has led to longer survival and paradoxically to a higher probability that patients finally go through diffuse tumor disease.

**Methodology:** A 55-yr male was diagnosed with cutaneous malignant melanoma in the dorsal area. In situ melanoma with negative margins was confirmed by histopathology after local wide resection was performed. Left axillary lymphadenectomy was performed after obtaining a positive fine-needle aspiration from a 22 x 23 mm lymph node. Two out of 11 lymph nodes proved to be positive. Upon referral to clinical oncology for adjuvant therapy an FDG PET/CT scan was ordered to rule out distant metastases.

**Results:** Two solitary discrete foci of abnormal uptake were observed in the distal interatrial septum and in the pericardium adjacent to the left ventricular apex. The former looked like a focal thickening of the interatrial septum in the echocardiogram. Ventricular disynchrony was also evident. An ECG showed very low voltage in all derivations and the echocardiogram.

**Conclusion:** Owing to their high propensity to generalized hematogenous spread, malignant melanomas frequently metastasize to the heart being the tumor with the highest rate of cardiac metastases. These may imitate valvular heart disease or cause cardiac failure, ventricular or supraventricular heart rhythm disturbances, conduction defects, syncope, embolism or pericardial effusion. FDG PET/CT can be useful to diagnose cardiac metastases in a timely manner.
Evaluation of Postinfarction Aneurysm of Left Ventricle Using SPECT-CT

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**Background:** Aneurysm of the left ventricle is one of the most frequent and severe complications of Q-wave myocardial infarction. Incidence rates of the aneurysm in patients who have suffered from ischemic heart disease are estimated between 10% and 35%. The increasing number of surgical interventions due to ischemic heart disease and frequent incidences of different forms of postinfarction left ventricular aneurysm, are leading towards an increased interest in the evaluation of the functional and morphological states of the myocardium.

**Methodology:** We have analyzed 45 patients (all men) with ischemic heart disease, postinfarction cardiosclerosis and with left ventricular aneurysm which were hospitalized in the Institute Heart Ministry of Health of Ukraine between 2012 and 2015. Preliminarily, all patients underwent coronary ventriculography and doppler echocardiography. SPECT-CT scanning was conducted on GE “Infinia Hawkeye” gamma camera using ECG-synchronization by “single day” protocol in the rest. Radiopharmaceutical 99mTc-MIBI was administered intravenously with activity of 555-740 MBq. Patients examinations began in 45 min after radiopharmaceutical injection. Received images were reconstructed using computer program “Myovation” and ECToolbox in sagittal, coronal and axial planes. Visual assessment of left ventricular geometry performed using slices along vertical axis and 3D-mode program. Results of patient examinations were performed using the following algorithm: visual evaluation, semiquantitative assessment and quantitative analysis.

**Results:** In SPECT-CT scans, the left ventricular aneurysm was visualised well enough in all patients as a region with negligible radiopharmaceutical absorption. In all patients with aneurysm of left ventricle, a sharp perfusion decline in the aneurysm localization point was observed with absorption percentage from 5 to 12% (8,2±3,5% in average) with heart geometry disruption. The following was observed:

- In 29 patients (64,4%): homogeneous perfusion decline, pointing to absence of viable heart tissue in aneurysm region and in adjacent segments.

- In 16 patients (35,6%): inhomogeneous decline of perfusion. This can suggest a possible existence of viable myocytes in region of aneurysm. Based on SPECT-CT data of patients with postinfarction aneurysm of left ventricle, most of the cardiac damage has been observed at the apex, frontal wall and at the anterior portion of the interventricular septum (26 patients, 57,8%).

- In 11 patients (24,4%): aneurysm of apex-antero-lateral localization without spreading to septum.

- In 8 patients (17,8%): aneurysm of apex.
Quantitatively, - aneurysms in 8 patients (17.8%) were small and occupied <10% of area (mostly aneurysms of apex); - in 12 patients (26.7%), aneurysms occupied >10% of area (14.5±3.2% in average) - in 25 patients (55.5%), aneurysms were large with undefined outlines and occupied >20% of area (24.3±4.6%).

**Conclusion:** Homogeneous decline of perfusion in aneurysm region, percentage of absorption of radiopharmaceutical between 5 and 12% and disruption of geometry of the left ventricle are the scintigraphic signs of aneurysm of the left ventricle. Functional assessment of postinfarction aneurysm of the left ventricle using SPECT-CT of myocardium is valuable additional diagnostic method to ultrasound examination and coronary ventriculography.
IV. Setting up a nuclear medicine and/or diagnostic imaging facility

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The Effective Value of PET/CT in Diagnosing Cardiovascular Disease and Pediatric Cancer: A Comparative Study

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Background: Combined PET/CT systems have emerged as promising imaging modalities and are being more routinely used in clinical settings. PET/CT is an established entity in the work-up of several oncologic disorders and is making forays in the diagnosis of inflammatory diseases, leading to increased use for cardiac and neurologic applications. Although PET is on the move in cardiovascular medicine and new developments are likely to increase its application and impact in clinical practice, some similarities and interrelationships between its cardiac applications and applications for tumor imaging should be noted. This study aimed to prospectively study the clinical experience with PET/CT in cardiac diseases and in pediatric malignancies to evaluate and compare the efficacy of this imaging system in both diseases, and to determine if it provided additional diagnostic information on the disease status.

Methodology: Thirty two cardiac patients with previous history of myocardial infarction, left ventricular dysfunction and coronary artery disease (CAD) underwent the imaging procedures consisting of PET/CT, echocardiography and invasive angiography. Diagnostic sensitivity of these less invasive modalities for detection of myocardial viability was compared to invasive coronary angiography. Additionally, 54 pediatric cancer patients were included in this study [28 had lymphoma and 26 had soft tissue sarcoma (STS)]. Seventy two scans were performed for whole body in all patients for initial diagnosis and staging.

Results: In the current study, coronary angiography was used as the gold standard. PET/CT has high diagnostic value in the assessment of myocardial viability when compared to echocardiography, and also in malignant disease if distant metastases are detected with regard to staging of the primary tumor. It may influence the treatment decision in both diseases. The diagnostic sensitivity of cardiac PET/CT, cardiac angiography and echocardiography was 98.2%, 93.4% and 82.5%, respectively. Diagnostic sensitivity of PET/CT in myocardial viability at per-vessel based assessment was 80.2% for LAD, 77.6% for LCX, and 100% for RCA. The overall sensitivities, specificities & positive and negative predictive values of the imaging system for all the suspicious sites in pediatric malignancy were 94.22%, 92.72%, 93.68% and 93.33% respectively. The sensitivities and specificities for initial staging of malignant lymphomas were ranged 70%-100% and 90.48%-100% respectively. They ranged 80%-100% and 92%-100% respectively in STS.

Conclusion: This study concluded that the PET/CT is the gold standard for noninvasive functional imaging in cardiovascular disease as well as in pediatric oncology. It has high diagnostic value in the assessment of myocardial viability in patients with known CAD. Technical developments in PET/CT scanning in cancer management may increase the precision of radiotherapy planning and thus improve tumor control and reduce treatment- related morbidity. The use of PET/CT in the management of pediatric malignancy is recommended to facilitate the sparing of normal structures and the escalation of dose. Further studies are recommended in cardiovascular patients for the incorporation of PET/CT into patient management.
Radionuclide Ventriculography Utility in Monitoring Cardiotoxicity Cancer Treatment: Experience in a Cancer Center

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Background: Cancer is a health problem with a high prevalence in the general population. Cardiotoxicity is a significant toxicity from cancer treatment, which requires close monitoring during treatment for early detection and measures for its control. Nuclear medicine methods are necessary for accurate follow-up treatment, showing independent operator advantages compared with ultrasound.

Methodology: One retrospective analysis of a population of 599 cancer patients in early stage cancer treatment was performed without structural heart disease, who underwent ventriculography control. Impairment of ventricular function, defined as ejection fraction (EF) less than 50%, was observed in 52 patients. The evaluation of these patients was completed by performing an ultrasound scan (echocardiogram). The analyzed information obtained from demographic data, previous history of cardiovascular disease, cardiovascular risk factors, type of cancer treatment received correlated with data obtained studies of ventricular function by echocardiography and VTG.

Results: Of the total patients were evaluated with VTG (599p.) 52 p. Fey had values of less than 50%, equivalent to 8.67% of all study patients who began treatment for cancer. This population had an average age of 53.035 years; 71.2% were female. Main cancers in decreasing order were: breast (69.2%), lung cancer (9.6%) and renal cancer (7.7%). The prevalence of risk factors presented included: smoking (36%), hypertension (26%), dyslipidemia (26%), and diabetes (5.8%). History of cardiovascular disease: myocardial infarction (5.8%), angina (5.8%), peripheral artery disease (3.8%). Prior revascularization rate was 1.8 and 5.8% had percutaneous angioplasty. As for the non-surgical treatment for cancer, 94.2% had chemotherapy and 48.1% had radiotherapy. 78.8% received chemotheraphy with anthracyclines and 48.1% received monoclonal antibodies. 9.6% of patients had symptoms and signs of heart failure. In the assessment of ejection fraction by: VTG = arithmetic average of 45.22 with a standard deviation of 3.7 Echocardiogram = arithmetic mean with a standard deviation 48.27 5.42 Correlation coefficient between the two methods = 0.8620 significance level of p <0.0001 Paired samples t-test mean difference 3.0192

Conclusion: A low prevalence of impaired ventricular function was observed in cardiotoxicity. The prevalence of coronary risk factors was slightly low. A tendency to associate further deterioration of the function with female combined regimen of anthracycline monoclonal antibodies and radiation was observed. Suitable linear correlation between the values obtained by VTG Fey and observed by echocardiogram. Based on the analysis of the Bland- Altman, an average of 3 points higher difference in the values obtained by echocardiography. It is observed that there is greater reproducibility of the method with VTG involvement with more uniform values in the results. They can not be obtained conclusive results to be but an observational study findings suggest that allow non-inferiority radioisotopic method with respect to ultrasound observed.
Cardiac Nuclear Medicine in Paraguay: An Effective and Affordable Intervention From the Public Health in Prevention and Treatment of Noncommunicable Chronic Diseases


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Background: According to the World Health Organization (WHO), cardiovascular diseases (CVDs) are the main cause of death in the world among non-communicable diseases. In particular, low and medium income countries are affected disproportionately, as more than 80% of cardiac deaths are produced in these countries and affect men and women equally, with expectations that by 2030, more than 23 million people will die from CVDs (1). Publications of the International Atomic Energy Agency (IAEA) show that a decrease of CVDs has been observed in developed countries due to the introduction of cardiac prevention strategies using gammagraphy nuclear imaging, particularly in terms of secondary prevention. The fact that a substance can be labeled, studied and localized in the organism, and its uptake degree quantified (2, 3) in nuclear cardiology is clinically useful for the diagnosis of acute (detection of the vulnerable plaque) and chronic (assessment of viability and myocardial denervation) coronary diseases (4, 5, 6) as well as in cardiac sarcoidosis, post-transplant rejection and even in the acute aortic syndrome. Nuclear cardiology has the unique capacity of “predicting the future” for people at risk of CVDs (7). In the same way, the causes of death by non-communicable diseases are led by cardiovascular pathologies in Paraguay and among them, ischemic heart pathology (8). These high mortality rates do not only represent a burden for the people, families and communities but also obstruct the socio-economic growth of low income countries. The actions and interventions necessary to integrate the management of these chronic diseases are among the public health priorities in the world and are urgent (9, 10).

Methodology: Paraguay has the unique possibility of offering a public level service in the area of diagnosis by Nuclear Medicine in the facilities of the Instituto de Investigaciones en Ciencias de la Salud (IICS) which has a modern infrastructure that follows national and international guidelines of radiologic protection. Apart from this, the qualification of human resources abroad and the donation of a SPECT (Single-photon emission computed tomography) gamma chamber (11) were achieved through several national and regional projects of technical cooperation of the IAEA.

Results: After several efforts to implement the service, it is attempted to obtain the maximum benefit. Initially, the service was centered in its diagnostic application addressed to the pathologies prevailing in the country like the thyroid pathologies and bone metastasis.

Conclusion: Currently, the IICS is strengthening bonds with the Ministry of Public Health and Social Welfare and, along with the IAEA through the strengths obtained, acts as an institution that train new human resources and establish a diagnostic and prognostic service for cardiovascular pathologies apart from strengthening bonds at public health level in order to face the main health problems with great impact on the population.
Flow Mediated Vasodilation (FMD) Carotid Intima Media Thickness (IMT) for Evaluating Endothelial Dysfunction in Patients with Coronary Artery Disease


Background: Flow mediated vasodilation (FMD) of the brachial artery following transient occlusion is almost exclusively mediated by the nitric oxide. Dysfunction of the endothelial cells is a systemic process and the most important initiating event for atherosclerosis. Abnormal coronary endothelial function may precede the development of angiographically evident coronary plaque and predictive of cardiovascular events. Common carotid artery Intima Media Thickness (IMT) and plaque evaluation may represent a complementary predictive tool for detection of cardiovascular diseases.

Methodology: Forty four patients (Age: 53±12 yrs, Male: 37 patients) with different forms of coronary artery disease on coronary angiography were evaluated in the Institute of Nuclear Medicine and Allied Sciences, Dhaka and Department of Cardiology, Dhaka Medical College Hospital during the period of January 2015 through Dec 2015. Brachial arterial endothelial function was assessed by using Toshiba Nemio 30 ultrasound machine with high frequency vascular transducer (5.5-7.5 MHz), which measured the percentage of flow mediated vasodilation (% FMD). Initially normal diameter of the brachial artery was measured, the artery was occluded with the cuff of blood pressure monitoring machine and raised systolic blood pressure by 60 mm Hg after full obliteration of radial pulse, it was kept for 5 min. After full releasing the pressure cuff arterial diameter was measured, and 10% increasing diameter was designated as normal. Throughout the procedure the transducer was placed in the same position. Both common carotid arterial IMT was evaluated through the same vascular ultrasound machine and IMT was measured in the distal part of the artery and within 2.5 cm from the carotid bulb. Measurements were taken at the end of systole and definitely from the distal wall. IMT of 0.8 mm was considered as normal. Subsequent three readings were taken and maximum values were recorded for data analysis.

Results: The mean diameter of the carotid and brachial artery were 7 ± 1.5 mm and 5 ± 0.5 mm respectively. The mean % change of FMD was 4.67 ± 4.91 and the mean carotid arterial IMT was 1.19 ± 0.27 mm. The carotid arterial IMT and % FMD measurements showed statistically strong correlation (p<0.00001), demonstrating that lower % change of FMD values corresponded to an increased carotid IMT. More interestingly two patients showed reduction of brachial arterial diameter rather than increasing diameter after releasing the pressure cuff and both of them had triple vessels coronary artery disease. Most of the patients did not feel intolerable pain or discomfort in their hands during the procedure.

Conclusion: Strong correlation between carotid IMT and % change of FMD demonstrates a concomitance of anatomical and functional vascular alterations in coronary artery disease, regardless of the severity of the atherosclerotic lesions. Combination of both of these noninvasive and cost effective imaging modalities may play very important role for evaluating endothelial dysfunction that would be helpful for prevention of upcoming coronary events in such a developing country.
Abstract ID: 171

**A Comparison of Patients’ Tolerance and Side Effects: Dobutamine versus Dipyridamole Stress Myocardial Perfusion Imaging**

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**Background:** There is a high prevalence of CAD among the Mauritian population, essentially because of high local prevalence of Type 2 Diabetes. Traditionally, patients were diagnosed for CAD mainly by ECG, physical stress test, cardiac ultrasound, biochemistry and clinical assessment. In early 2014, at the Nuclear Medicine Department of J. Nehru Hospital, Rose Belle, Mauritius. Pharmacological cardiac stress test using Dipyridamole was introduced and it was a major breakthrough in the management of patients. By the end of year 2015, dobutamine stress test was then started. Aim: This study aimed to compare the major side effects and their possible complications from our patients by these two pharmaceuticals.

**Methodology:** Two batches of patients (each batch of 50 patients) were studied during their pharmacological stress test and side effects were recorded. In one group dipyramole was used whereas in the other group dobutamine was used. A resting ECG was performed in all subjects prior to stress test. The pharmacological agent used in the test was Persantine ® (dipyridamole), with doses calculated by the formula 0.56mg/kg, administered intravenously over 4 mins, with a maximum of 40 mg. All doses were diluted with normal saline up to a volume of 20 ml. In the other case dobutamine was infused incrementally starting at a dose of 5-10 mcg/kg/min, which was increased at 3 mins interval to 20, 30 and 40mcg/kg/min. Doses were diluted with normal saline. During administration of both pharmaceuticals patients were encouraged to perform light physical exercise (movement of extremities). Blood pressure and ECG patterns were closely monitored. Only patients who were physically compromised and with normal vitals were qualified to undergo pharmacological stress MPI.

**Results:** Common side effects were recorded and compiled hereunder:

**Dipyridamole (persantine):**
- Palpitation: 0%
- Chest Pain: 64%
- Headache: 52%
- Dyspnea: 10%
- Ventricular Arrhythmia: 0%
- Dizziness: 20%
- Hypotension: 2%
**Dobutamine:**
- Palpitation: 24%
- Chest pain: 28%
- Headache: 16%
- Dyspnea: 18%
- Ventricular Arrhythmia: 20%
- Dizziness: 0%
- Hypotension: 0%

Please see Bar Chart.

**Conclusion:** Dipyridamole was found safer than dobutamine although patients complained of minor side effects with the former agent. Even when patients complained of side effects in the case of dipyridamole, aminophyline was readily available and given intravenously (with a minimum of 125mg, eventually escalating the dose to 250mg) 4 minutes after injection of radiotracer, with a slow administration technique, to reverse the side effects. Good and quick response was observed with aminophyline. On the other hand, dobutamine was found to be well tolerated by most patients but certain frequent cardiac side effects were noted mainly ventricular arrhythmias which can be more challenging to manage if condition deteriorates. Hence, unless contraindicated, dipyridamole is our agent of choice in performing pharmacological stress MPI in our department, although it is higher in costs.
Cardiac Nuclear Imaging in Mauritius in the Absence of PET and Hybrid Nuclear Imaging Facilities

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**Background:** The advent of industrialization in Mauritius in the early 1970’s shifted the burden of disease from infectious to non-communicable diseases namely type 2 diabetes, arterial hypertension & coronary artery disease (CAD). However, in spite of the steady rise in the incidence of CAD among the population, the medical management for both, therapeutic and diagnostic, was quite rudimentary including only conservative treatment after diagnosis based on clinical, ECG and biochemical reports. In 1986, the first coronary angiography was performed and from then onwards, it remained the exclusive diagnostic method for CAD until the launching of myocardial perfusion imaging studies at the Nuclear Medicine Department in 2003 under the coaching of IAEA experts. Actual imaging facilities: The department has (1) A single-head SIEMENS gamma camera (E-CAM) (2) A dual-head MEDISO gamma camera (Nuclide) Imaging studies performed: (1) Gated/non-Gated stress/rest Tc99m Sesta-MIBI SPECT Myocardial Perfusion Imaging scans, Physical (Treadmill), Pharmacological (Dipyridamole, Dobutamine) (2) Multi-Gated Acquisitions (MUGA) scans for assessment of LVEF and myocardial contractility.

Evolution of our services: The contribution of Nuclear cardiac imaging has unquestionably been of great value to cardiologists for the better management of CAD. Although issues were encountered at the beginning, our imaging studies quickly gained in confidence and is today a well established diagnostic asset for cardiologists for: (1) Initial diagnosis in case of -Inconclusive cardiac stress tests. -Physically compromised patients not eligible for physical stress test. (2) Assessment of viability of myocardium prior to invasive or surgical interventions. (3) Objective evaluation of LVEF in patients with Cardiac failure. (4) Cardiac assessment of post-chemotherapy patients. Graphical representation of cardiac nuclear imaging studies in the Department (2001-2015) as attached file.

Future perspectives: In view of the increasing prevalence of CAD, the Department is striving to meet up with the challenge of a heavier workload. This includes the acquisition of (1) a Cadmium Zinc Telluride (CZT) camera which by providing better image definition and faster image acquisition will help to tackle the increasing backlog of referred patients for MPI. (2) PET-CT cardiac imaging. (3) use of other Radio-tracers and Pharmacological stressing agents, such as thallium, adenosine, regadenoson etc.

**Conclusion:** The advent of Nuclear Imaging Technology in Mauritius in 2001 and the introduction of cardiac nuclear imaging studies as a well established service offered by our Department (the only Nuclear Medicine Department on the island) has been a valuable asset. And if given the opportunity to develop further its infrastructure and human resource capacity, we will hopefully attain the golden standard in the diagnosis and management of coronary artery disease in Mauritius.
Establishment of first Nuclear Cardiology Set-Up in SWAT-Northern Pakistan

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Swat a remote valley in northern Pakistan with a population of about 2.5 million, was deficient in nuclear cardiology facility. Considering the acute nature of coronary heart disease, immense problems were faced by cardiac patients referred to big cities for Nuclear Cardiac Studies. We took an initiative to establish a nuclear cardiology set-up in Swat Institute of Nuclear Medicine, Oncology & Radiotherapy (SINOR). The concept of Nuclear Cardiology was new to the town, and its introduction as a new diagnostic modality in a remote area was an uphill task, in terms of logistics, capacity building of human resource and confidence building of referring community. In first phase the logistic requirement were fulfilled to meet the national & international standards. For this purpose a Dual Head Gamma Camera, Treadmill with stress ECG/BP monitoring equipment were installed and a fortnightly contract of MO/Tc-99m Generator and MIBI kits supply was initiated with Isotope Production Division (IPD), of PINSTECH Islamabad. In second phase Doctors, technicians and supporting staff of the Institute were trained in Nuclear Cardiology Protocols, ECG and Advance Cardiac Life Support System by senior nuclear physicians and cardiologist. Since our start in 2013, we have conducted more than 300 cardiac studies on various standard protocols and the confidence of referring physician is ever increasing.
V. Radiopharmaceutical production using cyclotrons and radionuclide generators - including good manufacturing practices and quality assurance aspects - with special reference to imaging agents for CVDs

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Production of Copper-62 PTSM Perfusion Agent Using Copper-62/Zinc-62 Radiopharmaceutical Generators in Iran

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Background: The use of short-lived copper radionuclides such as 64Cu & 62Cu has advantages for clinical positron emission tomography (PET) applications, including lower radiation dose to patients and serial imaging capability. In this work the zinc-62/copper-62 generator system has been evaluated as a potential PET radionuclide generator system.

Methodology: Copper-62-pyruvaldehyde-bis (N4-methyl thio semi carbazone) (62Cu-PTSM) is being prepared with different 62Zn/62Cu generators as potential marker of myocardial perfusion. These high yield generators which produce 62Cu (t1/2 = 9 min) from a longer-lived parent (62Zn, t1/2 = 9.3 hours), now provide a practical means of producing 62Cu- radiopharmaceutical in hospitals on-site. The Quality Control tests were performed for both generators and 62Cu-PTSM radiopharmaceutical as well.

Results: The results show that the eluted copper-62 and the final radio pharmaceutical have the radiochemical purity more than 99.99 %

Conclusion: due to the high content of radioactivity of the homemade generators they can be easily shipped to the PET Centers and 62Cu-PTSM has potential for use in clinical PET studies as a unique short life source of radiopharmaceutical in myocardial perfusion imaging.
F-18 FDG PET Tracer Production for Cardiovascular Applications at Siriraj Hospital by F300E SUMITOMO Module

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Background: Decision making in revascularisation for patients with known coronary artery disease (CAD) is based on coronary lesion severity and myocardial viability. In the Division of Nuclear Medicine, Siriraj Hospital, approximately 300 myocardial perfusion SPECT imaging (MPI) using Tc-99m sestamibi or Tl-201 are done each year. It has been known that either Tc-99m sestamibi or Tl-201 uptake underestimates myocardial viability in comparison to F-18 FDG PET. Therefore, patients with moderate and severe defects at rest MPI may benefit from additional metabolic PET imaging using F-18 FDG in differentiating between myocardial hibernation and scar prior to final therapeutic decision.

Methodology: The cyclotron used in Siriraj Cyclotron Center is HM-20S model, proton and deuteron beam (Sumitomo Heavy Industries, Ltd., Tokyo, Japan). The typical F-18 production uses proton beam energy of 20 MeV with a beam current approximately 50-100 mA. O-18 enriched water (3.5 mL) is loaded in the F-18 target chamber. The amount of F-18 which can be produced from a 15 minute-irradiation is about 1.2 Ci. The radiosynthesis of F-18 FDG starts with the production of F-18 fluoride in a cyclotron. After cyclotron production of F-18 using proton beam irradiation of O-18 enriched water via 18O(p,n)18F reaction, the irradiated O-18 enriched water is then transferred from the target site to the F300E FDG synthesizer module (Sumitomo Heavy Industries, Ltd., Tokyo, Japan) in the hot laboratory to proceed for F-18 FDG production.

Results: The FDG synthesis time for this module is about 25 minutes. After purification process, the radiochemical purity is more than 95% with approximately 60% yield (cor-rected to EOB). All radiolabelling processed are performed according to the United States Pharmacopeia.

Conclusion: The F-18 FDG radiopharmaceutical agent can be produced by F300E Sumitomo module with a high yield and very high radiochemical purity. This PET tracer will have a promising role in further appropriate management of CAD patients in our hospital, apart from its well accepted role in oncology.
Synthesis and Biological Evaluation of $^{68}$Ga-AMD3100 as a Possible PET Imaging Tracer for Cardiovascular Disease

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**Background:** The role of CXCR4 receptor as therapeutic targets in cardiovascular disease was investigated. The AMD100 as a familiar antagonist to CXCR4 is contributed in recovery of defects in myocardial infarction. Noninvasive targeted-CXCR4 SPECT and PET imaging to determine cardiovascular disease may be identified regional CXCR4 upregulation in some of the cardiovascular disease. We report the development of radiolabeled CXCR4 tracer to follow cardiovascular diseases.

**Methodology:** $[68]$Ga-labeled$^1$-[1,4-Phenylenebis(methylene)] bis-1,4,8,11-tetraazacyclotetradecane ($[68]$Ga-AMD3100) was prepared using generator-based $[68]$GaCl3 and AMD-3100 for 15 min at 60°C.

**Results:** Radiochemical purity: >99% ITLC/HPLC, specific activity: 50-60 GBq/mmol in acetate buffer. Stability of the radilabelled complex was investigated in fresh human serum (37°C) up to 2h. For survey of biodistribution studies, the radiolabelled agent was administered to wild-type mice and was followed up to 2h.

**Conclusion:** Our previous study on $^{67}$Ga-AMD3100 and recent study on $^{68}$Ga-AMD3100 would be introduced to the new series of radiolabeled tracer to CXCR4 for prognosis and following of cardiovascular defects based on CXCR4 through noninvasive SPECT and PET imaging methods. Key words: Cardiovascular disease, $^{68}$Ga-AMD3100, CXCR4
Enhancing the Bioavailability of 99mTc-MIBI in Myocardial Perfusion Imaging by Utilizing the Pheroid® Technology Drug Delivery System

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Background: In Africa, cardiovascular disease (CVD) is the second most common cause of death (11% of total deaths) and it is estimated that the incidence of CVD will double by the year 2020. Developing countries are markedly more affected by CVD due to higher disease risk (caused by dietary factors) and limited access to health care. A substantial number of casualties from CVD are prevalent in the working age group of the African population, further contributing to economic strain due to the loss in the productive work force. This presentation is focused on radiopharmaceutical production where an established radiopharmaceutical is optimized by formulation in a drug delivery system that alters bioavailability and pharmacokinetic characteristics. The Pheroid® drug delivery system is a unique micro- or nano-emulsion produced by an environmentally safe and inexpensive manufacturing process from non-toxic ingredients. When the radiopharmaceutical is entrapped in the Pheroid® vesicles during manufacturing, higher levels of the radiopharmaceutical reach the target site upon administration.

Methodology: The 99mTc-MIBI formulated in Pheroid® was compared with the standard formulation in Sprague Dawley rats. The animals were sacrificed 2 hours after receiving either the control or test formulation. Organs were harvested and the distribution of the radiopharmaceutical was determined by counting the activity present in each organ (Scintispec Well Counter) and expressing the results as % of injected dose per gram of organ (%ID/g).

Results: It was revealed that the intravenous administration of 99mTc-MIBI entrapped in Pheroid® vesicles resulted in an increase from 1.52 %ID/g (in the standard 99mTc-MIBI injection control group) to 4.56 %ID/g of administered dosage present at the myocardium (Table 1). This radiopharmaceutical composition therefore may allow for a reduction in dosage administered which will reduce the exposure of the patient thereby adhering to ALARA. The cost associated with myocardial perfusion imaging can also be lowered by a significant margin if the dosage is reduced, making this service available to more patients. Alternatively the amount of activity in the heart may provide clearer, higher resolution images. In preparation of a planned first in human study, further in vivo animal work was performed to optimize the formulation for safe intravenous use (particle size and sterility) and to provide quality assurance standards.

Conclusion: Future work include a first-in-human study (hybrid phase I/II trial) on 16 patients at Steve Biko Academic Hospital, South Africa (planned for 2017) to prove clinical feasibility of this invention in clinical practice. Drug carrier systems are used frequently in the pharmaceutical industry to optimize established drugs. This area of research is however largely unexplored in nuclear medicine and this patented application of Pheroid® technology has potential to improve the characteristics of SPECT and PET agents already in clinical use.
Capacity-building for in-house Development of Cardiac SPECT/CT and PET/CT Imaging Radiopharmaceuticals in Pakistan

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Background: According to World Health Organization (WHO) data, the number of deaths due to cardiovascular diseases (CVD) globally and especially in low-income countries including Pakistan, is increasing very rapidly. The aim of this study is to present current status of Good Radiopharmacy Practice related to SPECT/CT and PET/CT imaging of cardiovascular diseases (CVD) in the country.

Methodology: In Pakistan, we perform the myocardial perfusion studies by 99mTc-sestamibi on SPECT/CT with locally produced Lyophilized Sestamibi kits (PIN-SCAN, 99mTc-MIBI kits, etc.), and perfusion-glucose metabolism imaging with 18F-FDG on PET/CT with our on-site cyclotron at INMOL, Lahore. Radiolabeling is carried out by adding a sufficient amount of sterile, non-pyrogenic, oxidant-free sodium pertechnetate (99mTcO₄⁻) eluate from the 99Mo/99mTc generator to the kit vial and heating the mixture in a boiling water bath for 10 min, followed by cooling at room temperature for 15 min. Quality control is performed by using acetone and saline as mobile phase while ITLC/SG plates as solid support. Perfusion-glucose metabolism imaging is performed on PET/CT by using 18F-FDG which is produced by using our on-site 16.5 MeV GE cyclotron, GE MX chemistry synthesis modules and consumables from Advance Biochemicals (ABX), Germany. Quality control parameters of 18F-FDG are assured according to US pharmacopoeia. Due to excellent image quality of PET/CT in absolute quantification of myocardial perfusion with 13N-ammonia, we are in a process of configuring 13N target in cyclotron to produce on-site 13N-ammonia by 16O(p,n)13N reaction.

Results: After radiolabeling and reduction of 99mTc with stannous ions, sestamibi forms a stable complex with radiometal through isonitrile groups. Isonitriles are actually volatile and unstable compounds, so MIBI is developed in stabilized form as copper tetrafluoroborate adduct - [Cu(MIBI)₄]BF₄, which is decomposed during radiolabeling carried out at elevated temperature. Regarding quality control, in saline as mobile phase, we get Rf for 99mTc-MIBI = 0, Rf for 99mTcO₄⁻ = 0.85–1.0 and Rf for 99mTc-reduced/ hydrolyzed = 0.0; while in acetone, as mobile phase, we get Rf for 99mTc-MIBI = 1.0, Rf for 99mTcO₄⁻ = 0.45–0.55 and Rf 99mTc-reduced/ hydrolyzed = 0.45–0.55. For quality control and quality assurance of 18F-FDG, we follow limits as prescribed in US Pharmacopoeia, e.g., pH of product 4.5 – 7.5, Radiochemical purity >95%, Half-life 105 – 115 min, Chemical purity – Kryptofix <0.05 mg/ml, Residual solvents (Ethanol: 0.5g/100ml, Acetonitrile: 0.04g/100ml and Acetic acid: 0.3571g/100ml), Endotoxins <2.5EU/ml and pressure in Filter Integrity Test >50 psi.

Conclusion: From above figures and facts, it can be concluded that in Pakistan, in-house developed cardiac radiopharmaceuticals under GMP environment are successfully applied in cardiac SPECT/CT and PET/CT imaging to handle cardiovascular diseases and planned to be further strengthened in near future.
VI. Issues of medical physics, instrumentation and image processing and analysis

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Cardiac SPECT Imaging Procedure: Computer Simulation

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Background: Myocardial perfusion SPECT imaging (MPSI) plays a key role in diagnosing cardiovascular disease and, at the moment, MPSI is one of the most widely performed diagnostic procedures. Worldwide, 15-20 million myocardial perfusion imaging procedures are performed annually and numbers of the imaging procedures are projected to continue to grow. While there are apparent advances in myocardial perfusion SPECT imaging, this diagnostic method is now one of the largest contributors to medical radiation burden on the population in developed and developing countries. During the past several years, the need to reduce radiation has become a central issue in cardiac imaging.

Methodology: In the present paper, we will focus on software solutions of this problem. In clinical studies, the improved OSEM algorithms with resolution recovery have demonstrated a potential to decrease SPECT acquisition time, injected radioactivity, or both. However, MPI is a complex process and comprehensive studies are needed for effective optimization in accordance with ALARA principle. This requires attention to the peculiarities of the anatomical structure of patients and to all of the steps involved in SPECT image formation because artifacts can arise at any step. Such studies can be efficiently performed using computer simulation method. The simulation method has a great potential in studying various factors affecting the image quality with reduced count statistics including specific patient anatomy. We designed a phantom of Tc-99m distribution in a patient body (Mathematical Torso Model - MTM-1) corresponding myocardial perfusion SPECT procedure. Projection data (planar images) were generated with the standard and reduced count statistics. Reconstructions were performed using standard OSEM and an improved Maximum a Posteriori Entropy-based (MAP-ENT) algorithms.

Results: The results on computer simulation of a myocardial perfusion SPECT procedure using OSEM and MAP-ENT reconstruction algorithms are presented. The effect of high liver uptake as a potential artifacts source for reduced dose was studied.

Conclusion: A comparative analysis of reconstructed images has shown an advantage of the MAP-ENT algorithm in simulation of protocol with the reduced radiopharmaceutical dose.
Abstract ID: 37

Modernization of Gamma Cameras

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**Background**: Nuclear Medicine is a diagnostic specialty of functional-molecular imaging type and to a lesser extent therapeutic; employing for such purposes, different types of radioisotopes in the form of open source. For these studies it’s essential to use medical Imaging, as this facilitates the early detection of oncological disorders and the treatment of them. A device of key images to the endocrine and oncological diagnosis is the Gamma Camera (G.C.) The G.C. is a device that allows nuclear medicine studies by intravenous injection or inhalation, of radioactive substances in quantities scientifically harmless proven to the body. The G.C. existing in developing countries are becoming obsolete in the technological aspect; in many of these countries, there are only semi-digital or analog systems. The disadvantage of upgrade these computers because of the high cost thereof is presented. The Facultad Politécnica UNA, has an inoperative G.C., which was donated by the Instituto de Investigación en Ciencias de la Salud (IICS -UNA), which is intended for use in laboratory practices. It is intended to conduct a comprehensive survey of the current situation of the device, in order to diagnose the real problem you have and raising the solution through low-cost microcomputers with acquisition cards interconnected by local area networks; and designing a new connection interface to achieve the G.C. is again operational.

**Methodology**: The project methodology is based on experimental study, through the development and testing. The developed system consists of an electronic card, which captures the XYZ coordinates, of G.C. used for the project. Said plate allows the digitization of analog signals, which are sent to a standard personal computer, which performs the image processing using the developed software. The software developed, allows processing and reactivating each study obtained with the G.C. and quantify semi-automatically values and curves. All studies were performed with pin hole collimators. To validate the system, the same studies were carried out with an actual G.C. and with similar equipment, currently operating, in another diagnostic center.

**Results**: This project arises from the ongoing need for public and private services of diagnoses and treatments in oncology; the same at country level have few facilities to perform the necessary studies. Currently is being implemented in testing phase and facilitates access to people from different social strata for the diagnosis of diseases through nuclear medicine, because public health services are deprived of such equipment for diagnostic studies, which will be of great benefit for the prevention and treatment of oncological diseases.

**Conclusion**: It’s possible to reactivate a nuclear medicine service, through the development of a system that allows upgrade a old generation gamma camera; through the development of a signal acquisition system for G.C. Also to design and develop software’s for image processing, and facilitate access to diagnostic to low-income patients with oncology and endocrinial diseases, through nuclear medicine.
Abstract ID: 79

**Fully Automatic Ascending Aorta Segmentation From Multi-Modality Images Using a Proposed Features Model**

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**Background:** Cardiac vessels segmentation is one of the hot topics in current research due to its importance for non-invasive diagnosis of cardiovascular diseases. For cardiologists, inspecting the vascular structures is of very high importance to assess patient’s cardiovascular risk. Current developmental techniques in imaging modalities including CTA (Computed Tomography Angiography) and PC-MRI (Phase-Contrast Magnetic Resonance Images) has brought attention to the possibility for non-invasive assessment for CAD (Coronary Artery Disease) patients. In this paper, we will focus on segmenting the beginning of the cardiac tree which is the ascending aorta beginning from the aortic arch down to the ostia points (from which the coronaries emerge); from both CTA and PC-MRI images. Our main objective is to achieve accurate segmentation of the ascending aorta to help in multiple further processing; as for CTA images being able to determine the ostia locations that reside at the lateral sides of the segmented ascending aorta will lead to an efficient automatic seeding for heart coronaries segmentation. And for PC-MRI images; the accurate segmentation of the ascending aorta helps quantify blood flow for assessing the cardiovascular system looking for suspected diseases.

**Methodology:** This paper presents a novel approach for the automatic segmentation of the ascending aorta. The novel approach is an algorithm that works without the need for setting manual seed points or applying preprocessing like bone removal, heart region isolation or setting a region of interest. Instead, the proposed algorithm automatically detects and segments the ascending aorta using an aorta features model that is built based on the anatomical characteristics of the ascending aorta. These features present the geometric shape, size, spatial location among the organs and intensity characteristics of the ascending aorta.

**Results:** The proposed segmentation methodology begins with aorta detection through features model fitting augmented with Hough transform, where the ascending aorta is identified from the descending aorta and any other circular structures based on the proposed features model. After detection, the whole ascending aorta is segmented up from the aortic arch down to the ostia points using a novel automatic seeded region growing approach. The proposed algorithm has three main advantages: 1) Its fully automatic i.e. no user interaction needed, 2) real-time performance even with large datasets, 3) robust since parameters values are the same for all the tested datasets. The proposed algorithm is tested and validated on the Computed Tomography Angiography database provided by the Rotterdam Coronary Artery Algorithm Evaluation Framework and Phase-Contrast Magnetic Resonance Images acquired using 1.5 Tesla - MRI scanners, for a five volunteer patients, containing overall time frames of ninety time frames.

**Conclusion:** The detection and segmentation of the ascending aorta succeeded in all the test cases acquired from the two imaging modalities; proving the robustness of the features model and the proposed algorithm in the automatic segmentation process even on data from different modalities and different scanner types.
Deep Inspiration Breath Hold Techniques (DIBH) Based on 3DCRT to Reduce Heart and Lung Dose for Left Breast Cancer with Custom Made Respiration-Monitoring Device Using LPT System

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Abstract ID: 160

Background: Radiation treatment to the left breast is associated with increased cardiac morbidity and mortality. The deep inspiration breath hold technique (DIBH) can decrease radiation dose delivered to the heart and lung. Deep Inspiration Breath hold, utilizing a respiration-monitoring device by using LPT system has been used in our clinic to reduce cardiac dose and lung dose for patients receiving left-sided breast irradiation compared to free breathing (FB).

Methodology: Between July and October 2015, a total of 10 patients with left-sided breast cancer underwent two computed tomography scans each with the DIBH using LPT system and using FB after mastectomy. The scans were retrospectively re-planned using standardized criteria for the purpose of this study. Treatment plans were generated by 3DCRT technique. The DIBH plans for each patient were compared with FB plans using dosimetric parameters.

Results: All patients were successfully planned with the DIBH technique using LPT system. Significant differences were found between the DIBH and FB plans for mean heart dose (4.49 vs. 5.95Gy, p=0.009), heart V30 (4.74 vs. 6.82 %, p=0.006), V20 (6.41 vs. 9.12 %, p=0.004), and mean left anterior descending coronary artery (LAD) dose (20.39 vs. 24.93Gy, p<0.001). The mean left lung dose (8.18 vs. 9.29Gy, p=0.001) and lung V20 (20.26 vs. 21.82%, p=0.1366). There was no significant difference in the mean left lung dose, mean right lung or mean dose to the contralateral breast.

Conclusion: This study reports that the use of the DIBH technique using LPT system in breathing adapted radiotherapy for left-sided breast cancer is easily feasible in daily practice and significantly reduces the radiation doses to the heart, LAD and lung, therefore potentially reducing cardiac risk.
Comparison of Imaging Performances of Cardiac Dedicated Ultrafast Solid State SPECT Camera with Conventional Dual Detector Rotating SPECT Camera in a Phantom Study

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Background: Myocardial perfusion imaging (MPI) has been widely used in clinical practice because of its well-documented value in the diagnosis and prognosis of coronary artery disease (CAD). The new cardiac dedicated ultrafast cameras with cadmium–zinc–telluride (CZT) solid state detectors and multiple-pinhole detector design combining with innovation in reconstruction software allows significant improvement in sensitivity of the cardiac cameras. The aim of this study is to compare imaging performances of cardiac dedicated ultrafast CZT (CDU-CZT) camera with conventional cardiac dedicated dual head SPECT (CD-SPECT) camera.

Methodology: An anthropomorphic cardiac phantom was used to simulate rest cardiac Tc-99m Sestamibi (MIBI) studies. Myocardial space of the phantom was filled with 12.8 MBq Tc-99m and ventricular cavity was filled with 0.74 MBq Tc-99m. An empty space (2x1.5x0.5cm) which simulates myocardial perfusion defect was placed inside the myocardial cavity. Images was taken with CDU-CZT SPECT camera (GE Discovery NM 530c) and conventional CD-SPECT camera (GE Optima). Imaging performances of the cameras were compared in different acquisition times or activities. Images were acquired with CDU-CZT SPECT camera for 1.5, 3, 6 and 12 min. and with CD-SPECT camera for 6 sec/frame (3min), 11 sec/frame (6 min), 23 sec/frame (12 min) and 45 sec/frame (24 min). Defect detectability, image quality and image contrast were evaluated both visually and quantitatively for each set of images.

Results: While defects were discernible with the CDU-CZT SPECT camera even at 1.5 min images, it was not detectable until to 45 sec/frame (total 24 min. acquisition) with conventional CD-SPECT camera. Image contrast and quality also improved with the CDU-CZT SPECT camera than the conventional CD-SPECT camera.

Conclusion: CDU-CZT SPECT camera with its reconstruction algorithm increases sensitivity 10-15 times when compared with conventional single photon emission computed tomography (SPECT). These innovations reduce dose and acquisition time while maintaining image quality.
Radiation Protection for Personnel and Dose Reduction for Patients

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Background: The increasing use of diagnostic radiology is unquestionably beneficial. The issue of medical radiation protection is therefore achieving central importance for the health of both patients and radiation professionals. It can be said to be well established that the effects of radiation are cumulative and lead to increased incidence of cancers, cell deaths, genetic damage and numerous forms of body tissue pathology. Before undertaking any radiological examination, it is important that the physician, radiologist and technologist all understand the potential risks of radiation and also its advantages or benefits to patients. The potential risks of radiation comprise of stochastic (of which probability increases with dose) and deterministic (of which severity increases with dose) effects. The current radiation protection standards are based on three general principles:

a) Justification of a practice i.e. no practice involving exposures to radiation should be adopted unless it provides sufficient benefit to offset the detrimental effects of radiation.

b) Protection should be optimized in relation to the magnitude of doses, number of people exposed and also to optimize it for all social and economic strata of patients.

c) Dose limitation, on the other hand, deals with the idea of establishing annual dose limits for occupational exposures, public exposures, and exposures to the embryo and fetus. (Seeram & Travis, 1997). Any new radiological technique is subject to this principle.

Optimization of protection can be achieved by optimizing the procedure to administer a radiation dose which is as low as reasonably achievable (ALARA), so as to derive maximum diagnostic information with minimum discomfort to the patient (Seeram & Travis, 1997).

Methodology: The staff of the Radiology department working in the Cardiovascular Imaging facility routinely wear TLD badges, which are replaced every 3 months and the collected badges sent for reading to estimate the dose recorded. This is used to calculate the collective dose. Areas around the department are monitored for background radiation using survey meter and also any form of leakage from the tube assembly. During exposure the survey meter is placed at the radiographer’s exposure console to check for any scattered radiation and the values recorded. Some of the methods to reduce radiation exposure, which show the maximum benefits of radiation protection and cause minimum extra costs, are also the simplest. These include avoiding repeat exposures by employing proper exposure factors, and maintaining a proper record of films so that repeat examinations can be avoided wherever possible (Robinson & Grainger, 1997). This optimization is possible by good quality assurance and quality control.
Results: Cumulative values of recorded radiation doses for eleven radiation workers for one (1) year indicates that these values are lower than the annual dose limits for occupationally exposed persons. Graphically shown in figure 1.9 - 1.10.

Conclusion: Factors which can contribute to dose reduction and quality assurance are, the use of high frequency three phase generator equipment, use of high KV technique and low mAs, (using the shortest exposure time), beam collimation and using proper beam filtration.
VII. Quality management, quality control, quality assurance and audits in nuclear medicine and/or diagnostic imaging

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Appropriateness of Myocardial Perfusion Scintigraphy (MPS) in Coronary Artery Disease at Sultan Qaboos University Hospital

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Background: Myocardial Perfusion Scintigraphy (MPS) is already an integral part of many clinical guidelines for the investigation and management of angina and myocardial infarction, but the technique is underutilized in Oman where an estimated 333 studies per million are performed each year. However the appropriateness for performing these studies is not known. Objective: To evaluate whether the medical applications of myocardial perfusion scintigraphy (MPS) in the nuclear medicine service at Sultan Qaboos University Hospital (SQUH), a tertiary teaching cardiology hospital, are suitable to the indications proposed by the American Medical Societies in 2009.

Methodology: We reviewed the medical records of 423 patients that underwent MPS at SQUH from 1 January till 31 December 2014. Demographic characteristics, coronary risk factors and appropriateness criteria of medical applications were studied. The Appropriateness Criteria for nuclear imaging exams created by the American College of Cardiology (ACC) and the American Society of Nuclear Cardiology (ASNC) 2009 were used to assess the appropriate use of MPS.

Results: The mean age was 50 years (24-84). Of the 423 records reviewed, 194 (46%) studies were performed in men and 229 (54%) females. The indications for performing MPS were 338 (80%) for diagnosis, 63 (15%) for follow up and 22 (5%) for prognosis. The risk factors were 296 (70%) with hypertension, 254 (60%) with diabetes mellitus, 34 (40%) with dyslipidemia, 30 (35%) were overweight and 38 (45%) had more than two risk factors. 42 (10%) of these patients had heart failure and 63 (15%) had chronic kidney disease. According to ACC 2009, 389 (92%) were considered an appropriate indication and 34 (8%) were inappropriate for performing MPS.

Conclusion: This study shows that there were 8% of indications for MPS that were inappropriate according the ACC 2009 Appropriateness Criteria, which could be reduced by educating the referring physician about the appropriate criteria for performing MPS.
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**Cardiac Imaging Reports: Are We Communicating?**

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**Background:** Panama, a 4 million-habitant country, has cardiovascular disease as the first cause of death. Noninvasive cardiac imaging in Public Hospitals include Cardiac SPECT, MUGA, Cardiac CT and Cardiac MRI examinations are conducted by Nuclear Physicians and Radiologists. There are no Cardiologists involved in the Imaging Departments, which can add clinical competences to the team. Communication involves an issuer (the imaging specialist) to give a message (the report) by means of a code (graphic, verbal or written) to a receiver (the attending physician). Purpose: We would like to know how communication is taking place between clinicians and imaging specialists, and if the information issued by the reports fulfills its objectives of effectiveness and relevance, allowing decision-making to clinicians.

**Methodology:** This is a descriptive study. 70 Clinicians including Attending Physicians and Residents in Oncologic Hospital (300 beds) and Complejo Hospitalario Social Security Hospital (1000 beds) from Cardiovascular Surgery, Internal Medicine, Oncology and Cardiology were invited to fill the surveys which contained 23 multiple-choice questions.

**Results:** • 20 Surveys where completed. • Clinicians ordered Cardiac studies on a regular basis (weekly or daily) in 87% of cases, but communicated personally with Imaging Specialists occasionally in 50% of the cases, standard communication is by the means of printed reports. Although both Hospital have RIS-PACS system, 75% of informal Electronic communications consisted on emails and Whatsapp, because of the absence of an electronical health record. • While reporting in CT and MRI always helped in decision making, cardiac nuclear medicine tests showed mixed results: HEART SPECT is almost absent in public hospitals, so only 42% indicated that Nuclear Medicine Cardiac tests helped in decision making. Timing of the report was not an issue as most clinicians indicated that reports arrived on time to make decisions. • Emergency or critical findings were well communicated in 75% of cases while, ambiguous reports were perceived in 87% of cases. • Clinicians stated that training in noninvasive cardiovascular imaging was in 75% of cases poor or non-existent. Only 30% stated that knew well terms used in the reports. The report more easy to understand was Cardiovascular CT. Standardized reports where received only in 28% of the cases. All stated that receiving some image or graphic with the report would improve understanding. • Clinicians recommended that the best practices for Imaging specialist in reports should include always include Conclusion (87%) mention Differential Diagnosis (62%) and to integrate images in reports (50%). From the point of view of the clinicians, the Imaging specialist could improve the workflow through supporting the clinician’s decision on cardiac imaging (62%).

**Conclusion:** Communication between clinicians and cardiac imaging specialists exists in different degrees, in the forms of verbal, written and electronic communication. The survey shows the point of view of clinicians which will allow Imaging Departments in Public Hospitals of Panama improve communication skills with their colleagues. Inclusion of images, Training in Cardiac Imaging and Report Terminology, would improve understanding of the code and increase communication.
Continuous Improvement of Nuclear Cardiology Practice Based on QUANUM Program


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Background: The establishment of Quality Management Systems (QMS) in Nuclear Medicine (NM) services has contributed to increase the efficacy and safety of the diagnostic and therapeutic procedures and it is a basic tool to enhance the quality of patient care. Nuclear Cardiology involves a complex set of activities and requirements to fulfill the client’s expectations and provide services of excellence. The main goal of this work is to show the improvements and benefits of nuclear cardiology practice experienced as results of implementing a QM system in our NM service based on the QUANUM program.

Methodology: Quality manual prototypes and procedures templates created during previous IAEA technical cooperation activities were used as a reference to develop Nuclear Cardiology procedures and its complementary documentation. Patient oriented internal audits were performed using the QUANUM_tool spreadsheets in order to simplify the evaluation process and the QNUMED software has been used to manage the documental system and the service indicators. Clinical protocols for data acquisition, image processing and reporting of cardiac studies were reviewed and optimized according to international and local recommendations and a continue follow-up and revision of other key areas such as radiopharmacy, radiation protection, control of instrumentation was also carried out; several actions to support the clinical process have been performed as continuous client satisfaction monitoring.

Results: The procedures and record forms developed and implemented to support and enhance the nuclear cardiology activities were uploaded to the QNUMED platform, after optimizing each step of the clinical process. It warranty an appropriate patient management, data collection, processing and analysis of images, as well as the availability of basic information to the whole staff by intranet and allows the required traceability of relevant clinical data. The performed internal audits showed an increasing tendency on the overall scoring computed with the QUANUM_tool (first estimated value: 73% vs latest computed value: 89%); concerning cardiac studies the highest opportunities for improvements were identified in the areas of Quality Control/Quality Assurance and Reporting and Follow-up activities with partial scorings of 80.6% and 75.0%, respectively (Figure 1a). Improvements were also achieved from basic areas such as the control of the nuclear medicine’s instruments and radiopharmacy. A regular QC program is in place and systematic trend analysis of the most important quality control test is recurrently performed (figure 1b). Enhancements in operational activities for labeling and quality control of radiopharmaceuticals, dose assignments procedures assisted by the nuclear cardiologist, etc have been also achieved. Client satisfaction is systematically evaluated from the analysis of periodical surveys collected from patients and reference physicians,
showing satisfactory results (e.g. from about 105 surveys more than 92% were reported as “Very Good” or “Excellent”).

**Conclusion:** The establishment of a QMS in our NM service has contributed in a significant way to the improvement of patient and staff safety during the cardiac studies, increasing the efficacy, level and quality of such studies. The cumulated experiences are being shared with local nuclear medicine services at national level.
A Conceptual Framework to Facilitate the Assessment of Myocardial Perfusion Image Quality

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Background: Successful interprofessional relationships in the health care practice are a foundational aspect for promoting collaborative health care (Little et al., 2014:143). In nuclear medicine, the quality control roles in MPI and other cardiac procedures require attention from both nuclear medicine radiographers (NMRs) and nuclear medicine physicians (NMPs) (Heller & Hendel, 2011:39). Such a mandate requires professionals who work together towards achieving such a goal to have an inter-professional relationship. While many medical organizations have moved towards collaborative practice, through inter-professional relationships, the reality in many cases is still the traditional medical dominance (Yelder & Davis, 2009:347). However, what could be viewed as medical dominance in the departments in this study, is an overlap of roles between NMRs and NMPs. Therefore, this poster presentation presents an initial conceptual framework (ICF) and the revised conceptual framework (RCF) which is inclusive of the inter-professional relationship concepts which emerged from the participants in this study.

Methodology: The methodology presented in this poster was qualitative in nature in which six focus groups and ten face to face interviews were conducted between NMRs and NMPs respectively. The ICF was formulated based on concepts essential in producing an image of optimum quality using information from related literature and experiences of the researcher. Consequently, an interview guide based on the ICF was used for the focus groups and adapted for the interviews. The target population was sampled for three cohorts namely; NMRs who acquired and processed the images, NMRs who acquired the images and assessed only the quality of the images and the third cohort consisted of NMRs who acquired the images which were automatically transferred to the NMPs’ work stations who subsequently processed them.

Results: The focus group and face to face interviews were tape recorded and transcribed under ethically approved conditions. Using thematic analysis, each useful and meaningful statement was assigned a code that captured its meaning (Chiang-Hanisko et al, 2016:2). The codes were assigned using Atlas ti. programme for qualitative analysis and grouped into families which were then clustered into themes. One of the themes captured concepts relating to inter-professional relationships which were deemed essential during the assessment of myocardial perfusion image quality practices and were used to formulate the RCF which is presented in this poster. These concepts were; collaboration, consultation, in-house training by NMPs, acknowledgement, communication, consistency and many others.

Conclusion: The concepts of inter-professional relationships which emerged from the study were deemed important in the assessment of myocardial perfusion image quality, as it is the second most performed imaging procedure in the departments in this study. The inter-professional relationship should be iterative in nature and participative with health care professionals agreeing on a common goal and adapting their discipline through specific goals (Korner et al., 2015:2). Similarly optimum myocardial perfusion image quality should be the goal for both the NMRs and NMPs. Therefore the RCF could be used in nuclear departments to facilitate the assessment of myocardial perfusion image quality.
VIII. Ethics, leadership and education in nuclear medicine and/or diagnostic imaging
Abstract ID: 153

Ethics, Leadership and Education in Integrated Medical Imaging

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Diagnostic imaging is a dynamic field, which has evolved rapidly during the past few decades. New modalities have developed and research techniques have migrated into clinical practice. Imaging has seen a greater integration of various modalities, defining the entity of diagnostic clinical imaging sciences. Nuclear medicine has undergone a metamorphosis over the past 30 years. Established scintigraphic techniques for detecting breaches in the blood-brain barrier and liver masses has been replaced by ultrasound, computerised tomography (CT) and magnetic resonance imaging (MRI). Simultaneously, there has been significant growth in the use of positron emission tomography (PET), sentinel node imaging, targeted radiotherapy and several molecular imaging techniques. Radiology has experienced exponential growth with regard to helical multi-slice CT scanning using multiple-row detector arrays for the simultaneous collection of data at different slice locations, allowing rapid acquisition of large datasets of longitudinal volumes. The optimal MRI field strength in general clinical practice is 1.5 tesla (T), while 3 T allows mapping of cerebral cortical function by utilising blood oxygen level-dependent (BOLD) imaging. An important influence on medical imaging since the beginning of the 21st century has been the increasing availability of hybrid imaging systems. These systems enable a more integrated approach, and define the unitary entity of diagnostic clinical imaging sciences. The concept of hybrid imaging is simple – PET or a single photon emission computed tomography (SPECT) scanner is integrated with a CT scanner on a single platform. The patient is examined using both techniques in immediate succession without any positional changes. Images are fused and displayed by dedicated software. Detailed anatomical imaging combined with the high sensitivity of functional information provides much more information than would be provided by the two individual techniques. The composite images are also generally better appreciated by clinicians. Ethics has to do with the set of moral principles. It is a form of shared values or principles governing the way a Medical professional interacts with patients and other health professionals. Medical imaging involves using specialized equipment to gather visual data to determine what’s happening within a patient’s body. You may be required to look at bones, muscles or organs as you help doctors determine such things as whether a woman is pregnant with a boy or girl, whether a patient is ill due to a cancerous growth or whether a teenager has broken his leg. The images and data you collect can be used in a variety of medical fields. The education required for a career in medical imaging is dependent on the specific field of medical imaging that you enter. Some careers require intensive formal training and education, while others involve training on the job. All programs require training in medical terminology, anatomy, safety and equipment operation. You will get hands-on clinical experience as well.
IX. Radiation protection for personnel and dose reduction for patients

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**Dose Optimization in Paediatric Cardiac X-Ray Imaging**

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**Background:** Pediatric catheterization exposes patients to varying radiation doses. Dose optimization was assessed by obtained radiation data collection. Biplane X-ray angiography Siemens Artis zee equipment was used for clinical procedures. It is equipped with two flat detectors - a frontal detector measuring 30x38cm (48 cm diagonal) and lateral detector measuring 20x20cm (25cm diagonal). The flat detectors are mounted on C-arm of the angiography system and move through a 360 degrees range around the patients. Objective: To quantify the patient radiation dose reduction after the introduction of an X-ray imaging technology using advanced real time image noise reduction and optimized acquisition chain for fluoroscopy in pediatrics and adult population with congenital heart disease

**Methodology:** Patients and radiation doses were retrospectively collected August 2014 - August 2015 for 100 consecutive patients treated with a system using state of the art image processing and reference acquisition chain. Radiation dose was quantified using dose area product (DAP), while procedure complexity using fluoroscopy time, procedure duration and volume of contrast medium. Patients were divided into three weight groups: A) below 10kg B) 10-40 kg and c) over 40kg.

**Results:** For below 10kg, 10-40kg, over 40kg mean DAP values were 63.7cGycm2, 200 cGycm2, and 1900cGycm2 with quantification at 50%, 70% and 60% respectively.

**Conclusion:** The new system provides significant patient dose reduction compared to the reference system. Despite no other changes in the procedural approach, X-ray imaging technology provides a substantial radiation dose reduction.
PET Radiopharmaceuticals and Their Use in Hospital Practice in Turkey

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Background: A number of improvements have been performed in the development of both nuclear medicine imaging modalities and radiopharmaceuticals since the 1950s. Clinical medicine has come a long way from the use of rectilinear scanners, gamma cameras capable of performing dynamic studies and SPECT with a single and multi-detected gamma cameras in 1980s. PET and SPECT started to be integrated with CT as PET/CT and SPECT/CT in the 2000s. PET was first combined with CT in 1998, and it came to routine use all around the world in 2001 (1, 2).

Methodology: Positron emitter radionuclides (F-18, C-11, O-15, N-13, Ru-82, Ga-68, etc.) can only be used in order to detect by PET/CT depending on higher energy level of beta emitters (511 keV) which are produced in cyclotrons artificially by using medical accelerators. These short half-lived radionuclides can be obtained by different metabolic and biochemical pathways. These radionuclides can be utilized by themselves or by conjugating with different ligands, drug delivery systems, peptides, molecules after radiolabeling process to become radiopharmaceuticals.

Results: Approximately 500–1000 PET/CT imaging apparatuses have been added worldwide in 2004 (1, 2). The popularity of PET/CT imaging modality mostly depends on available properties and proper accumulation mechanisms of 18F-FDG (3). More than 70 PET/CT centers are present in Turkey in public and private hospitals. Nuclear Medicine is a popular department in diagnosis, research and tumor staging all around the world as well as in Turkey.

Conclusion: Many PET radiopharmaceuticals have been developed for oncological imaging more than 30 years. Similar to other countries, 18F-FDG is still the gold standard and widely used PET radionuclide for not only diagnosis but also cancer staging, evaluation of therapy responses in Turkey. Its drawback is specificity and sensitivity of 18F-FDG which is not optimal for every cancer type such as well differentiated or low degree cancers (4). Although PET/CT is mostly used for oncological diagnostic purposes for different cancers and staging, different PET radiopharmaceuticals have different applications like in neurology and cardiology. About 390 PET/CT are used for these different purposes at Nuclear Medicine departments in Turkey. Some of them are used at public hospitals related with the Ministry of Health and some others are used for private purposes. About 45 of them are used for educational purposes at research hospitals as part of universities for both routine applications and research of novel PET radiopharmaceuticals. The use of PET in development and formulation of novel PET radiopharmaceuticals are gradually becoming very popular in Turkey, as well as around the world.
A Protocol to Optimize the Radiation Dose in Coronary CT Angiography to Sufficient Image Quality in Overweight Patients

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Background: Overweight and obesity are a worldwide epidemic according to the recent World Health Organization global estimates that revealed that in 2014, 39% of adults aged 18 years and over are overweight. The overweight patients challenge the efficacy of cardiac CTA and in many cases, the image quality obtained does not justify the high radiation doses given to those patients, therefore specific attention should be given in research studies to imaging of this high risk group. Objective: To assess the subjective and objective image quality parameters and to estimate the radiation dose of coronary computed tomography angiography using 2 different protocols in overweight patients.

Methodology: In this current prospective, randomized-controlled clinical trial, one hundred and twenty consecutive overweight patients with Body Mass Index ≥ 25 and < 30 kg/m² were randomized into two groups and were scanned using a 64 multislice coronary CT angiography. Sixty patients (protocol A) were examined using a low radiation dose protocol at 100 kV and another sixty patients (protocol B) were examined using a standard protocol at 120 kV. Images were reconstructed and assessed by two blinded independent radiologists who assessed the image quality of each coronary segment using a 4-point scoring scale (1 = non-diagnostic, 4 = excellent) and measured the objective parameters as image noise, contrast-to-noise (CNR) and signal-to-noise ratio (SNR). Radiation dose was calculated for both protocols. Justification of the referrals and the adoption of imaging referral guidelines among the existing radiologists and referring physicians were also assessed.

Results: The coronary artery image quality scores, SNR and CNR were not significantly different between protocols A and B (p > 0.05), the image quality scores were 3.61 ± 0.70 versus 3.64 ± 0.47, respectively. Protocol A was associated with greater noise (35±6 versus ± 27±3 Hounsfield units) respectively ; (p<0.01). The effective radiation dose was significantly lower in protocol A (4.41 ± 0.53 mSv) than that in protocol B (8.93 ± 1.74 mSv, p < 0.01) with subsequent 49% reduction in radiation dose. The justification of exposure analysis revealed 71% of the referrals of the study group were justified, however no adoption of specific imaging referral guidelines among the radiologists or the referring physicians within the center.

Conclusion: In overweight patients, adoption of 100 KV protocol that is used in normal weight patients can confidently achieve a satisfactory image quality with 49% reduction in radiation dose. Further training on imaging referral guidelines is required among radiologists and referring physicians to control the unjustified CCTA examinations.
Acquisition Parameters Affecting Image Contrast in Single Photon Emission Computed Tomography (SPECT)

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Background: Cardiovascular diseases (CVDs) kill more people globally than any other disease. Nuclear imaging technology plays an ever more central role in detecting these diseases early. It is used to improve “outcomes” for patients, meaning that early and precise disease diagnosis informs effective treatment and leads to a faster, more complete return to health. Various physical factors limit the quality of the SPECT images. Among these are matrix size and motion type. A general definition of contrast is that it is the ratio of signal change of an object of interest, such as a lesion, relative to the signal level in surrounding parts of the image. Aim: The aim of the present work is to evaluate different physical factors: matrix size & motion type, affecting the image contrast in Single Photon Emission Computerized Tomography (SPECT) in order to optimize the patient’s examination on the gamma camera in nuclear medicine facility.

Results: Generally, we found that the image contrast by using Iterative method is higher than it by using FBP in most of factors. The big advantage of the iterative approach is that accurate corrections can be made for all physical properties of the imaging system and the transport of g-rays that can be mathematically modelled. In the present study it was found that, matrix size doesn’t affect contrast values in SPECT studies, but contrast by using matrix 128x128 is small higher than 64x64. And S&S continues gives the best contrast value in motion types. In Matrix Size, a non-significant difference observed between contrast values in 128x128 and 64x64 matrix size. The count rate with 64x64 higher greater than count rate with 128x128 matrix size and that is because the pixel size in 64x64 is larger than pixel size in 128x128 matrix size, at which it is able to collect more counts. In Motion Type, a statistically significant difference observed between contrast values by changing motion type. S&S continues, gives the best contrast value because it doesn’t lose any counts.

Conclusion: Finally, contrast parameter in SPECT studies by using Iterative method is higher than it by using FBP in most of physical factors.
Development a New Technique for Breast Attenuation Correction in Myocardial Perfusion Scintigraphy Using Computational Methods

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Background: One of the limitations of nuclear medicine studies are false-positive results that lead to unnecessary exams and procedures associated to morbidity and costs to the individual and society. One of the most frequent causes for reducing the specificity of myocardial perfusion imaging (MPI) is photon attenuation, especially by breast in women. Objective: To develop a new technique to compensate the photon attenuation by women breasts in myocardial perfusion imaging with ⁹⁹mTc-sestamibi, using computational methods.

Methodology: A procedure was proposed which integrates Monte Carlo simulation, computational methods and experimental techniques. Initially, the chest attenuation correction percentages were obtained using a phantom Jaszczak and breast attenuation percentages by Monte Carlo simulation method, using the EGS4 program. The percentages of attenuation correction were linked to individual patients’ characteristics by an artificial neural network and a multivariate analysis. A preliminary technical validation was done by comparing the results of the MPI and catheterism (CAT), before and after applying the technique to 4 patients. The t-test for parametric data, Wilcoxon, Mann-Whitney and q² for the others were used. Probability values less than 0.05 were considered statistically significant.

Results: Each increment of 1 cm in the thickness of breast was associated to an average increment of 6% on photon attenuation, while the maximum increase related to breast composition was about 2%. The average chest attenuation percentage per unit was 2.9%. Both, the artificial neural network and linear regression, showed an error less than 3% as predictive models for percentage of female attenuation. The anatomical-functional correlation between MPI and CAT was maintained after the use of the technique.

Conclusion: Results suggest that the proposed technique is promising and could be a possible alternative to other conventional methods employed today.
Challenges and Opportunities for Improvement on Current Nuclear Cardiology Practices and Radiation Exposure in Brazil: A Cross-sectional Survey

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Background: The practice of Nuclear Medicine (NM) is widely used in Latin America, in particular in Brazil. Myocardial Perfusion Imaging (MPI) represents more than 55% of tests performed in the Nuclear Medicine Services (NMS) in Brazil. Over 240,000 tests are undertaken in the public health system each year and more than 800,000 MPI are done in private practice each year. However, the actual condition of the Brazilian nuclear cardiology practice is not well known because the techniques are heterogeneous among the NMS. Due to the exponential growth in recent years, important concepts about radioprotection must be taken into account because of the risks regarding the ionizing radiation. The International Atomic Energy Agency (IAEA) promoted the research “IAEA Nuclear Cardiology Protocols Survey” (INCAPS), which adopts 8 “best practices” to evaluate the exposures to ionizing radiation during the MPI (1. Avoid thallium stress; 2. Avoid dual isotope; 3. Avoid too much technetium; 4. Avoid too much thallium; 5. Perform stress-only imaging; 6. Use camera-based dose-reduction strategies; 7. Weight-based dosing for technetium and 8. Avoid inappropriate dosing that can lead to “shine through” artefact).

Methodology: Cross-sectional study in centers performing MPI, a standardized questionnaire was sent by email for all NMS (404) in Brazil and a local leader provided the answers for data collection. The objective is to evaluate the adherence of the “best practices” defined by INCAPS.

Results: In a total of 56 respondent services, we observed that 100% of the NMS do not use thallium-201 or dual isotope as the preferred protocol. The use of Technetium-99m, 52.86% inject activities above the threshold recommended by the IAEA (1332 MBq or 36mCi), resulting in a higher effective dose, more than 15 millisievert (mSv) in 35.84% and 58.82% of the NMS, the 2-day protocol and 1-day protocol, respectively. “Stress-only” is practiced by only 28.57% of NMS, therefore, only 30.4% uses camera-based dose-reduction strategies. Only 50% of the NMS answered that always adjust the doses by weight and 29.41% manage miscalculated doses in 1-day protocol.

Conclusion: The lack of standardized techniques reflects directly on the diversity of protocols found in the country, affecting the reproducibility and quality of the MPI. This analysis, according to the parameters adopted by INCAPS, shows us that a considerable number of NMS in Brazil do not follow the “best practices”; only 32.1% of NMs adopted at least six of them. Worldwide there are great efforts to reduce the radiation used in patients on diagnostic imaging. Despite the difficulties faced in some regions of Brazil, almost all the observed deficits can be resolved without increased costs, highlighting the importance of developing strategies for adherence of “best practices” in implementing the MPI, existing opportunities to improve the quality of MPI in Brazil. This comprehensive view of the nuclear medicine practices in cardiology may be used in policy-making in healthcare.
Abstract ID: 39

**Dynamic Single Photon Emission Computer Tomography on Dedicated CZT Camera in Assessment of Myocardial Flow Reserve in Patients with Three-Vessel Coronary Artery Disease**

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**Background:** To assess the myocardial flow reserve in patients with three-vessel coronary artery disease (MVCAD) by dynamic SPECT using dedicated semiconductor (cadmium-zinc-telluride)-based gamma camera.

**Methodology:** This work included twenty patients (15 males and 5 females; mean age 63.3±12.6 years) with MVCAD with the presence of stenosis greater than 70% according to invasive coronary angiography. Control group consisted of 7 men and 2 women (25±4 years) without any cardiac diseases (healthy volunteers). All patients and volunteers underwent dynamic myocardial SPECT using semiconductor (cadmium-zinc-telluride)-based gamma camera, with ⁹⁹mTc-MIBI as a radiopharmaceutical. Acquisition protocol was as follows: (1) rest radiopharmaceutical injection (volume 1 mL; dose 185 MBq); 5-min list-mode acquisition; (2) stress radiopharmaceutical injection (volume 1ml; dose 740 MBq) followed by two-minute adenosine infusion (160 mcg/kg/min); then additional two-minute adenosine infusion (160 mcg/k/min). List-mode (5-min duration) was started simultaneously with the injection of the radiopharmaceutical. All scintigraphic images were acquired on the hybrid SPECT/CT unit (GE Discovery NM/CT 570C). Using dedicated software (Dynamic Analysis Tool), we received dynamic data reflecting the passage of the radiopharmaceutical in the walls and in the cavity of the left ventricle. To assess myocardial flow reserve, we calculated the ratio of the mean counts value from the left ventricular myocardial region (apex, anterior, lateral, and septal wall) to the integral under the curve from the left ventricular cavity. The index of myocardial blood flow reserve was calculated by dividing the ratio acquired in stress test by the ratio obtained at rest.

**Results:** The average values of the myocardial flow reserve index for the left ventricle (in general) in a MVCAD group and in a group of healthy volunteers were significantly different: 1.41±0.48 and 1.88±0.43, respectively (p<0.05). Regional myocardial blood flow reserve index was also significantly different in patients with MVCAD and in healthy volunteers: 1.34±0.43 and 1.88±0.38 for the apex of the left ventricle, respectively (p<0.05); 1.44±0.41 and 1.95±0.45 for the lateral wall, respectively (p<0.05); 1.32±0.44 and 1.63±0.43 for the anterior wall, respectively (p<0.05); and 1.44±0.77 and 2.06±0.38 for the septal wall, respectively (p<0.05).

**Conclusion:** Dynamic myocardial rest-stress SPECT using dedicated semiconductor (cadmium-zinc-telluride)-based gamma camera allows for identifying low myocardial flow reserve in patients with three-vessel coronary artery disease. It can be helpful in assessment of severity of myocardial perfusion abnormality in these patients. These preliminary results require verification and comparison with other modalities. The study was supported by a grant from the Russian Science Foundation (14-15-00178).
Background: The Monte Carlo simulation is widely used nowadays in medical imaging and represents an alternative to model the interactions radiation-matter, calculate the necessary corrections to the dosimetric applications or even determine the physical quantities inaccessible by measuring. The present work represents a simulation of diffraction effects in the purpose of the evaluation of the image produced in a gamma camera using Monte Carlo SIMIND simulation. The objective is to evaluate the spatial resolution to improve the image quality produced in gamma general purpose camera using the Monte Carlo SIMIND program.

Methodology: We simulated a cylindrical phantom filled by water introducing in the center a cylindrical source filled of yttrium90 (90Y). Method: the simulation was done by studying the line spread function LSF according to the source-detector distance, the type of detector and the energy. The FWHM was evaluated for all the simulations. We used different collimators LEGO HEGP, HEGP and LEHR at different energies (47; 75; 140,245; 511) keV.

Results: The results show that the collimator “LowEnergie High Resolution” LEHR has the best spatial resolution in comparison with other collimator used. We evaluated the function LSF using the LEHR collimator for different source-detector distances and it was concluded that as the distance decreases the spatial resolution increases. The results were compared to the FWHM and the FWTM functions for different collimators changing the energy and the distance and got the same results.

Conclusion: The results show that the LEHR collimator is recommended to get a good resolution for the range of energy we used.
Abstract ID: 53

**Occupational Radiation Protection in Interventional Cardiology**

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**Background:** It is recognized that the Interventional radiology is a practice delivering significant radiation doses for patients and practitioners. Promoting the optimization of radiation protection is then of great importance in the field. Performing dosimetry studies permits to have an idea about the quality of the equipment and the importance of practical and experience of the practitioner. This work was carried out in a Moroccan hospital where the staff team was equipped by the individual and collective protective equipment.

**Methodology:** Three practitioners participated in the study, only one of whom made the implantation of pacemaker and the radio-frequency ablation (doctor A), the two others practiced coronarography, coronary and mitral dilatation (doctors B and C). The dosimeters were placed on the chest for the whole body Hp (10) placed below and above the lead apron, pastilles in plastic pouches H* (10) were stuck to the protective eyewear and TLD (Hp (0.07)) were used for the extremities (left hand and left ankle). The period of measurement lasted a month. Every morning, dosimeters were placed at the locations listed above by the person who performed measures and who attended the whole of interventions. The dosimeters were collected at the end of the day.

**Results:** The results show that the mean values of extremities and whole body’s doses depend on the type of procedure used and the expertise of the practitioners. Moreover, the values of extremity doses reached 897 mSv, corresponding to the doctor A practicing the most irradiating procedure providing much fluoroscopy time. For doctors B and C, the values didn’t exceed 211mSv. The doses received by lens, vary between 34 and 110 mSv while the dose recommended by the new European regulation 2013, is 20mSv. Generally, the mean values of extremities and whole body doses are in the norms recommended.

**Conclusion:** The mean doses of the whole body and extremities correspond to the international standards. Furthermore, more vigilance should be taken to improve the protection and the practices in order to decrease the lens doses. In perspective, collaboration in a project focused on lens dosimetry is programmed with an European expert research team.
 pediatric Cardio Vascular 320-row CT Angiography: Effect of 80-kV, Tube Voltages on Image Quality, Contrast Volume and Radiation Dose

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Background: To prospectively evaluate image quality parameters, contrast volume and radiation dose at the 80-kilovolt (kV) setting during computed tomography angiography on a 320-row computed tomography scanner, with pediatric population.

Methodology: We enrolled 50 consecutive young patients (2 months to 12 years old). All patients were scanned using 80-kV tube voltage settings. Image quality was assessed. Attenuation in the aorta and perivascular fat tissue and image noise were measured. Automatic tube current modulation was used for each case. The mAs, volume CT dose index (CTDIvol), and dose–length product (DLP) values were recorded and the effective dose calculated. In order to use the appropriate radiation dose for the appropriate patient, automated software such as SURE Exposure Pediatric measures the size and attenuation of each patient. The effective radiation dose were estimated using a chest conversion coefficient (0.014).

Results: Diagnostic image quality was achieved in 100% with 80-kV. Mean contrast injection rate and main material volume were significantly lower for the 80-kV CT Angiography. The effective radiation dose was reduced.

Conclusion: The 80-kV setting allows significant reductions in contrast material volume and effective radiation dose while maintaining adequate diagnostic image quality in pediatric population. Keywords: 80-kV, 320-row computed tomography, contrast material, radiation dose.
Operator Radiation Exposure: A Randomized Trial Comparing Right and Left Radial Approaches in Coronary Interventions


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Background: The radial approach is the most frequently used arterial access in our center for coronary interventions due to the lower rate of vascular complications, increased patient comfort, as well as decreased mortality in primary angioplasty. Previous studies showed controversial results regarding relative radiation dose received by the first operator (FO) when performing right radial (RRA) versus left radial approach (LRA). The aim of the present study was to evaluate radiation dose received by the FO during coronary procedures through RRA and LRA.

Methodology: This was a prospective randomized trial. From February 2015 to March 2015, patients older than 18, with an indication for coronary intervention, were recruited. Exclusion criteria were: failure to achieve the randomized vascular approach, prior CABG with internal mammary artery graft, end stage renal failure and/or hemodialysis and patient preference. Radioprotection devices for the FO included: leaded equivalent skirt, vest and thyroid shield, leaded glasses, screen and curtain under table, as well as leaded equivalent skirt for the patient between waist and knees. All procedures were performed by three operators, who were equipped with 1 dosimeter (DMC3000 radiation detector), located on the outer left side of the thyroid shield. Clinical and procedural variables were recorded: duration of the study (minutes), fluoroscopy time (FT-minutes), number of scenes (NS), dose-area product (DAP-mGym²), total radiation (TR-mGym) and radiation dose to the FO (mSv). t test for comparison of means was used, with alpha value ≤ 0.05.

Results: 97 patients were randomly assigned to the RRA (45 patients) or the LRA (52 patients). 58 patients were men. The mean age was 63.3 ± 1.1 years (26-83 years). There were no significant differences related to cardiovascular risk factors, BMI and clinical presentation between groups. Study duration 34.8 ± 3.9 vs. 32.8 ± 3.7 (p = 0.998), number of scenes (NS) 16 ± 1 vs. 14 ± 1 (p = 0.277), fluoroscopy time 11.7 ± 1.4 vs. 10.2 ± 1.4 (p = 0.441) were similar between groups, but the LRA was associated with greater dose-area product (mGym²) 10322,0 ± 1046,4 vs. 7117,7 ± 807,4 (p = 0.016), total radiation dose 1932,9 ± 136,3 vs. 1260,6 ± 136,3 (p = 0.009) and radiation dose to the FO 53,2 ± 87,5 vs. 30,4 ± 5,3 (p = 0.013).

Conclusion: RRA was associated with a statistically significant lower dose of radiation received by the FO as compared to LRA. These results argue in favor of the RRA as the first choice when performing coronary interventions by radial approach.
Abstract ID: 73

**Radiation Exposure to Thumb of Nuclear Medicine Physician During Injections in Nuclear Cardiology Procedures**

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**Background:** In a busy nuclear medicine department like ours, a substantial number of injections are given (depending on the number of cases) and if there are not enough nuclear medicine physicians available to distribute this radiation exposure, then whatever little exposure he/she may receive, has to be validated. Although it is a standard practice to inject using the lead syringe shield (to use shield to reduce the radiation exposure), to inject into the already secured line by vein-flan or butterfly in place of direct i.v (to reduce time taken for inj.) and to maintain as much distance as possible. When we use the lead shield, by the very virtue of its design, it does give protection to the fingers which are rolled around the cylindrical part of the lead to hold to syringe-shield containing the syringe but when we press the piston to push the contents of the syringe, there is no protection to the isolated unprotected thumb during that procedure. Thus, we tried to estimate the radiation exposure to the ‘thumb’ during the injection.

**Methodology:** We estimated the average time taken to push the piston during injection to the patient and it came out to be approximate 3 seconds. It means, whatever the amount of activity is being injected to the patient, it gives exposure to the unprotected thumb for that much period. Secondly, it was not possible to directly measure the radiation exposure during the injection period because it was cumbersome to put the dosimeter between the thumb and the piston and then push. Even if we tried in some cases, it significantly increased the time taken for injection. Thirdly, the radiation exposure from each injection was too low for the threshold of the dosimeter to give us some measurable reading.

**Results:** So, we tried to circumvent this uneasiness by putting the dosimeter directly in front of the piston of the loaded syringe with the average amount of activity used during that month, with syringe shield in-situ; separately on the table, for the calculated total time taken for all the injections (total no. of cases x 3 sec) and calculated the reading.

**Conclusion:** This exercise gave us the radiation exposure reading of 3μsv to the unprotected thumb in one month, which can be extrapolated to the annual radiation exposure of around 36μsv; which is way below the recommended international guidelines for annual radiation exposure to the extremities. So, there is no need to panic but this study does give us some data for the thumb.
Abstract ID: 83

National Cancer Institute, University of Gezira: Nuclear Cardiology: Challenges, Problems and Solutions

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Background: Nuclear Medicine Department, National Cancer Institute, University of Gezira, NCI - is considered a unique center outside the capital of Sudan (Khartoum), and has advanced diagnostic equipment to help in diagnosis of malfunction organ, such as thyroid, kidneys function and spreading of cancer cells, heart disease. Myocardial perfusion scintigraphy (MPI) provides anatomical, physiological, and functional information about the heart muscle and its blood flow. Ventricular ejection fraction and wall motion evaluation are now possible with the introduction of technetium myocardial perfusion radiopharmaceuticals and the use of gated single photon emission tomography (SPECT) techniques. In 2006 SPECT gamma camera has been installed in our center and since that time, there were shy and simple attempts to gain benefits in doing myocardial perfusion scintigraphy of a cardiac patient. However it failed for the many reasons, (e.g. a lack of knowledge of relevant specialists to the possibility of our section in doing this kind of scan at that time, and the lack of personal training for this type of scan, and the weakness of good relations and coordination among the relevant centers). In 2012, the serious attempts to cardiac imaging began, whereas, they made sure of the existence and a viability of all components and liability such as: gamma camera, ECG, treadmill, infusion pump, and software program of cardiac and so on. Then all these components and gamma camera program were tested and checked by scanning of a volunteer in a rest study, and his images were reviewed, processed and approved at all levels, and also displayed in the final shape for reporting.

Methodology: There have been several contacts and consultations with Wad Medani heart center for the possibility of helping doing myocardial perfusion imaging for their patients. It was agreed to transfer the patients whom were involved in imaging to our department for the preparation of patients and making necessary arrangements before nuclear imaging. Also it was agreed that a cardiologist is to be attended or alternate to oversee the exercise study.

Results: These efforts resulted in imaging four patients until now. Two of them were in of resting studies and two in of exercise studies at first and then at rest in one day protocol. Stress and rest images:

Conclusion: Still there are some obstacles need to be solved: - There are no NM specialist residents in our department, only one cardiologist collaborates with our department. Most of the relevant specialists do not know the possibility of the work of this diagnosis in the department. - All this resulted in lack of the number of patients who were attended to the center for Cardiac imaging. Also the difficulties of obtaining pharmacological stress agents like Persantine injection which was not authorized in Sudan.

- We recommended: to distribute more media release to relevant specialists and centers. Also to train and to employ more NM specialists collaborated with more cardiologist, and work on the provision and maintenance of gamma camera.
Is It Eligible to Evaluate the Performance of a Heart Dedicated SMARTZOOM Collimator with a Thyroid Phantom?


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Background: The IQ-SPECT system was developed by Siemens to allow shorter image acquisition time or reduced administered patient dose in myocardial perfusion imaging. In this work, we tried to evaluate the performance of dedicated multifocal “SMARTZOOM” collimator integrated in IQ-SPECT system by using a thyroid phantom.

Methodology: We used a thyroid phantom having approximately the size of a normal heart. Three cold nodules of different sizes are simulated by solid cylinders of polymethyl methacrylate (PMMA). A hot nodule is represented by a perforated cylinder. The phantom was filled with a solution containing 9 MBq (250 μCi) of 99mTc and placed within a rectangular container of PMMA filled with water to create attenuation. Images were acquired using a hybrid dual-head SPECT/CT gamma camera (Symbia T6; Siemens) first with SmartZoom collimators (IQ-SPECT technique) and then with standard parallel hole low energy high resolution collimators (conventional myocardial SPECT/CT). The acquired images were reconstructed by iterative 3D Flash (3 iterations, 10 subsets) with attenuation correction for both techniques.

Results: Images acquired with conventional myocardial SPECT / CT showed three polar cold zones corresponding to the solid PMMA cylinder. With IQ-SPECT, however, cold foci were not individualized and images were impossible to evaluate.

Conclusion: IQ-SPECT gave a considerably poorer spatial resolution of the acquired thyroid phantom compared to conventional myocardial SPECT/CT. We concluded that the thyroid phantom is not appropriate for the IQ-SPECT technique. These results support that the IQ-SPECT’s SmartZoom collimator and reconstruction algorithm dedicated to myocardial perfusion imaging have been optimized only for a precise 3D cardiac shape.
Abstract ID: 118

Assessment of Radiation Dose and Estimated Lifetime Attributed Risk of Cancer Incidence for Selected Contemporary Coronary Computed Tomography Angiography (CCTA) Protocols

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Background: Coronary computed tomography angiography (CCTA) has been increasingly used in the diagnosis of coronary artery diseases (CAD) due to its less invasive nature, high spatial and temporal resolution, as well as high diagnostic sensitivity. CCTA with the use of more than 64-slice scanners is currently a widely performed procedure in many clinical centers worldwide. Given its high radiation dose associated with CCTA examinations, prospectively ECG-triggered CCTA is recommended as a preferred protocol for dose reduction. Objectives: This study aimed to assess the organ and effective doses (ED) for prospectively ECG-triggered CCTA using five state-of-the-art CT scanners and imaging protocols. The lifetime attributable risk (LAR) of cancer incidence was also estimated and compared.

Methodology: Prospectively ECG-triggered CCTA was performed using five commercially available CT scanners: 64-slice single source CT (SSCT), 128-slice dual source CT (DSCT), 128-slice SSCT, 256-slice DSCT and 640-slice SSCT scanners. Absorbed doses were measured in 34 organs using optically stimulated luminescence dosimeters (OSLDs) loaded in a standard female adult anthropomorphic phantom (CIRS ATOM female phantom Model 702-D). ED was computed using phantom measurement data as well as DLP-to-ED conversion factor. LARs for breast, lung and other cancers incidence were estimated using the measured organ dose.

Results: Both breasts and lungs had the highest radiosensitivity and received the highest radiation dose during CCTA examination. Young women who are less than 30 year-old had higher LAR for breast cancer but after 30 year-old, the LAR for lung cancer was higher. The LAR for lung cancer in men was about half of the women’s. The ED ranged between 1.34 ± 0.48 to 6.06 ± 0.72 mSv, where the highest ED was observed in 64-slice DSCT, followed by 64-slice SSCT, 128-slice SSCT, 128-slice DSCT and 640-slice SSCT.

Conclusion: This study provides the most recent update on specific organ dose measurement and ED from prospectively ECG-triggered CCTA examination using five state-of-the-art CT scanners and imaging protocols. The highest ED estimated was 6.06 ± 0.72 mSv and the highest LAR was 65 per 100,000 population for breast cancer incidence. LAR for breast cancer increases exponentially for younger women hence the use of CCTA examination needs to be considered carefully in this population.
Estimation of Patient Doses in Cardiac Imaging Using Ionising Radiation

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**Background:** The number of cardiac diagnostic procedures that involve ionising radiation has increased over the last decade. Physicians that order and justify those procedures must and should be familiar with doses and with the risk that arise from the usage of ionising radiation in these procedures.

**Methodology:** In order to reduce and to assess the doses in cardiac imaging procedures, we wanted to estimate the radiation exposure of patients. We assessed the effective dose of 50 patients after a nuclear medicine myocardial perfusion imaging (stress/rest 1 day protocol using Tc-99m MIBI), dose of 50 patients after conventional coronary angiography (CA) and dose of 50 patients after cardiac computed tomography angiography (CTA). Effective doses were estimated using different techniques for different modalities. Radar website conversion coefficients were used for nuclear medicine myocardial perfusion imaging procedure. For interventional cardiology procedures, we used PCXMC 3.0, while computed tomography effective doses were assessed using CT-EXPO 1.4. Weighting factors selected correspond to the values from the ICRP 103 report.

**Results:** Obtained results were split according to the patient’s gender. Average effective dose received after myocardial perfusion imaging was 12.6±1.8 mSv (male: 11.4±0.9 mSv, female: 13.7±1.7 mSv). Estimated average effective dose after the coronary angiography procedure was 7.4±2.9 mSv (male: 7.3±2.7 mSv, female: 7.8±3.5 mSv). Highest doses were reported after CTA procedures. Average effective dose was 34.6±11.8 mSv. Male patients received dose 28.2±7.1 mSv, while estimated dose to female patients was 44.3±11.1 mSv.

**Conclusion:** The results show big differences in effective dose depending on the procedure. In general, female patients receive higher effective dose because of the radiosensitive organs. Dose to patients after CTA was alarmingly high, almost 6 times larger than the dose after conventional CA. Optimisation of imaging protocol should be considered.
Staff Radiation Exposure During Transthoracic Echocardiography Performed in Temporal Proximity to Myocardial Perfusion Imaging

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Background: Patients with chest pain undergo transthoracic echocardiography (TTE) and myocardial perfusion imaging (MPI) during their initial work up, at times in close temporal proximity. The length of the TTE procedure is examiner- and pathology- dependent. Radiation exposure of sonographers performing TTE on patients after MPI has not been determined. Objective: To evaluate the degree of exposure of echo-cardiographers and cardiac sonographers to MPI-related radiation during TTE in patients who recently performed nuclear cardiology procedures.

Methodology: Twenty patients who performed a Tc-99m sestamibi MPI and were referred for a same day TTE were included in the study. Ten TTE studies were performed by an echo-cardiographer (group 1) and 10 by a cardiac sonographer (group 2). Both examiners wore specially designed laboratory coats holding 7 thermoluminescent dosimeter badges (TLD’s) arrayed on the forehead, right and left wrists, anterolateral right and left chest, at the level of the sternal notch and the umbilical region. Clinical characteristics, administered radiotracer dose and estimated residual radioactivity were recorded and compared between the two groups. TLD recorded radiation levels were measured and compared with respect to position and examiner. TLD estimates of radiation exposure were deemed positive if above the threshold of 0.1 mSv, indicating if exposure of the examiner was at a level measurable by standard personal monitoring methods.

Results: There was no significant difference between the two groups in patient weight (78.1 ± 16.2 vs. 80.6 ± 14.7 kg, p=0.74), BMI (28.8 ± 4.2 vs. 28.5 ± 6.2 kg/m2, p=0.88), estimated residual radioactivity at the start of the TTE (906 ± 81 vs. 884 ± 73 MBq, p=0.57) or duration of TTE (45.4 ± 5.3 vs. 39.0 ± 8.2 minutes, p=0.051). Estimates of radiation exposure were positive in group 1 in the badges positioned in the anterolateral right chest and hand, 0.45 mSv and 1.02 mSv respectively, and in group 2 in the anterolateral right chest, right wrist and the umbilical region, 0.59 mSv, 1.06 mSv, and 0.15 mSv respectively.

Conclusion: Current results indicate that examiners performing TTE in patients who had same-day MPI can show positive levels of radiation exposure. In institutions in which it is expected that a relatively high number of patients may undergo both types of examinations on the same day the sequence of performing TTE and MPI should be scheduled to reduce occupational radiation exposure. If planned exposures for medical staff performing echocardiography studies could possibly fall in the range of 1 to 20 mSv/year these teams should be monitored according to the recommendations and guidelines of the International Commission of Radiological Protection (ICRP).
Background: There are various physical factors that limit the quality of the Single Photon Emission Computed Tomography (SPECT) images. The study will examine different acquisition parameters for the gamma camera such as matrix size and motion type. Also, it will cover the processing parameters like filtered back projection and iterative reconstruction techniques. Objective: The aim of the present work is to evaluate physical acquisition parameters affecting the cardiac imaging to optimize the patient’s examination time and image quality that are acquired with the gamma camera and workers radiation protection (through reducing time of radiation exposure) in cardiac SPECT facilities.

Methodology: The SPECT phantom filled with water mixed with (25 mCi) of 99m Tc, was positioned on a special holder attached to the imaging table. The cylinder axis of the phantom was parallel to the axis of rotation of gamma camera detector, within the rotational Useful field of view.

Results: A non-significant difference observed between contrast values in 128x128 and 64x64 matrix size. The count rate with 64x64 higher is greater than the count rate with 128x128 matrix size and that is because the pixel size in 64x64 is larger than pixel size in 128x128 matrix size, at which it is able to collect more counts. This is the same effect as in FBP, a non-significant difference observed in contrast values in 128x128 and 64x64 matrix size. Count rate with 64x64 is greater than 128x128. But generally, the contrast by using iterative method is higher than when using FBP in each matrix size. A statistically significant difference is observed in contrast values by changing motion type. But generally, the contrast by using iterative method is higher than it is by using FBP in each motion type.

Conclusion: Generally, we found that the image contrast by using iterative method is higher than when using FBP with most factors. The big advantage of the iterative approach is that accurate corrections can be made for all physical properties of the imaging system and the transport of g-rays that can be mathematically modelled. In the present study, it was found that matrix size doesn’t affect contrast values in SPECT studies, but contrast by using matrix 128x128 is small higher than 64x64. S&S also continues to give the best contrast value in motion types. In Matrix Size, a non-significant difference was observed between contrast values in 128x128 and 64x64 matrix size. In Motion Type, a statistically significant difference was observed between contrast values by changing motion type. S&S continues, gives the best contrast value. Finally, contrast parameter in SPECT studies by using Iterative method is higher than when using FBP with most physical factors.
Abstract ID: 178

**Occupational Doses Evaluation in Interventional Cardiology Using Active Dosimeters**

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**Background:** The knowledge of occupational doses associated to adverse effects risks is not dispersed completely among interventional cardiologists. The occupational doses evaluation helps to optimize the actions of protection and improving the culture of radiation protection. Our goal is to evaluate the occupational doses during interventional cardiology procedures including for diagnosis and therapy.

**Methodology:** This study was conducted at the university hospital of Universidade Federal de São Paulo-UNIFESP. 69 patients, both genders, underwent catheterization, angioplasty and both procedures. The procedures were performed by cardiologists at INNOVA 3100 GE angiography equipment installed with table-mounted lead drapes but without lead acrylic eye shield. We measured the occupational effective doses using active dosimeters manufactured by Mirion Technologies, Inc. (Instadose™) at left and right eyes, chest (over apron) and left ankle of cardiologists. We randomly selected 19 procedures in which we attached thermoluminescent dosimeters (TLD100) at the same regions in order to take them as reference detector. We recorded the anthropometric data as well as the technical data displayed in the monitors at the end of procedures.

**Results:** Considering the 50 procedures, the 3rd quartile (and median) values for DAP and Kerma Cumulative Dose were 13710 (8130) Gy.cm² and 2255 (1078) mGy. The 3rd quartile (and median) values for occupational effective doses were 0.088 (0.050) mSv (left eyes’ region); 0.0 (0.0) mSv (right eyes’ region); 0.10 (0.05) mSv (chest) and 0.15 (0.07) (ankle). The results (n=19) of occupational effective doses’ average value [range] using TLDs were: 0.082 mSv [0.028-0.418] for left eyes region; 0.026 mSv [0.002-0.082] for right eyes region; 0.101 mSv [0.017-0.389] for chest and 0.220 mSv [0.008-0.955] for ankle. The results (n=19) using active dosimeters were: 0.079 mSv [0.0-0.480] for left eyes region; 0.008 mSv [0.0-0.069] for right eyes region; 0.080 mSv [0.0-0.407] for chest and 0.100 mSv [0.0-0.570] for ankle. The 3rd quartile (and median) values for patient age and corporal mass index were 75 (63) years and 29.7 (27.0) Kg/m².

**Conclusion:** The occupational doses range is large once it is depending on technical- operational conditions and of the procedures complexity, as expected and demonstrated by using both kinds of dosimeters. The preliminary results indicate a sensitivity threshold lower for active dosimeter when compared with TLD for low levels of scattered doses. Important uncertainties are associated with these preliminary results meaning that it will be necessary to extend the data. The occupational doses in left eye region were higher when compared with right region and near to chest region values demonstrating the relevance of proper eye shield. The values obtained in the ankle region were the highest among measured points suggesting the importance of table-mounted lead drapes protection.
Myocardial Perfusion SPECT with General Purpose Collimators and Resolution Recovery: A Highly Accessible Means of Population Radiation Dose Reduction

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Background: In 2015, our department performed 1164 myocardial perfusion SPECT (MPS) studies. The median [inter-quartile range] administered activity for patients was 322MBq [289–378] giving a total radiopharmaceutical radiation dose (stress + rest) of 5.14mSv [4.63–6.05]. This is well below the 9mSv target set by ASNC recommendations. We employ 7/8 “best practice” techniques outlined in the recent IAEA INCAPS study: two-day imaging only with Tc-99m agents; a weight-based protocol and iterative reconstruction with resolution recovery (RR). The use of a solid-state gamma camera would enable a further dose reduction, however these cameras are expensive and have limited use. Additionally, INCAPS data showed that they account for <10% of MPS worldwide. We believe a more universal approach for dose reduction is to move from LEHR to more sensitive LEGP collimators, in combination with RR.

Methodology: Following a published multi-vendor phantom validation, we report findings from our clinical evaluation using LEGP collimators with RR. Patients were scanned sequentially with LEHR and LEGP collimators. Counts in the myocardium were matched by discarding counts from the LEGP image translating to a 40% reduction in administered activity. Based on the initial phantom validation work, optimum pixel size was 6.8mm for LEHR and 4.4mm for LEGP images.

Results: Clinical data showed that image quality with LEGP collimators is at least as good as those acquired with LEHR collimators (see figure: image shows stress (S) and rest (R) data with LEHR and LEGP collimators). On average, end-systolic and end-diastolic volumes were 16% (P<0.001) and 20% (P<0.001) greater respectively in LEGP images. On average, left ventricular ejection fraction was 3.5% points lower (P=0.009) in LEGP images. These changes are likely due to differences in pixel size.

Conclusion: This work with LEGP collimators demonstrates a simple and highly accessible method for attaining significant radiation dose reductions for MPS. Our findings give the potential for a radiation dose for two-day stress-rest MPS of 3-4mSv when using LEGP collimators. This would equate to a collective dose saving of ~2.3 man Sieverts for our 2015 workload. This dose reduction does not compare with that achievable using a solid-state camera, however, worldwide 90% of MPS utilises conventional gamma-cameras, which are likely to have LEGP collimators. Consequently, we believe this approach will result in a far greater reduction in total population radiation dose for MPS than that achieved by dedicated technology. This method should be accessible to all and therefore become widespread, without incurring additional cost and would be of particular interest to single-camera centres. Cost savings through reduced radio-pharmaceutical usage will appeal to centres, particularly in developing countries and to all departments being affected by technetium-99m shortages predicted in the coming years. Finally, this work highlights the key role that medical physicists play in the development and optimisation of imaging techniques, which can only be achieved through close work with their clinical colleagues.
Dose Reduction in Computed Tomography through Image Quality Improvement

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Background: Computed Tomography (CT) is one of the most commonly used medical imaging techniques, use X-rays to get a multidimensional image of the human body’s internal organs through several multidimensional images pick up about a fixed axis of rotation. CT provides high image quality showing the interior details with high precision. The risk of using CT as a medical imaging technique is the higher radiation exposure for obtaining the image with the required accuracy.

Objective: Dose reduction in cardiothoracic radiology by improving the image quality using advanced digital image processing techniques.

Methodology: Two sets of images taken by radiation exposure, the first set (number =60) was exposed to 100-kV tube voltage imaging and the second set (number = 60) was exposed to 120-kV tube voltage imaging. The image quality of the two images sets is improved by performing some image processing techniques for cardiothoracic image enhancement, and performing qualitative and quantitative evaluation of these techniques. Contrast enhancement, filtering, and denoising processes are carried out. The contrast enhancement is carried out using the adaptive histogram equalization. The filtering is carried out using median, Wiener, Lee, and Kuan filters. The denoising is carried out using wavelet and Curvelet transforms. The results are evaluated quantitatively using the Peak Signal to Noise Ratio (PSNR), Root Mean Square Error (RMSE), image smoothness, and Structural Similarity (SSIM). The results are evaluated qualitatively by two independent observers who were blinded to group allocation graded interpret-ability and the image qualities were recorded and compared.

Results: The quantitative evaluation shows that the contrast enhancement improves the image quality by improving the contrast between the image background and the object regions. Winner filter gives the lowest RMSE because it is designed for minimizing the MSE, which leads to a higher PSNR. The values of the image smoothness and the structural similarity have small difference between the different filters and the Winner filter still provides the best results. The denoising using Curvelet transform provides a little improvement of the PSNR compared to denoising using the wavelet transform. The qualitative evaluation shows that the same interior details of the image can be obtained when using either 100-kV imaging or 120-kV imaging.

Conclusion: The reduction of tube voltage imaging from 120-kV to 100-kV leads to a reduction in radiation dose, while the same interior details of the image can be obtained using either 100-kV imaging or 120-kV imaging. The cardiothoracic image quality can be improved using contrast enhancement, Winner filter, and Curvelet transform denoising.
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