The Current Role of Nuclear Cardiology
In Modern Health Care

IAEA Consultants’ Meeting
Vienna, Austria
August 23-27, 2010

Fernando Mut, MD
Uruguay
• Nuclear Cardiology: diagnosis vs. prognosis.

• Evidence for cost-effectiveness in CAD management.

• The need for quality studies.

• The role in prevention: asymptomatic patients.

• The power of combined (hybrid) imaging.

• Technical improvements.

• Functional imaging of atherosclerosis.
Cardiovascular deaths in the U.S. 1979 - 2004

Rosamond et al. Circulation 2008
Prognostic Value of MPI in Definite or Suspected CAD (n=28,920)

Event rate %

0.77% / yr
5.2% / yr

Underwood Eur J Nuc Med & Molecular Imaging 2004
Relationship Between Extent of Ischemia and Cardiac Events*
(n=1,689)

Adapted from Ladenheim ML, et al. J Am Coll Cardiol 1986

*Imaging protocols included thallium.

Adapted from Ladenheim ML, et al. J Am Coll Cardiol 1986
Prognostic Value of MPI (n=69,655)

- Low Risk: Normal Perfusion or SSS 0-3
- High Risk: Large Defects, SSS>13

- TI-201
- Tc-99m Sestamibi
- Tc-99m Tetrofosmin

- 0.85% / yr
- 5.9% / yr

Shaw & Iskandrian J Nuc Cardiol 2004
Current State of Health Care Systems

- **High Cost of “Sickness” or Symptom Care**
  
  ~50% of health care costs for end-stage or hospital care.

- **Reduced Cost for “Well” or Subclinical Care**

  **Early Intervention Model:**

  Shift care to early, subclinical diagnosis potential to reduce end-stage costs

Source: CMS, Office of the Actuary, National Health Statistics Group 2004
Prognostic Value of Quantitative SPECT:
Prediction of Cardiac Death & Nonfatal MI by Extent & Severity of Stress Myocardial Perfusion Abnormalities


![Graph showing the relationship between Summed Stress Score (SSS) and annual percentage of cardiac death (CD) or myocardial infarction (MI).](attachment:image.png)

- **SSS**: 0 (Low), 4 (Mild), 9 (Moderate), >13 (Severe)
- **% Annual CD or MI**
  - Low: 0.3, 0.5
  - Mild: 0.8
  - Moderate: 2.3, 2.9
  - Severe: 2.9, 4.2

Abnormal Stress SPECT: Risk Increases as Function of Perfusion Extent / Severity in All Populations

- No Hx CAD
- Known CAD
- Post-PTCA
- Post-CABG
- Men and Women
- Sx and Asx
- DM
- Elderly

Klocke et al. J Am Coll Cardiol 2003
Prognostic Value of MPS in Definite or Suspected CAD (n=69,655)

Cardiac Death or MI Rate (% / Year)

- Women
- Men
- Diabetics
- Non-Diabetics
- Diabetic Women
- Diabetic Men

High Risk = High Cost!

Low risk
High risk

Shaw LJ, Iskandrian AE. J Nucl Cardiol 2004
Risk of Cardiac Death & Ischemic Burden
Post-SPECT Therapeutic Decisions

10,627 patients
146 Cardiac death
492 All cause mortality

Medical therapy
Revascularization
Reduced risk = Reduced Cost!

*P<0.001

Hachamovitch et al. Circulation 2003
Pre-Rx TPD: 28%

12m TPD: 2%
RR = 0.47 (95% CI = 0.23-0.95) p = 0.037

Rates of Death or MI by Ischemia Reduction

Shaw LJ et al. Circulation 2008
Summary

- **A growing body of Economic Evidence** supports stress MPI testing as CE tool for appropriately selected women & men with known or suspected CAD.

- **CE Diagnostic Strategies in CAD:**
  - MPI as gatekeeper to Angio
  - Intermediate-High Risk pts.
  - Early D/C of ACS pts.
  - Asymptomatic pts.?

- **Stress MPI is a mature technology with well-established body of evidence!**
  - Highly accurate at guiding therapeutic decision making (functional data)
  - Anatomic data influence utilization of revascularization and increase costs; without a direct link to improved outcome.
Simplistic View of Cost Effectiveness Plane

- New Test
  - More Costly
- New Test
  - More Effective
- New Test
  - Less Costly
  - But More Costly
- New Test
  - Less Effective
- Old Test Dominates
- New Test
  - Less Costly
  - But Less Effective
- New Test Dominates
Road Map and Tools for Achieving Quality Nuclear Studies

Patient

Test selection

Image acquisition

Image interpretation

Results communication

Better patient care

Appropriateness criteria
Benchmarking
Provider education

Lab accreditation
Technologist cert.

Lab accreditation
Physician training
Physician competency

Key data elements
Uniform structured reports
Timeliness standards

Registries
Research Outcomes, Value

ACC-Duke Think Tank, JACC 2006
### Population is Aging

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<th>Country</th>
<th>Men</th>
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BRIC: Emerging Economies
Developing Countries

Population is aging

Implications to NC

Life tables for WHO member states, Geneva, WHO 2006
http://www.who.int/whosis/database/life_tables.cfm
Atherosclerosis progression

- Primary Prevention
- Disease Detection
- Risk Stratification
- Secondary Prevention
- Clinical Treatment
- Revascularization
Case from Brazil (Dr. Vitola)

- Man, 49 yo
- Stressful lifestyle
- High cholesterol, Hypertension
- Asymptomatic

- Calcium score CT: 408

- TMT
  - Bruce 14 min
  - ST negative
  - No chest pain
  - Duke Score 14
CCS: Cohort > 10,000 asymptomatic patients

15 - 46% SPECT abnormal

Shaw LS et al. Radiology 2003
He ZX et al. Circulation 2000
Berman DS et al. JACC 2004
Stress – Rest MPI (pre treatment)
Stress – Rest MPI (post PCI ADA)
Annual hard event rates as a function of % myocardium ischemic in asymptomatic pts.

Zellweger et al. J Nucl Cardiol 2009
Event-free survival vs. low or high risk myocardial ischemia in asymptomatic pts.

Zellweger et al. J Nucl Cardiol 2009
Incremental prognostic value of MPI in asymptomatic pts.

Zellweger et al. J Nucl Cardiol 2009
Incremental sensitivity for CAD detection of not-fused vs. fused MPI + CTA over MPI alone

Santana et al. J Nucl Cardiol 2009
MPI + CTA Fusion: single-vessel CAD
MPI + CTA Fusion: multi-vessel CAD
Incremental prognostic value of post-exercise gated SPECT

Candell-Riera et al. J Nucl Cardiol 2009
Advances in technical aspects of MPI

Digirad Cardius 3 XPO
Advances in technical aspects of MPI

CardiArc
Advances in technical aspects of MPI

D-SPECT
Higher System Sensitivity

CPM*10^3

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<th>A-SPECT</th>
<th>D-SPECT</th>
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<td>Stress</td>
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<td>Rest</td>
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* p<0.0001
Advances in technical aspects of MPI

MP-SPECT (Eagle Heart Imaging)
Advances in technical aspects of MPI

GE – Ultra Fast Cardiac
Advances in technical aspects of MPI

SIEMENS IQ SPECT
Stress and rest, 4 min each

SIEMENS IQ SPECT
Advances in technical aspects of MPI

Motion frozen (MF) reconstruction

Slomka et al. J Nucl Med 2004
Human thrombus imaging with 99mTc-Annexin V

Human thrombus imaging with $^{99m}$Tc-Annexin V

Endocarditis foci in rabbit

Rouzet et al. Circulation 2008
Potential for research:

- Clinical – asymptomatic target groups
  
  Pre-clinical evaluation
  Selective prevention
  Indicated prevention

- Technical – new parameters

- Mixed – CTA gold standard?
Candidates for SELECTIVE PREVENTION

- Diabetes >5 years
- Diabetes with poorly controlled glycemia
- Peripheral artery disease
- Cerebrovascular disease
- Atrial fibrillation
- Left ventricular hypertrophy
- Autoimmune diseases
- Non-cardiac major surgery
- Polycystic ovarian syndrome
- Early menopause (<40 years)
- Chronic renal disease
Thank you