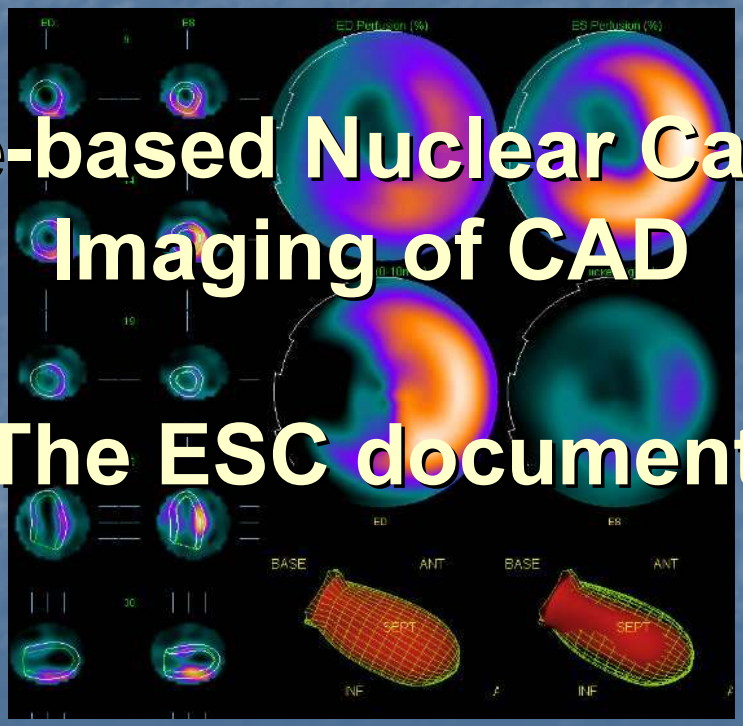
Technical Meeting on:
"Current Role of Nuclear Cardiology in the Management of Cardiac Diseases"
Vienna, 5-9 May 2008
Vienna International Centre

Evidence-based Nuclear Cardiology: Imaging of CAD

The ESC document



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SPECIAL ARTICLE

Clinical value, cost-effectiveness, and safety of myocardial perfusion scintigraphy: a position statement

Diagnostic value of myocardial perfusion scintigraphy in stable coronary artery disease

➔ Diagnosis of obstructive CAD in pts. with intermediate pre-test probability:

- Sensitivity = 87%
- Specificity = 73% (referral bias)
- Specificity using Normalcy Rate = 91%

Evidence: Class I, Level B Issuing body: ESC, ACC/AHA

➔ Additional comments:

- Gated SPECT
- Attenuation correction
- Scatter correction

…increase the accuracy of MPS

Diagnostic value of myocardial perfusion scintigraphy in stable coronary artery disease

- MPS as primary diagnostic test:
  - Women with diabetes
  - Anticipated poor exercise performance
  - Inability to exercise
  - Abnormal resting ECG
- MPS as secondary diagnostic test:
  - Women (alternative)
  - Non-diagnostic ECG
  - Unexpected ECG results
  - Intermediate Duke Treadmill Score

Recommendations for MPS in patients with suspected or known CAD according to current clinical guidelines

Clinical scenario	Recommendation	Issuing body	Class	Level
Chronic chest pain	Diagnosis of CAD in pts. w. intermediate pre-test likelihood:			
	Unable to exercise	ESC	I	B
	Abnormal resting ECG	ACC/AHA	I	B
	Identification of target coronary lesions	ESC ACC/AHA	I	B
	Assessment hemodynamic significance of known coronary lesions	ESC ACC/AHA	I	B
	Evaluation post PCI/CABG	ESC ACC/AHA	I	B

Recommendations for MPS in patients with suspected or known CAD according to current clinical guidelines

Clinical scenario	Recommendation	Issuing body	Class	Level
Acute chest pain	Detection resting ischemia	ESC ACC/AHA	IIb IIa	B
	Detection resting ischemia in low/intermediate risk pts. after UA/NSTEMI	ESC ACC/AHA	I	B
	Detection ischemia in pts. w. uncertain diagnosis	ESC ACC/AHA	I	A
	Assessment of infarct size and myocardium at risk after STEMI	ESC ACC/AHA	I	B

Recommendations for MPS in patients with suspected or known CAD according to current clinical guidelines

Clinical scenario	Recommendation	Issuing body	Class	Level
Pre-operative risk assessment	Risk stratification before elective non-cardiac surgery	ACC/AHA	I	C
Heart failure	Detection of ischemia and viability assessment	ACC/AHA ESC study group report	IIa	B
	Diagnosis of CAD	ACC/AHA	IIb	C

Prognostic value of myocardial perfusion scintigraphy in stable coronary artery disease

- Normal MPS in pts. with interm./high likelihood of CAD predicts very low event rate (≤1%/yr), yielding NPV≥99%.
- Even in pts. with risk factors, low event rate extend for ≥2 yrs.
- Abnormal MPS in pts. with interm./high likelihood of CAD increases annualized event rate x7, with risk 3-7% according to severity of defects.
- LVEF post-stress or EDV ≥70 ml indicate adverse outcome even if perfusion is normal or near-normal.
- Gated SPECT provides additional prognostic info over clinical, ECG and CA data, for the general population, following ACS, and after revasc.
- Markers of LV dysfunction are more predictive of death, markers of ischemia are more predictive of non-fatal cardiac events (angina, IM).

Myocardial perfusion scintigraphy after acute coronary syndromes

- Resting MPS to exclude ACS in pts. with chest pain and non-diag. ECG.
  Evidence: Class II a-b, Level B Issuing body: ESC, ACC/AHA

- Risk stratification in pts. with otherwise low/interm. risk after UA/NSTEMI
  Evidence: Class I, Level B Issuing body: ESC, ACC/AHA

- Selectively in pts. unable to exercise, inconclusive stress ECG, women.
  Evidence: Class I, Level A Issuing body: ESC, ACC/AHA

- Assessment of infarct size and myoc. at risk after uncomplicated STEMI:
  - STEMI with thrombolytic therapy, before CA.
  - STEMI with preserved LV function, uninterpretable ECG.

  Evidence: Class I, Level B Issuing body: ESC, ACC/AHA

Myocardial perfusion scintigraphy before non-cardiac surgery

➔ Risk stratification before elective non-cardiac surgery:

- Intermediate clinical predictors of cardiac risk + poor ex. tolerance
- Intermediate clinical predictors + high surgical risk
- High surgical risk + poor ex. tolerance regardless of clinical predictors

Evidence: Class I, Level C Issuing body: ACC/AHA

➔ Additional comments:

- Information derived from MPS should also be used for subsequent cardiac management of patients after surgery.

Myocardial perfusion scintigraphy for the assessment of viable and hibernating myocardium

➔ Assessment of viability in the initial evaluation of pts. with heart failure, known CAD, and no angina.
Evidence: Class IIa, Level B Issuing body: ACC/AHA

➔ Diagnosis of CAD in pts. with symptomatic LV dysfunction.
Evidence: Class IIb, Level C Issuing body: ACC/AHA

➔ Additional comments:

- Dysfunctional, viable myocardium associated with poor prognosis.
- This can be reversed with appropriate intervention (revascularization).
- European guidelines for chronic heart failure do not address the issue but ESC has made recommendations.

Cost-effectiveness of myocardial perfusion scintigraphy

Stable angina in intermediate likelihood of coronary artery disease

- In pts. with stable angina and intermediate pre-test prob. of CAD, MPS is more cost-effective than sECG and CA.
- MPS-led management results in 23-41% cost savings compared with direct CA.
- Normal sECG does not prevent additional diagnostic testing.
- Normal MPS is a strong deterrent of additional investigations.
- In pts. with known CAD, MPS leads to significant savings by limiting costly procedures to those with high-risk scans.
- Greatest cost-effectiveness in women, resulting in reduction of normal CA and increase in the detection of multivessel disease.

Cost-effectiveness of myocardial perfusion scintigraphy

Acute coronary syndromes

- MPS has a high NP accuracy for ruling out ACS and future cardiac events in pts. with chest pain, non-diagnostic ECG and negative enzymes.
- MPS can reduce costs by avoiding unnecessary admissions without compromising patient outcome.
- MPS-guided chest pain work-up decreases the rate of hospitalization.
- MPS influence triage decisions and lower the threshold for early discharge of pts. with low-risk scans.
- MPS may be particularly cost-effective in special subgroups like diabetics.

Safety

Radiation exposure

- Effective doses of different diagnostic procedures:
  - 1-day MPS (^{99m}Tc, 1600-2000 MBq, 43-54 mCi) = 12-20 mSv.
  - 2-day MPS (^{99m}Tc, 1200-1800 MBq, 32-48 mCi) = 4.5-9 mSv.
  - Stress-redist. (^{201}Tl, 74-111 MBq, 2-3 mCi) = 12.9-19.5 mSv.
  - Stress-redist.-reinj. (^{201}Tl, + 37 MBq, 1 mCi) = + 6.5 mSv.
  - Catheterization coronary angiography = 2-6 mSv.
  - Multi-slice CT angiography = 6-15 mSv.
- Comments:
  - Additional lifetime risk of fatal cancer: 0.04% / Sv in young/middle aged.
  - In elderly pts. risk is balanced by delay in event vs. life expectancy.

Diagnostic modality	Typical effective radiation dose (mSv)	Equivalent number of chest X-rays	Approximate equivalent period of natural background radiation
Chest (single PA film)[1-9]	0.02	1	3 days
Echocardiography[2]	0	0	0
Electron-beam CT[4,5]	1.5–2	75–100	7–9 months
Multi-slice CT[4–7]			
Calcium score	1.5–2.7	75–135	7–14 months
CTCA (16 slices)	6.5–10.7	325–535	2.7–4.4 years
CTCA s/p CABG (16 slices)	12.9	645	5.3 years
CTCA (64 slices)	10.5	400	3 years
Magnetic resonance imaging[1–3]	0	0	0
Catheterisation laboratory			
Diagnostic coronary study (Coronary angiography and ventriculography)[1,8,9,11]	2.1–7	105–350	0.9–2.9 years
Angiography s/p CABG[8]	6.3	315	2.6 years
Aortography[8]	4	200	1.6 years
Coronary angioplasty[1,3,8,9,11]	7.5–57	375–2,850	3–23 years
Carotid stenting[8,11]	10	500	4.1 years
Nuclear cardiology[1–3]			
^{201}Thallium-Cl (2 mCi)	17	850	7 years
^{99m}Technetium tetrofosmin (30 mCi)	8.5	425	3.5 years
^{99m}Technetium sestamibi (30 mCi)	8.9	445	3.7 years

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Safety

Complications from stress tests

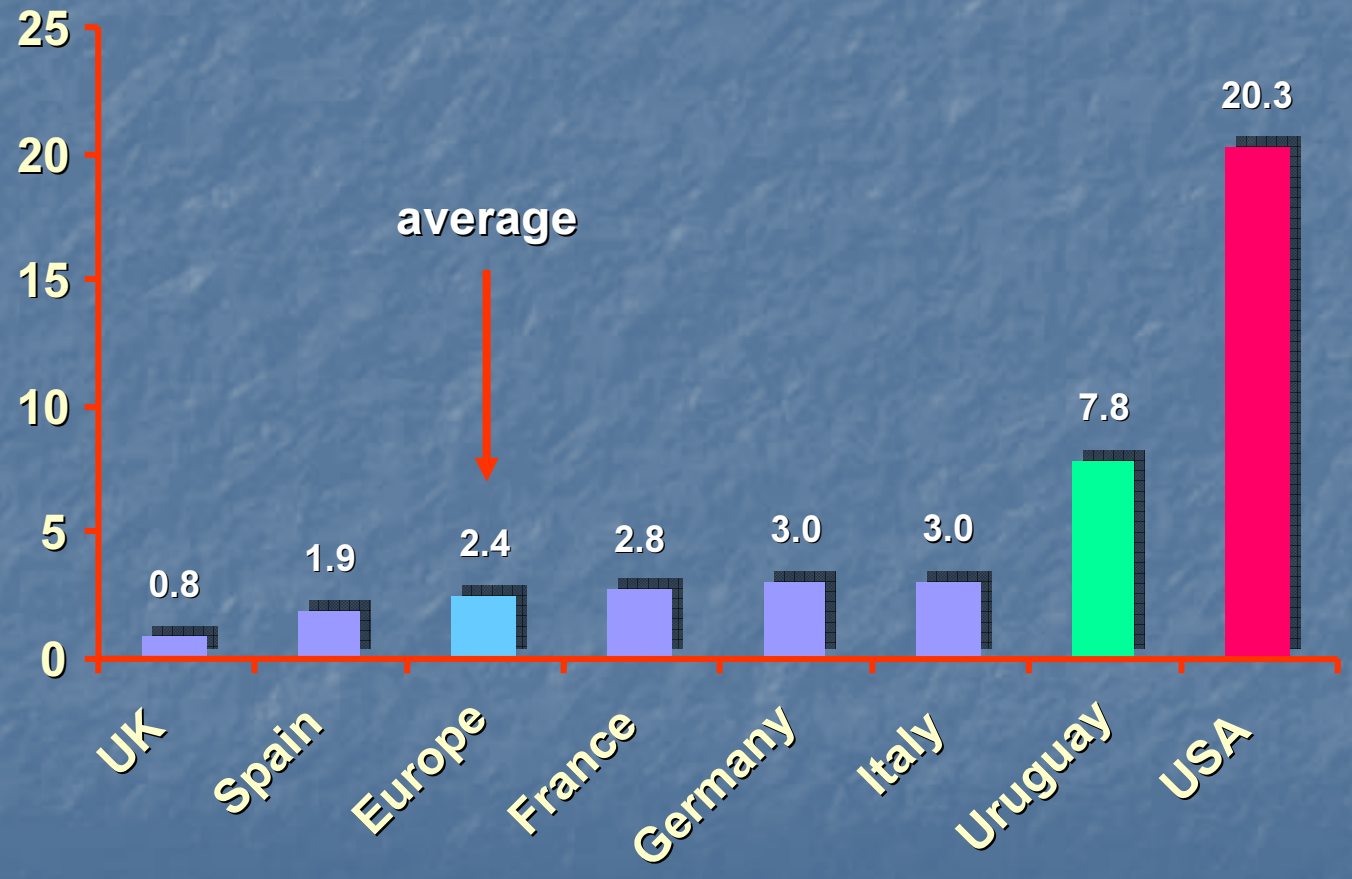
- Complication rates of stress tests (death, IM, sustained VT):
  - Dynamic exercise = 1.2 / 10,000.
  - Dypiridamole = 3.5 / 10,000.
  - Dobutamine = 29.8 / 10,000.

- Comments:
  - For dypiridamole, complication rate is low even shortly after an uncomplicated MI (<3 days).

Conclusions

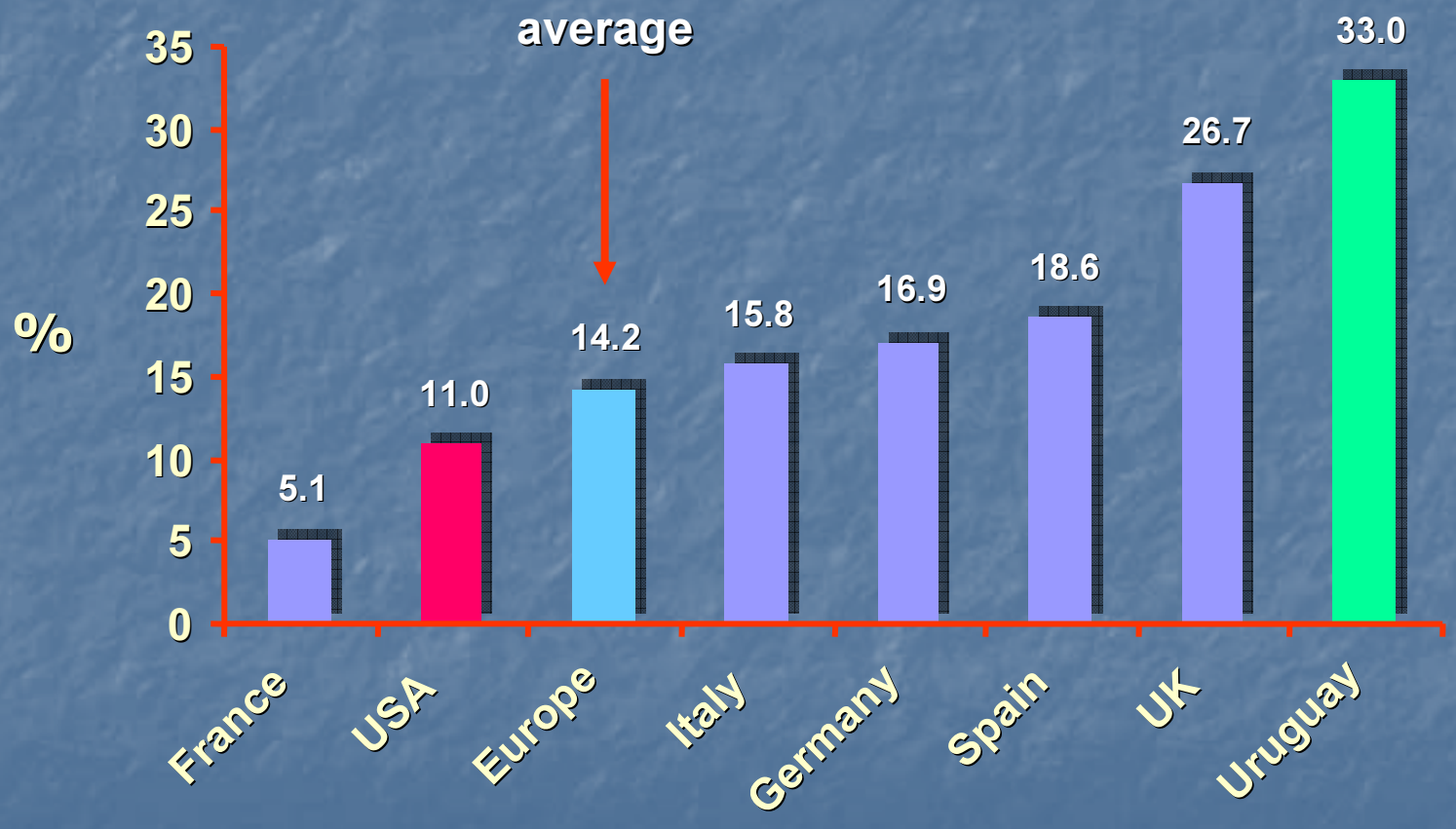
- MPS has proven a safe and highly cost-effective strategy for the early detection of obstructive CAD in symptomatic individuals.
- It is powerful to stratify patients according to their risk of cardiac death or nonfatal MI.
- It assists clinical decision-making with regard to medical treatment or intervention.
- MPS is successfully integrated in several guidelines for clinical practice in cardiology.

Rate of utilization of MPS in 2003 (studies/1000)



Sources: NICE, 2003 – Amersham Health, 2003 – SUBIMN, 2003

Growth of MPS utilization between 1998-2002



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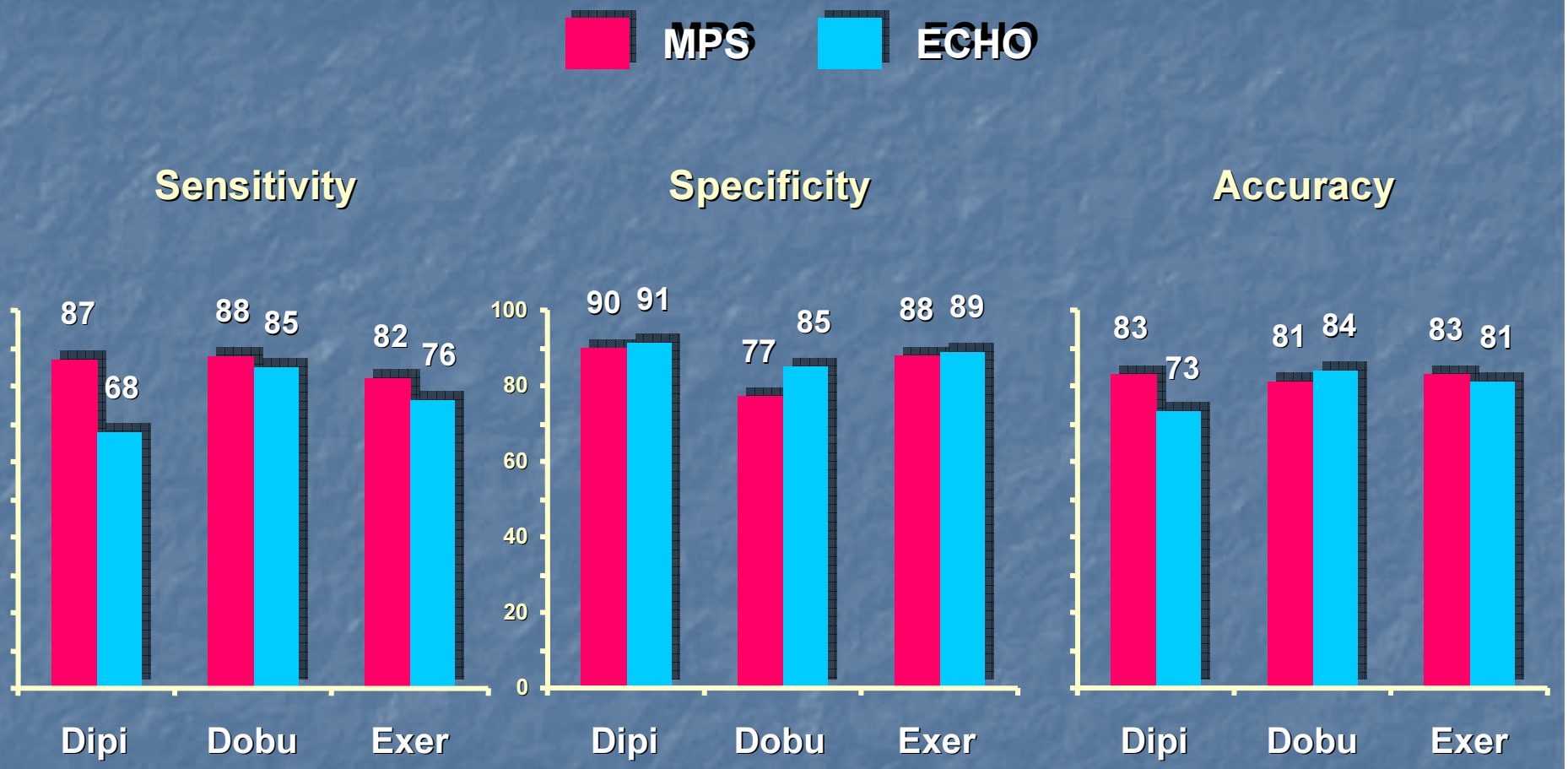
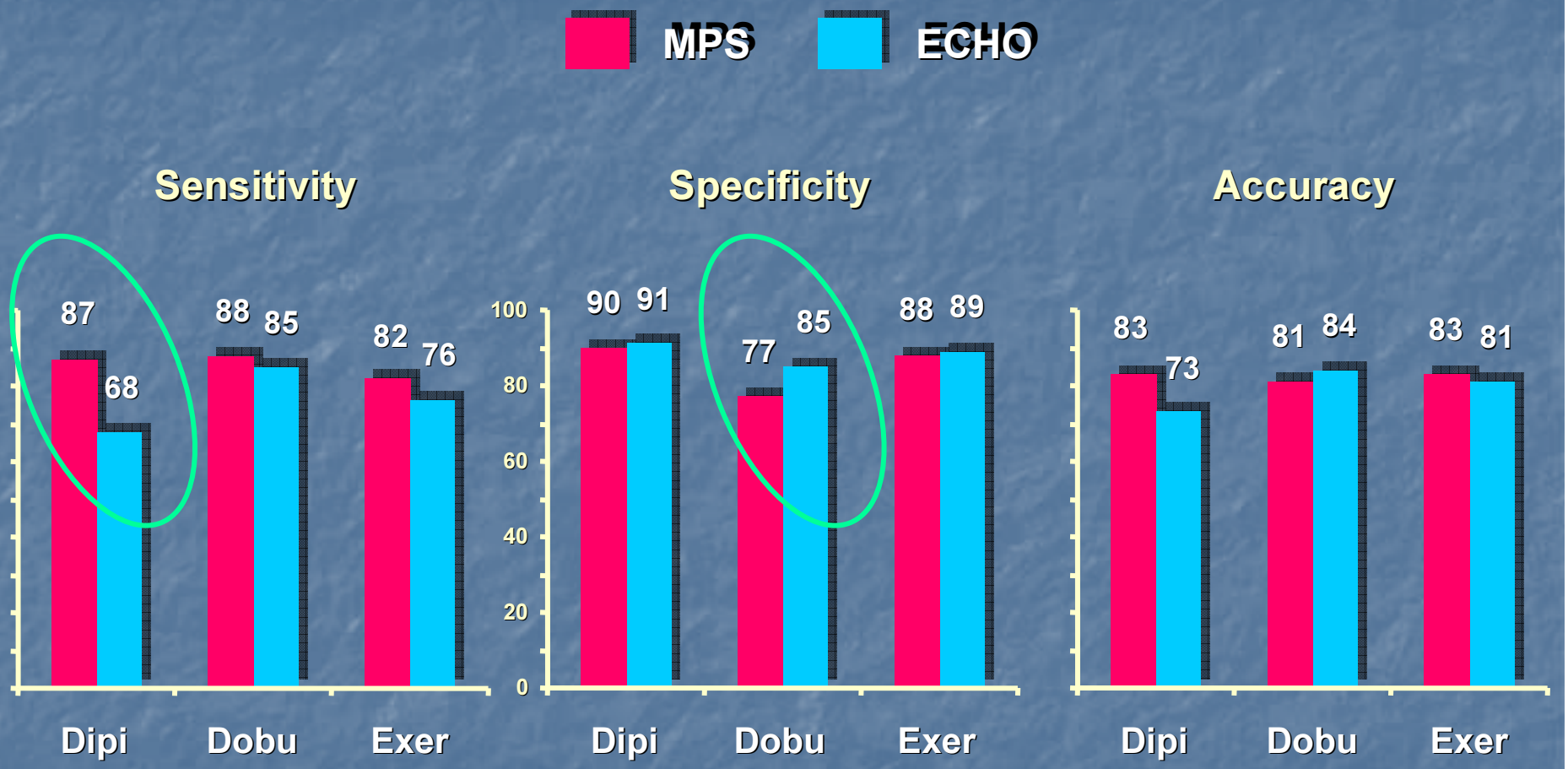
MPS vs. stress Echocardiography



Head-to-head comparison – 23 studies – 1,421 pts. in total.

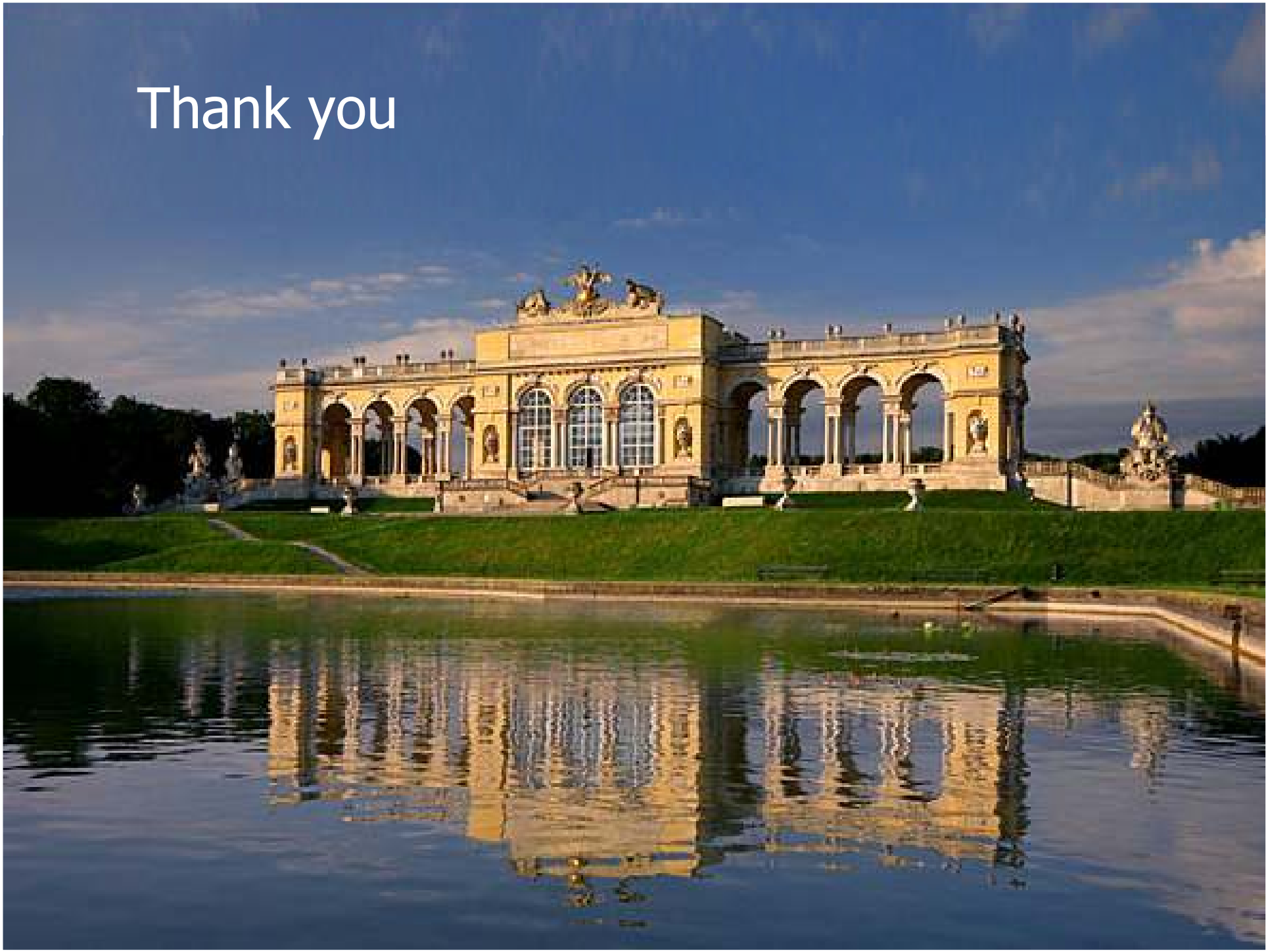
MPS vs. stress Echocardiography



Head-to head comparison – 23 studies – 1,421 pts. in total.

General situation and trends of MPS

- The technique is growing in all countries, at different pace.
- Still underutilized as compared to the USA.
- SPECT is the rule, planar imaging almost disappearing.
- Pharmacologic stress is increasing.
- Attenuation correction rarely applied.
- Gated SPECT increasing but still less than desired.


Thank you