Health Economics Jargon

- cost minimisation
- cost effectiveness
- cost utility
- cost benefit

Global costs

- Rest ECG £20
- Exercise ECG £70
- Echocardiogram (rest) £100
- Echocardiogram (stress) £200
- Myocardial perfusion imaging £220
- Coronary angiography £1100
- PTCA £2500
- CABG £4500
- Hospital bed £300
Historical Background

- Nuclear Perfusion Imaging as "a better stress test"
- Detection of anatomic CAD as benchmark for success
- Gold standard: Coronary Angiography?

Nuclear Cardiology

- Misconceptions:
  - Expensive stress test
  - Sensitivity < 100%
  - False positives, negatives
  - Imperfect correlation with angiography
- Disappointment led to the preference for coronary angiography instead

The Changing Paradigm

- Angiography provides information on anatomy
- Nuclear cardiology provides information on function/physiology
- Physiology is as important as anatomy, and perhaps more important
- Functional testing with nuclear imaging provides comparable prognostic information at lower cost than angiography, non-invasively
- Information provided by nuclear cardiology can reduce cost and optimize treatment

Is Physiology as important as Anatomy?

- Diagnosis of CAD is based on anatomy
- Amount of diseased myocardium, LVEF are powerful predictors of prognosis
- Can nuclear cardiology provide comparable prognostic information?
Prognostic value: Perfusion imaging vs Angiography

- Normal perfusion scan indicates good prognosis, even in patients with known CAD
- Nuclear imaging provides significantly greater information than clinical and stress test data
- Coronary angiography adds little additional data when nuclear, clinical and stress test data available

Prognostic value: Perfusion imaging vs angiography (The Proof)

- VANQWISH Study
- Post MI Risk Stratification Studies
  - INSPIRE study (post infarction study)
  - Patients with stable Chest Pain (COURAGE)
  - Heart Failure (IMAGING-HF)
  - Diabetic Heart Disease (DIAD)

Pharmacologic stress testing post-infarction

Quantitative Adenosine Thallium SPECT for early assessment post-MI Mahmarian et al Circ 1993
- Sensitivity for detection of residual stenosis at infarct-related artery 97%
- Sensitivity for detecting multivessel disease 70%
- Prediction of events by perfusion defect size
- Multivariate analysis
  - Perfusion defect size - potent predictor
  - LV ejection fraction - additional value
  - Number of diseased vessels - P = NS

The VANQWISH Trial
(Veterans Affairs Non-Q Wave Infarction Strategies in Hospital)
920 patients with non-Q MI randomised:

Invasive
MUGA Exercise/dip thallium
Revascularise (PTCA/CABG)

Conservative
Angiogram
Revascularise (PTCA/CABG)

Cath if angina + ECG change, ST depression on TMX or reversible ischaemia in >1 territory
The VANQWISH Trial
(Veterans Affairs Non-Q Wave Infarction Strategies in Hospital)
920 patients with non-Q MI randomised:

Death or Nonfatal Infarct

- Invasive
- Conservative

Discharge
One month
One year

p <0.004
p<0.012
p<0.05

How can use of Nuclear Cardiology reduce cost$?

- By reducing need for angiography / revascularization in low risk patients
- By identifying high risk patients who need intervention
- Evidence: studies comparing diagnostic approaches
  - Comparing outcome of medical vs invasive treatment in non-high risk patients
  - Economics of Non-invasive Diagnosis (ENDS study)
  - Economics of Myocardial Perfusion Imaging in Europe (EMPIRE study)

Cost effectiveness of MPI

Where are the savings?

- patient without CAD discharged without angiography
- patient with CAD managed medically without angiography
- avoid morbidity of angiography
- revascularisation targeted more effectively at high risk patients with most to gain

Economics of Myocardial Perfusion Imaging in Europe (EMPIRE)

- Comparison of diagnostic strategy, cost, diagnostic accuracy & clinical outcome
- 396 patients seen in 8 hospitals for suspected CAD, FU 2 years
- 2 hospitals (one MPI user, one non-user) in each country:
  - France, Germany, Italy, United Kingdom
Economics of Myocardial Perfusion Imaging in Europe (EMPIRE)

- Comparison of 4 diagnostic strategies:
  - 1. Ex ECG -> Cath
  - 2. Ex ECG -> MPI -> Cath
  - 3. MPI -> Cath
  - 4. Cath

- Endpoints: Accuracy and cost of diagnosis, management, clinical outcome

Economics of Myocardial Perfusion Imaging in Europe (EMPIRE): Results

- Lower costs with myocardial perfusion imaging
  - 32% less in patients without CAD
- Better diagnostic/treatment yield for angiography with myocardial perfusion imaging as gatekeeper
  - Lower normal angiogram rate (p = 0.07, 26% vs 43% in non-MPI cath)
  - Higher proportion of patients proceed to revascularization (p<0.05, 47% vs 31%)
- Better long-term freedom from symptoms in MPI users
  - (63% vs 37%, p<0.001)
  - Better targeted revascularization?
Economics of Myocardial Perfusion Imaging in Europe (EMPIRE)

Cardiac Events on follow-up

- Strategy 1
- Strategy 2
- Strategy 3
- Strategy 4
- MPI use
- No MPI use

p < 0.0001

Economics of Myocardial Perfusion Imaging in Europe (EMPIRE)

Mean 2 yr costs (UK pounds) for Pts without CAD

- MPI user
- Non-MPI user

32% lower costs

p < 0.0001

Economics of Non-Invasive Diagnosis Study (ENDS)

• Observational study comparing 2 diagnostic strategies:
  - 5,423 patients referred for direct cath vs
  - 5,826 patients referred for myocardial perfusion imaging with selective cardiac cath.
• 2 groups matched for pretest likelihood of CAD
• Comparisons of clinical outcome and costs
  - 7 hospitals (Cedars-Sinai, Cleveland Clinic, Duke University, Hartford Hospital, Roger Williams Medical Centre, St Louis VA and St Louis University Health Sciences Center)
• Shaw et al. JACC 1999;33:661-9
Compared to direct cath, myocardial perfusion imaging followed by selective cath associated with 30-40% lower revasc rate and equivalent death or MI rate.
Interventional treatment
Medical Treatment

Is Western data valid in Developing Countries?

- Many patients cannot afford numerous tests!
- Limited healthcare resources: concentrate on essentials!
- Price of coronary angiography may be subsidized more than cost of nuclear cardiology: Cheaper to do angiogram!
- Therefore, direct use of coronary angiography may be more cost effective than nuclear cardiology??

Investigation rates

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<th>UK 2000</th>
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Nuclear Cardiology Examinations

USA linear compound growth = 11.5% / yr

Approach

Interventional treatment
Medical Treatment

High risk (>> 1% risk event)
Low risk (< 1% risk event)

MYOCARDIAL PERFUSION IMAGING
Price is not the same as cost!

- **Price** = Amount paid by patient
- **Cost** = Actual cost of providing service, contrast, catheters, operating equipment, hospitalization, effect on subsequent Rx
- Subsidies can hide true cost of procedure
- Subsidies do not reduce cost but transfer cost from patient to taxpayer

Is nuclear cardiology cost-effective in developing countries?

- Due to subsidies, *price* of angiography may be only slightly more than price of nuclear test
- True *cost* of angiography is always greater than nuclear cardiology but may be subsidized (Paid for by taxpayer!)
- Subsidies favoring angiography may result in inappropriate use of angiography and/or PTCA/CABG with hidden costs to healthcare system/taxpayer

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Is nuclear cardiology cost-effective in developing countries?

- Price of nuclear cardiology test can be kept low by combination of high volume, pricing and use of subsidy
- Ratio of cost of nuclear test to cost of angiography important

Summary

- Prognosis and risk of cardiac events varies widely in patients with known or suspected CAD
- High risk patients should have early/urgent angiography and revascularization
- Low risk patients should be treated medically
- Non-selective approach to coronary angiography increases costs without reducing event rate
Summary

• Nuclear cardiology provides functional data which is prognostically as important as anatomic data
• Nuclear cardiology provides comparable prognostic information at lower cost than angiography, non-invasively
• Use of nuclear cardiology can reduce cost and optimize treatment

Summary

• Optimal choice of treatment in CAD requires balancing risk against benefit
• Nuclear cardiology is a valuable, non-invasive, relatively low cost tool in assessing that risk

Atypical chest pain

Stress Rest