Stress Echo: Role in Pre-Operative Assessment

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Talk Outline

- Types stress echo
- Dobutamine stress echo for ischaemia
- Role stress echo in peri-operative work up
- Does revascularisation affect peri-operative outcome
Stress Echo

- Introduced 1979
- 2D echo combined with a pharmacological, physical or electrical stress
- Versatile technique primarily used for detecting ischaemia & determining prognosis
- ESC Class IC indication high risk patients >3 clinical factors
- Diagnostic endpoint for detection myocardial ischaemia:
  - Transient regional wall motion abnormality distal to obstructive coronary artery stenosis
- Other uses:
  - Assessing presence myocardial viability
  - Assessing severity valve disease
  - Occult pulmonary hypertension
Types Stress Echo

- Pharmacological Dobutamine
  - Ischaemia
  - Low flow low gradient AS
  - Myocardial viability
- Physical (bike or treadmill)
  - Ischaemia
  - Valve disease
    - Mitral regurgitation
    - Mitral stenosis
    - Aortic regurgitation
- Electrical (PPM)
  - Ischaemia
Exercise Echo for Ischaemia

- Technically challenging
  - For treadmill test need patient quickly on the couch
  - Upright bike images can be tricky
  - Increased chest wall movement
  - Hyperventilation

- Limited to patients who can exercise

- Higher inter-observer variability compared Dobutamine stress echo

- Lower diagnostic accuracy
Stress Echo Patients with PPM

- Can do stress test via PPM
- Don’t get inotropic effect
  Dobutamine & required target heart rate may exceed device
- If possible use Dobutamine but may need adjust device upper rate
- Generally more tricky studies:
  - Wall motion abnormalities if paced
  - Particularly if switch from paced to unpaced during the stress test
  - ECG may be interpretable
Dobutamine Stress Echo

- Ischaemia
  - Investigation chest pain in patients intermediate risk
  - Assessment known coronary stenoses borderline severity
  - Risk stratification non cardiac surgery
- Benefit full TTE
- No ionising radiation
- Less good investigation exertional breathlessness & no ischaemic history

Argulian E Eur J Echocardiogr 2013
How Do We Do It?

- Omit beta-blockers, Diltiazem, Verapamil 48 hours
- Avoid heavy meal / caffeine on the day
- If windows adequate (95% patients) & no cause for symptoms found:
  - Widespread resting regional wall motion abnormalities
  - Severe PHT
- iv access & 0.5mL iv contrast agent
  - Sonovue
How Do We Do It?

Baseline Images
Dobutamine Stress Echo

- Continuous 12 lead ECG – lead position will be abnormal

- Images:
  - low dose 5micg/Kg/min
  - mid dose 20micg/Kg/min
  - peak 40micg/Kg/min +/- Atropine

- Aiming target heart rate: 220-age – 85%

- End points:
  - Completing protocol & attaining target heart rate at peak dose
  - Development new regional wall motion abnormalities
  - Worsening pre-existing RWMA
  - Failure develop hyperdynamic response
  - Adverse events e.g. VT
  - Chest pain / ECG change
Response to Dobutamine

**Normal**
- Improvement LV function
- Reduction end systolic cavity size
- All LV myocardial segments normal & become hyperdynamic

**Abnormal**
- > 2 adjacent myocardial segments worsen function
- Normal to hypokinetic or akinetic
- Hypokinetic to akinetic / dyskinetic
- Early vs. late
- Minimal myocardial segments vs. widespread
- Failure develop hyperdynamic function
- Sudden deterioration LV function ?? LMS
Contraindications Dobutamine Stress Echo

- Poor echo windows (5% patients BSUH)
- Unable to lie in left lateral position
- Poorly controlled atrial arrhythmia
- Uncontrolled hypertension (systolic >220 or diastolic >120mmHg)
- Acute MI < 6 weeks
- Recent ventricular arrhythmia
Predictive Value DSE

- Higher multivessel disease (MVD) compared single vessel
- Better for LAD territory than posterior circulation
- Exercise echo:
  - Sensitivity MVD
    - 85-100%
  - Sensitivity SVD
    - 59-94%
- Dobutamine increases heart rate & BP
- Dobutamine has primary impact contractility
- Usually target heart rate is reached
- DSE detect 93% patients >50% coronary artery stenosis
- Comparable to nuclear imaging
  - No soft tissue artifact
  - Sensitivity MVD
    - 91-98%
  - Sensitivity SVD
    - 66-95%

False Positive Stress Echo

- Ischaemia when reduction coronary flow reserve (CFR)
- In absence coronary artery disease, CFR reduced
  - Microvascular disease (syndrome X)
  - LVH (hypertension)
- Increased incidence false positive stress echo women
- False positive DSE not without long term risk

Mortality patients false positive & true positive DSE

From J Am Soc Echocardiogr 2010
Negative DSE

- Normal stress echo event rate
  - 0.1% per year non fatal MI
  - 1.1% cardiac death

- Also have prognostic factors
  - LV function
  - Exercise capacity

3D probability cardiac event over 5 years post negative exercise echo

Mazur W J Am Soc Echocardiogr 2003
Peri-Operative MI

- Either ‘conventional’ MI
  - Coronary artery plaque rupture
  - Thrombus formation
  - Vessel occlusion
- Peri-operative stress response:
  - Abnormal cytokine response
  - Catecholamine surge
  - Platelet activation
  - Reduced fibrinolytic activity
  - Vasospasm
- Or sustained myocardial supply / demand imbalance
Why Do a Stress Echo

- Pre-op risk stratification:
  - Assess risk planned surgery
  - Direct pre-op investigation / intervention
  - Inform patient about risk
- Main evidence intermediate & high risk vascular surgery
- Up to 60% patients peripheral vascular disease have underlying coronary disease
- Presence peripheral vascular disease associated with 6.6-fold increase relative risk death from coronary disease
- High risk morbidity & mortality patients with peripheral artery disease undergoing surgical procedures
- Markers increased risk:
  - Angina / prior MI
  - Prior heart failure
  - Severe renal impairment
  - Poor functional capacity
  - Severe valve disease
  - Inducible ischaemia on functional testing
- Peri-op cardiac events low patients few clinical variables
- Inducible ischaemia DSE predictive peri-op cardiac events (death/MI)
- Normal stress echo 100% negative predictive power

Non Vascular surgery

- Less evidence
- Likelihood coronary disease more general population coming for non vascular surgery lower
- Problems relying on cardiac symptoms in orthopedic population

- Dobutamine Stress Echo has incremental value over clinical (Eagle index), ECG & standard echo variables in non vascular surgery
- Normal stress echo 100% negative predictive value
- We can identify patients at increased risk of complication
- Evidence that intervening on coronary disease is elusive

Das MK J Am Coll Cardiol 2000
Does Intervening Help?

- DECREASE-V & CARP trials patients undergoing vascular surgery
- Revascularisation not associated mortality benefit
- DECREASE-V trial patients > 3 risk factors underwent DSE or stress nuclear imaging inducible ischaemia
- only 86% completely revascularised
- Short time interval between intervention & surgery
  - 29/7 (13-65) CABG
  - 31/7 (19-39) PCI
- Trial not powered to show difference between medical Rx & revascularisation in high risk patients
- Deaths patients post revascularisation from ruptured AAA before planned surgery

Poldermans J Am Coll Cardiol 2007
Does Intervening Help?

- CARP trial – nuclear stress testing
- Patients stable coronary disease randomized to medical treatment or revascularisation
- Post vascular surgery no difference in-house mortality or MI
- Non significant trend toward benefit revascularisation in high risk patients
- All male
- But high risk patients were excluded:
  - LMS >50%  
  - Severe AS  
  - LV EF <20%
- Doesn’t help us about role of screening high risk patients and revascularisation

Coronary Artery Revascularization Prophylaxis trial

McFalls NEJM 2004
Does Intervening Help?

- Fatal MI peri-op period often involves unstable plaque & plaque disruption
- Intervening on stable coronary lesion may not add to optimal medical therapy
- PCI & CABG associated acute inflammatory response
- Increased stent thrombosis rate ulcerated lesions & early post procedure

Dangas Circulation 2011, Daemen Lancet 2007

Off label/real world DES thrombosis Rotterdam/Bern Registry
What To do?

- No strong evidence
- Methodological issues with studies
- Some surgery very early post intervention / CABG
- Surgery (cardiac & non cardiac) associated systemic inflammatory response & pro-thrombotic state
- Risk intervention itself

- Coronary intervention symptomatic patients (ESC IA)
- Prophylactic revascularisation asymptomatic patients prior to high risk surgery (ESC IIB)
- Prophylactic revascularisation patient found to have LMS / proximal severe coronary disease following stress echo

Poldermans Eur Heart J 2009
ACC/AHA Guidelines

J Am Coll Cardiol 2007
Any Questions?

“I’m the doctor who brings the cards. I’m a cardiologist.”