A meta-analytic comparison of preoperative stress echocardiography and nuclear scintigraphy imaging

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CRD summary
This review assessed the accuracy of thallium imaging (TI) compared with stress echocardiography (SE) for predicting postoperative cardiac events. The authors concluded that SE was superior to TI in predicting postoperative cardiac events. Data presented indicated that both tests had only moderate/average discriminatory capacity for predicting MI/mortality. Limitations in the analysis and poor study quality may mean that the authors’ conclusions were not reliable.

Authors' objectives
To determine the accuracy of thallium imaging (TI) compared with stress echocardiography (SE) for predicting postoperative cardiac events.

Searching
MEDLINE was searched up to March 2005 unrestricted by language. Search terms were reported and did not include a diagnostic filter. In addition, each article was searched in PubMed under ‘related articles’. References of relevant articles were checked.

Study selection
Study designs of evaluations included in the review
The authors did not state criteria for study design.

Specific interventions included in the review
Studies that assessed SE or TI, or both, were eligible for inclusion if they stated the criteria for a positive test result.

Reference standard test against which the new test was compared
No inclusion criteria were stated for the reference standard test. Details of the reference standard used in the included studies were not reported, but it appeared to be the outcome of surgery (MI or death). In addition, it appeared that referral for angiography and revascularization had been used as an alternative reference standard.

Participants included in the review
Patients undergoing noncardiac surgery were eligible for inclusion. Studies of patients undergoing surgery for lung volume reduction, vascular problems (general), liver or renal transplantation, carotid endarterectomy or abdominal aortic aneurysm were included in the review. Some studies included patients with diabetes mellitus. Patients who did not undergo surgery were excluded from the analysis.

Outcomes assessed in the review
Studies reporting sensitivity and specificity (or from which they could be determined) were eligible for inclusion. Outcomes reported in the review were likelihood ratio (LR) (primary outcome) and sensitivity.

How were decisions on the relevance of primary studies made?
Two reviewers screened all potential studies for inclusion after obtaining full papers; it was unclear if this was carried out independently.

Assessment of study quality
Studies were assessed for methodological quality according to the following criteria: prospective data collection; consecutive enrollment of participants; whether outcome was blinded; routine screening for postoperative myocardial infarction (MI); surgical selection (proportion of patients sent for coronary angiography); and the proportion of patients revascularised. Quality assessment was carried out as part of data extraction, which was performed independently by two reviewers. Disagreements were resolved by discussion and consensus.
**Data extraction**
Two reviewers independently extracted data from the primary studies; any disagreements were resolved by consensus. The sensitivity and specificity of each test for predicting MI or in-hospital death were extracted. In addition, likelihood receiver operating characteristic (ROC) curve and 95% CI were calculated for each study. Patients who did not have surgery were excluded from the analysis.

**Methods of synthesis**

How were the studies combined?
Studies were combined in a meta-analysis using a random-effects model. Pooled likelihood ratios (LRs) with 95% confidence intervals (CIs) were reported. A summary ROC (SROC) was calculated for TI and SE. Publication bias was assessed using funnel plots.

How were differences between studies investigated?
Statistical heterogeneity was assessed using the $I^2$ statistic. Sensitivity analysis was performed to assess the effect of study quality (blinding) and surgical procedure (vascular). Post hoc sensitivity analysis was performed for study date (>1,995) and stressor (dobutamine, dipyridamole or atropine).

**Results of the review**
The majority of studies were not blinded by outcome. Participants in more than half of the studies in both groups were prospectively and/or consecutively enrolled. Routine screening for MI was more frequent in SE than TI studies, but results of the test were used to refer to angiography more often in TI than SE studies. The number of patients with cardiac disease, diabetes or congestive failure was similar across SE and TI studies, but patients evaluated with SE had more previous vascularisation and more patients were using β-adrenergic antagonists.

The unadjusted MI/death rates were 8.1 per cent for TI and 7.5 per cent for SE. SE was found to be superior for predicting a postoperative cardiac event than TI (LR 4.09, 95% CI: 3.21, 6.56 versus LR 1.83, 95% CI: 1.59, 2.10; p=0.0001) with fewer SE false negatives, based on all studies. Where direct comparisons of SE to TI were made, no statistical difference was found between tests, based on seven studies. Including only vascular studies, studies with blinding procedures, studies completed after 1995 or studies with routine screening for post-operative MI did not significantly change the results of the meta-analysis. Significant statistical heterogeneity was reported. However, a negative SE was a better predictor of an uneventful operation than TI (-LR 0.23, 95% CI: 0.17, 0.32 versus 0.44, 95% CI: 0.36, 0.54, P<0.02).

The rate of referral to angiography was more frequent in patients screened with TI than SE (LR 29.1, 95% CI: 18.5, 39.6 versus LR 12.0, 95% CI: 8.7, 16.2; p=0.02). The percentage of patients who were revascularised was greater in SE than TI tests (LR 57.5, 95% CI: 34.0, 81.0 versus LR 29.0, 95% CI: 18.0, 30.1; p=0.05).

**Cost information**
None stated.

**Authors' conclusions**
SE as a screening tool in patients with suspected cardiac disease before noncardiac surgery was superior to TI in predicting postoperative cardiac events.

**CRD commentary**
The review question was supported by inclusion and exclusion criteria, although the authors did not report criteria for reference standard. The search strategy was unrestricted by language, but only one electronic database was searched and no attempt was made to locate unpublished papers. Thus, it is possible that relevant studies were missed, although publication bias appeared to be assessed. Steps were taken to minimize reviewer error and bias in data extraction and validity assessment, but it was unclear whether similar procedures were undertaken for the initial stage of selection of studies. The quality assessment was limited and overall the quality of the included studies was poor (few studies had blinded outcome assessment and consecutive enrolment, and many had small sample sizes). In addition, study details were poorly reported. Data presented indicated that both tests had only moderate/average discriminatory for predicting
MI/death. In view of the heterogeneity found (possibly as a consequence of the lack of defined MI and apparent differences in baseline characteristics) it may not have been appropriate to pool studies. Limitations in the analysis and poor study quality mean that the authors’ conclusions may not be reliable.

**Implications of the review for practice and research**

Practice: The authors suggested that a negative TI should result in little change in perioperative management, but all patients with a positive test should be considered at increased risk for an event and managed with maximal medical treatment. Patients with moderately large defects should be referred to angiography.

Research: The authors did not indicate any implications for research.

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