The utility and potential cost-effectiveness of stress myocardial perfusion thallium SPECT imaging in hospitalized patients with chest pain and normal or non-diagnostic electrocardiogram

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Record Status
This is a critical abstract of an economic evaluation that meets the criteria for inclusion on NHS EED. Each abstract contains a brief summary of the methods, the results and conclusions followed by a detailed critical assessment on the reliability of the study and the conclusions drawn.

Health technology
The study examined the use of stress myocardial perfusion with thallium-201 to identify patients at high-risk for acute myocardial ischaemic events, who presented with chest pain and normal or non-diagnostic electrocardiogram (ECG).

Type of intervention
Diagnosis.

Economic study type
Cost-effectiveness analysis.

Study population
The study population comprised patients presenting with angina-like chest pain and a normal or non-diagnostic 12 lead ECG. Patients with suspected myocardial infarction (MI), known prior MI, percutaneous transluminal coronary angioplasty, or coronary artery bypass graft were not included.

Setting
The setting was a hospital. The economic study was carried out in Israel.

Dates to which data relate
The collection of effectiveness and resource use data started between July 1996 and September 1997 and lasted for an average of one year. The price year was not reported.

Source of effectiveness data
The effectiveness evidence was derived from a single study.

Link between effectiveness and cost data
The costing was carried out retrospectively on the same sample of patients as that used in the effectiveness analysis.

Study sample
Power calculations were not reported. A sample of 109 consecutive patients (52% male), with a mean age of 60.7 (+/- 13.7) years, was identified at the authors’ institution and considered for the analysis. After the thallium scan was performed, the patients were divided into two groups, according to whether the scan result was normal or abnormal, in order to examine the outcomes in the follow-up period. There were 25 patients (52% male) with an abnormal scan result and 84 (52% male) with a normal scan result. The mean age was 67 (+/- 12) years in the abnormal scan group and
59 (+/- 14) years in the normal scan group.

**Study design**
This was a case-control study that was carried out in a single centre, the Rabin Medical Center in Israel. All patients underwent a stress test, using either the symptom-limited treadmill exercise test (37 patients) or a pharmacologic stress test (dipyridamole; 72 patients). The patients were followed for one year using telephone interviews, and physicians' and hospitals' office records. The scan results were reviewed by two observers who were unaware of patient identity. The average length of follow-up was 11.7 (+/- 5.3) months. No patient was lost to the follow-up assessment.

**Analysis of effectiveness**
All of the patients included in the initial study sample were accounted for in the effectiveness analysis. The main outcome measures were:

- the rates of adverse cardiac events and revascularisation procedures;
- the positive and negative predictive values of abnormal scan results; and
- the length of hospitalisation from admission until scan performance, and from scan performance until discharge.

The analysis revealed that patients with abnormal scan results were significantly older, more hypertensive, and more likely to have had an abnormal stress ECG. Univariate and multivariate regression analyses were performed to identify independent predictors of adverse cardiac events.

**Effectiveness results**
In the group of patients with normal scan results (84), there was one nonfatal MI, while in 83 patients (98.8%) no events were observed during the follow-up period. Eleven coronary angiographies were performed.

In the group of patients with abnormal scan results (25), there were 6 (24%) nonfatal MIs and 1 (4%) cardiac death, while 10 patients (40%) did not experience any event. In this group, 14 coronary angiographies were performed, 4 patients (16%) underwent coronary artery bypass grafting, and another 4 patients (16%) underwent percutaneous transluminal coronary angioplasty.

Abnormal scans had a positive predictive value of 28% and a negative predictive value of 99%.

In the group of patients with abnormal scan results, the number of abnormal segments was 2.7 (+/- 2.3) in patients with 'hard' cardiac events and 6.7 (+/- 3.2) in patients with 'soft' cardiac events. All of the differences observed were statistically significant.

There was no statistically significant difference between the groups in terms of hospital stay from admission until scan performance. However, the length of hospital stay from scan performance until discharge was 6.8 (+/- 6.5) days in the abnormal scan group and 1.1 (+/- 2.4) days in the normal scan group, (p<0.00001).

The univariate regression analysis showed that hypertension, abnormal stress ECG, treatment with anti-anginal therapy, and abnormal thallium perfusion scan were predictors of adverse cardiac events. However, a multivariate regression analysis revealed that abnormal thallium perfusion scan was the only independent predictor of adverse cardiac events, (p<0.0016; odds ratio 32.3, confidence interval: 3.7 - 279).

**Clinical conclusions**
The effectiveness analysis showed that stress thallium-201 myocardial perfusion imaging had a significant prognostic value in patients hospitalised with angina-like chest pain and a normal or non-diagnostic ECG. The diagnostic test was effective in identifying those patients at high-risk for adverse cardiac events, for whom further invasive investigations were needed.
Measure of benefits used in the economic analysis
The health outcomes were left disaggregated and no summary benefit measure was used in the economic analysis. In effect, a cost-consequences analysis was carried out.

Direct costs
Discounting was not relevant since the costs were incurred during a short timeframe. The unit costs were presented separately from the quantities of resources used for most items. The health services included in the economic evaluation were scan imaging (using either exercise or pharmacological stress test), hospital stay coronary angiography, percutaneous transluminal coronary angioplasty and coronary artery bypass graft. The cost/resource boundary of the third-party payer appears to have been adopted. The costs were derived from the Israeli Health Authorities. The quantities of resources used were based on actual data derived from the sample of patients included in the effectiveness analysis. The price year was not reported.

Statistical analysis of costs
Statistical tests were performed to test the statistical significance of differences in the estimated costs.

Indirect Costs
The indirect costs were not considered in the economic evaluation.

Currency
New Israeli shekels (NIS). The exchange rate from NIS to US dollars ($) in September 2001 was NIS 4.33 = $1.

Sensitivity analysis
Sensitivity analyses were not carried out.

Estimated benefits used in the economic analysis
See the 'Effectiveness Results' section.

Cost results
The estimated cost per patient from admission to hospital discharge was NIS 11,193 for patients with a normal scan, and NIS 31,079 for patients with an abnormal scan.

Shortening hospital stay from admission until scan performance to 2 days led to reduced management costs for patients with normal scan results (from NIS 11,193 to NIS 7,243).

Omitting the unnecessary coronary angiographies would further reduce the total cost to NIS 6,058 for patients with a normal scan and NIS 28,052 for patients with an abnormal scan.

The reduction in costs for patients with a normal scan was statistically significant, (p<0.05).

Synthesis of costs and benefits
A synthesis of the costs and benefits was not relevant since a cost-consequences analysis was performed.

Authors' conclusions
Stress thallium-201 myocardial perfusion imaging performed in patients hospitalised with angina-like chest pain and a
normal or non-diagnostic electrocardiogram (ECG) would accurately distinguish patients requiring further diagnostic evaluation due to the high risk of experiencing adverse cardiac events (patients with abnormal scan results) from those who could be safely discharged from hospital (patients with normal scan results). The higher accuracy resulted also in cost-savings from the perspective of the service provider.

CRD COMMENTARY - Selection of comparators
The choice of the comparators (patients with normal versus abnormal scan results) was appropriate as it was possible to compare the outcomes associated with the different follow-up resulting from the results of the test. Although the objective of the study was to compare normal and abnormal scan results, it would also have been interesting to have compared the accuracy of thallium-201 with other diagnostic techniques that were only partially presented in this analysis. You should decide whether they are valid comparators in your own setting.

Validity of estimate of measure of effectiveness
The effectiveness evidence came from a case-control study. This has a limited internal validity, not only because of the retrospective design but also because the clinical outcomes were examined on the basis of the outcome rather than the intervention received. The scan results were interpreted by observers who were unaware of the patients’ identities. This should limit the impact of assessment bias. The length of the follow-up was appropriate. The study sample consisted of a consecutive group of patients and was likely to have been representative of the patient population. However, the evidence came from a single centre, which could limit the generalisability of the study results. Statistical analyses were conducted to investigate the possible impact of confounding factors. No justification was provided for the choice of the sample size. In fact, the authors acknowledged that the small sample size was a limitation to their analysis. These issues limit the internal validity of the analysis.

Validity of estimate of measure of benefit
No summary benefit measure was used in the analysis because a cost-consequences analysis was conducted. Please refer to the comments in the 'Validity of estimate of measure of effectiveness' field (above).

Validity of estimate of costs
The cost analysis was limited to the costs borne by the hospital for patient management. Resources incurred outside of the hospital setting, or after the initial hospitalisation, were not considered. Therefore, a narrow perspective was adopted in the analysis. The unit costs were provided for each item, which enhances the possibility of replicating the analysis. Similarly, the source of the data was given. However, the price year was not reported, which makes reflation exercises in other settings difficult. Statistical analyses of the costs were carried out, but the cost estimates were specific to the study setting and no sensitivity analyses were performed.

Other issues
The authors did not compare their findings with those from other studies. They also did not address the issue of the generalisability of the study results to other settings. Sensitivity analyses were not performed, which limits the external validity of the analysis. The study referred to a general group of patients with diagnostic uncertainty and this was reflected in the authors’ conclusions. The authors noted some limitations of the study. These included the small sample size, the lack of blinding, and the potential impact of selection bias.

Implications of the study
The study results suggested that referring a clinically stable patient with a normal thallium scan to an aggressive evaluation added no prognostic value and was not justified. Therefore, a patient hospitalised with chest pain and non-diagnostic ECG, undergoing a stress thallium-201 test 48 hours after admission, should be safely and efficiently discharged with no need for further inpatient or outpatient cardiac evaluation.
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