HERU Briefing Paper

HEALTH ECONOMICS RESEARCH UNIT

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THE VALUE OF MYOCARDIAL PERFUSION SCINTIGRAPHY IN THE DIAGNOSIS AND MANAGEMENT OF ANGINA AND MYOCARDIAL INFARCTION: A PROBABILISTIC ECONOMIC ANALYSIS

Key Messages

1. **Coronary heart disease (CHD) is the commonest cause of death in the UK.**
2. **The use of myocardial perfusion scintigraphy (SPECT) for diagnosis appears worthwhile.**
3. **When it is believed that CHD is highly likely to be present, there is no gain from using SPECT.**
4. **Other non-invasive methods of diagnosing CHD exist, and additional research is needed to determine the value of these approaches.**
5. **Further research is needed to better determine longer-term outcomes, especially on the use of these services and on quality of life following diagnosis.**

Background

Coronary heart disease (CHD) is the most common cause of death in the UK, causing over 106,000 deaths in 2004. Death rates in the UK are amongst the highest in the world, and there were over 421,000 inpatient cases receiving treatment for CHD in NHS hospitals in 2004/2005. This represents 5% of all inpatient cases in men and 2% amongst women. The cost of CHD to the UK health care system in 2003 was estimated as £3.5 billion rising to £7.9 billion when informal care and productivity losses were included.

Coronary artery disease (CAD) is the most common cause of CHD, with most CAD caused by the narrowing of the large and medium sized arteries serving the heart. Methods of detecting and assessing the presence and extent of CAD have become increasingly important in deciding treatments. Alternative health technologies exist to do this but their relative merits are uncertain.

The aim of this study was to perform an economic evaluation on the use of Single Photon Emission Computed Tomography myocardial perfusion scintigraphy (SPECT) for diagnosis and management of CAD compared to other methods of making a diagnosis.

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Method

Diagnostic strategies involving SPECT with or without Stress Electrocardiography (ECG), and Coronary Angiography (CA), were compared to diagnostic strategies that did not involve SPECT. A well recognised approach, a decision tree framework, was used to model the different combinations of tests that formed part of the different diagnostic strategies compared. For each strategy considered, the probability of making a correct or incorrect diagnosis was estimated. The longer term consequences of the different possible diagnoses were estimated using a particular type of decision analysis framework, a Markov Model, describing the management of patients with suspected CAD.

Structure of the decision tree model (Figure 1)

The strategies considered in the decision tree were derived following consultation with clinical colleagues and from the literature. The strategies compared were:

a) ECG; followed by SPECT if the findings of the stress ECG were positive or indeterminate; followed by CA if the findings of the SPECT were positive or indeterminate

b) ECG; followed by CA if the findings of the ECG were positive or indeterminate

c) SPECT; followed by CA if the findings of the SPECT were positive or indeterminate

d) CA (invasive test as first option)

A patient who has survived the diagnostic process would be classified in one of the following seven diagnostic situations:

a) Low Risk

b) Medium Risk

c) High Risk

d) Classified as low risk but actually high risk (a false negative)

e) Classified as low risk but in fact medium risk (a false negative)

f) Classified as medium risk but actually low risk (a false positive)

g) Classified as medium risk but actually high risk.

Structure of the Markov model

The diagnostic situations described above represent the situations that a patient may find themselves in at the start of the Markov model. The Markov model itself is composed of a set of states of health which define the longer term consequences of each diagnosis. The likelihood that the patient might experience any of these consequences is given by a set of state transition probabilities. Within the model it is assumed that a patient can only move between health states once per cycle. The cycle is a relevant time period meaningful to the development of CAD, which in this case was taken to be one year.

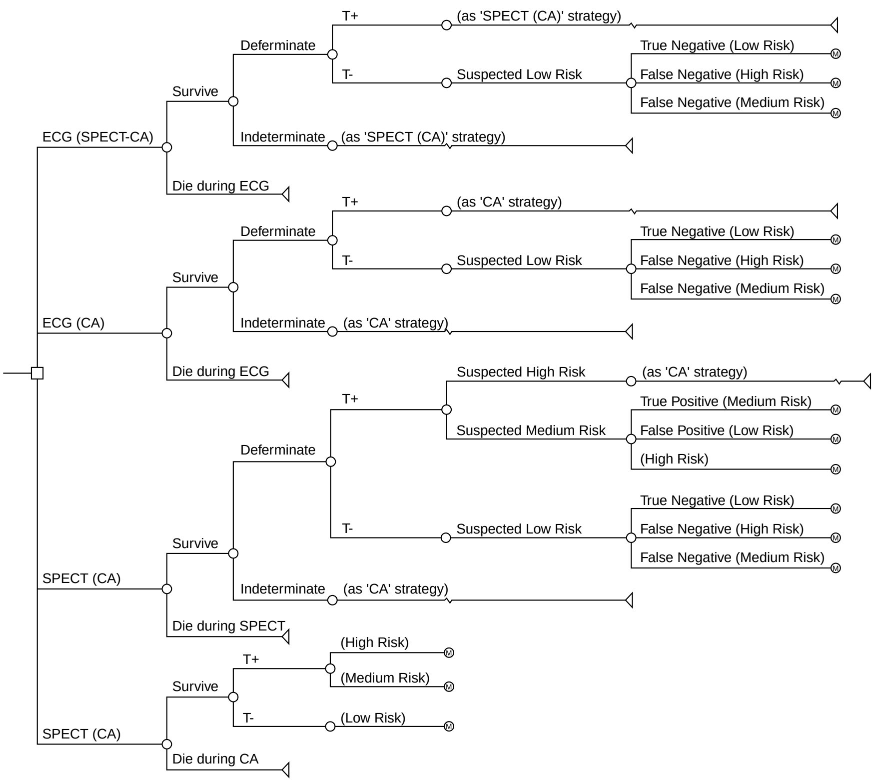


Figure 1: Decision Tree Model for the diagnosis of CAD

ECG = Stress Electrocardiography

SPECT = Single Photon Emission Computed Tomography myocardial perfusion scintigraphy

CA = Coronary Angiography

In addition to the disease states, the Markov model also considered the effect of revascularisation for those people diagnosed as low, medium or high risk of CAD. Patients who received and survive a revascularisation would of course incur the costs of that treatment but would also enjoy its benefits (i.e. lower risk of death and myocardial infarction) until they either die or it is felt these benefits would no longer be obtained.

Cost-effectiveness was measured in terms of additional cost per additional quality adjusted life year (QALY) gained (this is often called the incremental cost-effectiveness ratio or ICER). The data needed to provide estimates of costs and QALYs were obtained from a series of systematic reviews related to: 1) diagnostic performance, 2) patient outcomes and 3) economic evaluations and costing studies (1). Within the model all costs were expressed in 2001/02 sterling pound and QALYs were derived from quality of life weights obtained from literature (2). The Markov model was used to estimate cumulative costs and QALYs for a cohort of 60 year old patients over a 25 year time horizon.

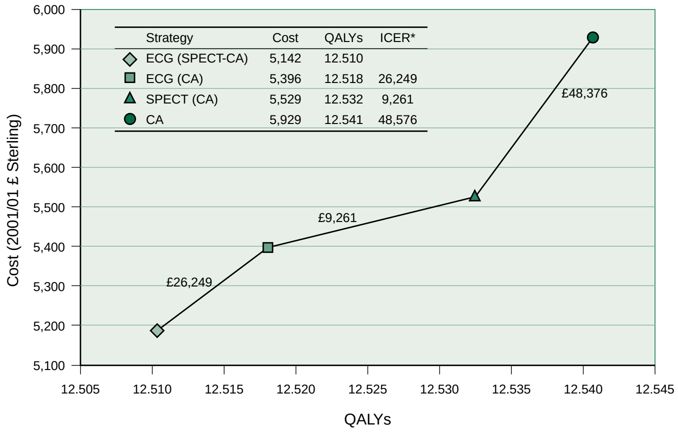
Many of the estimates required for the economic model were not precisely known and, in order to reflect this uncertainty, prior probability distributions were specified following usual practice, (3, 4) and a probabilistic sensitivity analysis was performed.

Results

Results were obtained for different levels of CAD prevalence or pre-test risk (e.g. 10.5%, 30%, 50% and 85%). Within these analyses, the more costly but more effective strategy is compared with a less costly but less effective strategy. At every prevalence level tested, the least costly but also least effective strategy was ECG-SPECT-CA and the most costly but most effective strategy was CA. Results for the 10.5% prevalence level (5) (believed fairly typical of the risk of CAD amongst those presenting for diagnosis) are shown in this briefing paper.

At this prevalence level (Figure 2), it is more cost effective for the NHS to provide a mix of ECG-SPECT-CA strategy and SPECT-CA strategies for diagnosing presenting patients than to use the ECG-CA strategy alone.

Figure 2: Cost Effectiveness Plane. 10.5% prevalence of CAD.

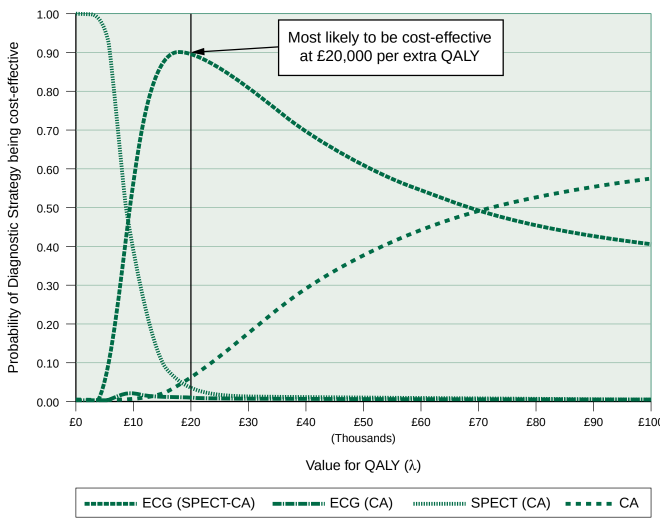


* Cost-effectiveness of moving from the less costly to the next more costly strategy

Sensitivity Analysis

Further extensive sensitivity analyses were also conducted (reported in detail in (1)). In summary, it was found that at a 10.5% prevalence level and a £20,000 willingness to pay for an extra QALY (a standard threshold adopted by, for example, the National Institute for Health and Clinical Excellence (NICE)), SPECT-CA has a 90% likelihood of being considered the most cost-effective strategy (Figure 3). For a 30% prevalence of disease, strategies that involve SPECT are also most likely to be cost-effective at a £20,000 threshold. However, when the prevalence of disease is higher than 30%, it becomes increasingly likely that CA is the most cost-effective strategy.

Figure 3: Cost-effectiveness acceptability curves (*): prevalence 10.5%.



(*) Cost effectiveness acceptability curves show how likely a strategy would be considered the best one compared to the other strategies.

Conclusions

Strategies that involve the use of SPECT are recommended when the pre-test likelihood of CAD is believed to be low. Should such strategies be adopted the number of invasive tests required would reduce. At higher levels of prevalence of CAD, strategies that do not involve SPECT are recommended. However, additional sensitivity analyses show that strategies that involve Echocardiography (ECHO) may also be potentially cost-effective (not shown). The results are dependent, however, on the longer term outcomes following correct and incorrect diagnosis, and further research is needed to better determine the magnitude of these longer-term outcomes, especially, those relating to costs and quality of life.

For further details about this study see:

Hernández R, Vale L, The value of myocardial perfusion scintigraphy in the diagnosis and management of angina and myocardial infarction: a probabilistic economic analysis. Med Decis Making (forthcoming) and reference (1).

This briefing paper describes work conducted by the Economic Evaluation Programme of the Health Economics Research Unit (HERU). Further information about this topic may be obtained by contacting Rodolfo Hernández at HERU, University of Aberdeen, Foresterhill, Aberdeen AB25 2ZD (email: r.a.hernandez@abdn.ac.uk).

For further information about HERU please visit our website at **http://www.abdn.ac.uk/heru**. The Health Economics Research Unit (HERU) receives core funded from the Chief Scientist Office (CSO) of the Scottish Executive Health Department (SEHD) and the University of Aberdeen.

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