Cost-effectiveness of coronary CT angiography versus myocardial perfusion SPECT for evaluation of patients with chest pain and no known coronary artery disease

Min JK, Gilmore A, Budoff MJ, Berman DS, O'Day K

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.

CRD summary
This study examined the cost-effectiveness of diagnostic strategies that included coronary computed tomography (CT) angiography and myocardial perfusion single photon emission CT, for patients with chest pain and no history of coronary artery disease. The authors concluded that CT angiography was the best strategy, where the prevalence of the disease was moderate. The cost-effectiveness methods were valid and generally well presented. The authors’ conclusions appear to be robust.

Type of economic evaluation
Cost-effectiveness analysis, cost-utility analysis

Study objective
This study examined the cost-effectiveness of various diagnostic strategies for individuals with chest pain and no known coronary artery disease (CAD). The strategies included computed tomography (CT) angiography and myocardial perfusion single photon emission computed tomography (SPECT).

Interventions
The diagnostic strategies were: invasive coronary angiography (ICA); CT angiography with ICA for positive or equivocal findings; CT angiography with ICA for positive findings and myocardial perfusion SPECT for equivocal findings; myocardial perfusion SPECT with ICA for positive or equivocal findings; and myocardial perfusion SPECT with ICA for positive findings and CT angiography for equivocal findings.

Location/setting
USA/out-patient setting.

Methods
Analytical approach:
The analysis was based on a decision model, with short- and long-term horizons, for a typical 55-year-old man with chest pain and no prior history of CAD, but a 30% risk of obstructive CAD. A Markov model was used for period after diagnosis to the patient’s lifetime. The authors stated that the analysis was carried out from the perspective of the payer.

Effectiveness data:
The clinical data were from the selected published sources, including the Assessment by Coronary Computed Tomographic Angiography of Individuals Undergoing Invasive Coronary Angiography (ACCURACY) prospective multicentre trial, supplied the diagnostic accuracy of CT angiography and defined the patient population. The diagnostic accuracy of myocardial perfusion SPECT was calculated as the average of data from studies published between 1989 and 2001. Meta-analyses and systematic reviews were used for other model parameters. The accuracies of the diagnostic tests were the key inputs to the analysis.

Monetary benefit and utility valuations:
The utility values were from the Clinical Outcomes Using Revascularization and Aggressive Evaluation (COURAGE) quality-of-life study.

Measure of benefit:
The benefit measures were the rate of correct diagnosis for the short-term analysis and quality-adjusted life-years (QALYs) for the long-term analysis. The QALYs were discounted at an annual rate of 3%.

Cost data:
The economic analysis included the costs of the diagnostic tests, aspirin, simvastatin, atenolol, isosorbide mononitrate, percutaneous transluminal coronary angioplasty, coronary artery bypass graft surgery, and treatment of acute myocardial infarction. The costs of hospitalisations and diagnostic tests were from Medicare reimbursement data, while those for drugs were from the Red Book. All costs were in US dollars ($) and the price year was 2008. The long-term costs were discounted at an annual rate of 3%.

Analysis of uncertainty:
One-way sensitivity analyses were carried out on the model inputs. A probabilistic analysis, based on a Monte Carlo simulation, was undertaken to calculate the mean values for the model outcomes at CAD prevalence rates of 30%, 50%, and 80%. The ranges of values were based on published evidence or plausible estimates.

Results
In the short-term analysis, the projected costs were $2,771 with ICA, $2,158 with myocardial perfusion SPECT, then ICA, $2,075 with myocardial perfusion SPECT then CT angiography or ICA, $1,843 with CT angiography then ICA, and $1,770 with CT angiography then myocardial perfusion SPECT or ICA. The rates of correct diagnosis were 99.9% with ICA, 96.4% with SPECT then ICA, 96.28% with SPECT then angiography or ICA, 98.63% with angiography then ICA, and 98.21% with angiography then SPECT or ICA.

After excluding dominated strategies, which were less effective and more expensive, the incremental cost per correct diagnosis was $73,175 with ICA (compared with CT angiography then ICA) and $17,516 with CT angiography then ICA (compared with CT angiography then myocardial perfusion SPECT or ICA).

In the long-term analysis, after excluding dominated strategies, CT angiography then SPECT or ICA was the reference strategy (least expensive) and produced 15.0244 QALYs at a cost of $14,910.87. CT angiography then ICA produced 15.0261 QALYs at a cost of $14,945.92, resulting in an incremental cost per QALY of $20,429. All the other strategies were dominated and myocardial perfusion SPECT was never cost-effective.

The most influential inputs were the accuracy of CT angiography, that of myocardial perfusion SPECT, and CAD prevalence. At a very high prevalence of CAD (over 80%), ICA was the preferred strategy. CT angiography then SPECT or ICA, and CT angiography then ICA remained dominant in most scenarios. The probabilistic sensitivity analysis confirmed these findings.

Authors' conclusions
The authors concluded that, with intermediate CAD prevalence, coronary CT angiography then ICA was the best diagnostic strategy for the evaluation of patients with stable chest pain and no known CAD.

CRD commentary
Interventions:
The comparators were appropriately selected as the available diagnostic strategies were considered. A description of each diagnostic pathway was provided. The authors stated that other imaging tests, such as echocardiography, magnetic resonance imaging, and positron emission tomography, were not included because more than 80% of imaging tests, in the USA, were by SPECT, which was the main comparator.

Effectiveness/benefits:
No details of a literature review were given, but valid sources were used, as most of the evidence came from clinical trials, systematic reviews, and national registries. These data sources were only partly described. The key clinical input, which was the accuracy of CT angiography, was from a large multicentre clinical trial. The clinical inputs were widely tested in the sensitivity analyses. Little information was given on the derivation of the utility values; the source was given, but the instrument used was not. The rate of correct diagnosis appears to have been a relevant outcome for the short-term analysis and from a clinical standpoint, while QALYs are more useful for decision makers. They also allow...
direct comparisons to be made with the benefits of other health technologies.

Costs:
The cost categories were representative of the viewpoint stated. Most of the costs were from Medicare data, a typical US source, and were presented as category totals. The price year was reported and the cost estimates were treated deterministically in the base case. The impact of variations in the economic estimates was tested in the sensitivity analysis.

Analysis and results:
The results were clearly presented. The expected costs and benefits were appropriately synthesised, using an incremental approach, which allowed the exclusion of dominated strategies. The uncertainty was investigated using valid approaches and the findings were clearly illustrated and discussed. The costs and QALYs were discounted for the long-term analysis. The transfer of these results to other settings might be difficult and they should be considered to be specific to the US context. They were also specific to patients with no prior history of CAD and cannot be transferred to those with diagnosed CAD.

Concluding remarks:
The cost-effectiveness methods were valid and were generally well presented. The authors’ conclusions appear to be robust.

Funding
Supported by a grant from GE Healthcare.

Bibliographic details

PubMedID
20177094

DOI
10.1148/radiol.09090349

Original Paper URL
http://radiology.rsna.org/content/254/3/801.abstract

Indexing Status
Subject indexing assigned by NLM

MeSH
Chest Pain /economics /radiography /radionuclide imaging; Coronary Angiography /economics; Cost-Benefit Analysis /economics; Decision Support Techniques; Humans; Quality-Adjusted Life Years; Sensitivity and Specificity; Tomography, Emission-Computed, Single-Photon /economics; Tomography, X-Ray Computed /economics

AccessionNumber
22010000901

Date bibliographic record published
10/11/2010

Date abstract record published
23/02/2011