Multi-detector computed tomography in coronary artery bypass graft assessment: a meta-analysis

CRD summary
This review assessed the diagnostic accuracy of multi-detector computed tomography (MDCT) for determining occlusion or stenosis following a coronary artery bypass graft. The authors concluded that MDCT can safely be used to rule out significant stenosis or occlusion. Limitations in the literature search and reporting of the review, particularly the definition of stenosis, mean that this conclusion should be viewed with caution.

Authors' objectives
To determine the diagnostic accuracy of multi-detector computed tomography (MDCT) in determining stenosis and occlusion in patients with coronary artery bypass grafts.

Searching
MEDLINE was searched without any language restrictions; the search terms were reported but the dates covered were not. Studies accepted for publication, but not yet published, were eligible for inclusion. Further studies were sought by screening the bibliographies of retrieved articles.

Study selection
Study designs of evaluations included in the review
No inclusion criteria for study design were specified.

Specific interventions included in the review
Studies assessing the diagnostic performance of 8-slice, 16-slice or 64-slice MDCT in determining stenosis and occlusion of coronary artery bypass grafts were eligible for inclusion. The majority of the included studies (13 out of 15) were of 16-slice MDCT. No definition of stenosis was reported, thus the diagnostic threshold used by the included studies and by the review was unclear. Imaging was classed as early if conducted within 30 days of surgery and late if conducted after this period.

Reference standard test against which the new test was compared
The included studies were required to use coronary artery angiography as the reference standard.

Participants included in the review
Studies of patients undergoing imaging assessment to determine the patency of coronary artery bypass grafts were eligible for inclusion. The mean age of the patients, where reported, was between 58 and 69 years. The studies included both venous and arterial grafts.

Outcomes assessed in the review
The included studies were required to report sufficient data to calculate the sensitivity and specificity for each outcome of interest. The outcomes were stratified by extent of disease (stenosis or occlusion) and type of graft (venous or arterial), but outcome data for individual studies were not reported.

How were decisions on the relevance of primary studies made?
Two reviewers participated in decisions on the relevance of the primary studies. No further details of the process of screening for inclusion were reported.

Assessment of study quality
The methodological quality of the included studies was assessed using the QUADAS tool for the quality assessment of
diagnostic accuracy studies. This tool includes items relating to external validity, reporting quality, verification bias, incorporation bias and blinding of test interpreters. Two reviewers independently extracted the data.

Data extraction
Two reviewers independently extracted the data. Test and participant characteristics, definitions of stenosis and occlusion (not reported), and 2x2 contingency data on test performance (not reported) were extracted. The data were analysed by graft. Data on the adequacy of visualisation and reasons for inadequate visualisation and false positives were also recorded.

Methods of synthesis
How were the studies combined?
Pooled estimates of sensitivity, specificity, positive and negative predictive values and the diagnostic odds ratio, with 95% confidence intervals (CIs), were generated using a fixed-effect model. Summary receiver operating characteristic curves were also reported, along with their Q* (point of maximal sensitivity and specificity) values and area under the curve. The model used to generate these curves was not reported.

How were differences between studies investigated?
Multivariate regression analysis was used to assess the impact of individual QUADAS items, use of beta-blockers, symptomatic status, and post-operative period on test performance as expressed by the diagnostic odds ratio. The analyses were subgrouped by graft type (arterial or venous)

Results of the review
Fifteen studies, providing data on a total of 1,845 grafts, were included in the review. The total number of participants was unclear (not reported for 1 study); the median of reported data was 44 (range: 13 to 96). Thirteen studies of 1,791 grafts provided data on occlusion and 8 studies of 777 non-occluded grafts provided data on stenosis.

Occlusion (13 studies, 1,791 adequately visualised grafts).
The overall estimate of sensitivity was 97.6% (95% CI: 95.3, 99.0) with a corresponding specificity of 98.5% (95% CI: 97.7, 99.1). Subgrouping by graft type did not significantly change these estimates. Beta-blocker use, symptomatic status and post-operative period did not significantly affect test performance; studies which reported reasons for withdrawal were associated with significantly improved test performance. There were 70 inadequately visualised grafts.

Stenosis (8 studies, 777 adequately visualised, non-occluded grafts).
The overall estimate of sensitivity was 88.7% (95% CI: 79.0, 95.0) with a corresponding specificity of 97.4% (95% CI: 95.9, 98.4). Subgrouping by graft type did not significantly change these estimates. Beta-blocker use, symptomatic status, post-operative period and items relating to methodological quality did not significantly affect test performance. There were 101 inadequately visualised grafts.

Authors' conclusions
The diagnostic performance of MDCT approaches that of coronary artery angiography for the determination of graft stenosis and occlusion. MDCT can safely be used to exclude significant stenosis or occlusion without confirmatory angiography.

CRD commentary
The review addressed a clearly stated research question which was defined by appropriate inclusion criteria, the notable exception being the lack of a definition for stenosis; an explicit definition is important to the interpretation of results. The search strategy, though not restricted by language, was limited to a single bibliographic database and reference screening. It is therefore possible that a significant proportion of available data might have been missed. Measures to
avoid the introduction of error and bias during the review process were reported. The methodological quality of the included studies was assessed using an appropriate tool, and the results used to assess the impact of individual quality items on test performance using appropriate statistical methods. However, since the results of the quality assessment were not reported, the quality of the evidence upon which the review is based cannot be adequately judged. Similarly, though some details of the included studies were reported, individual study results and, crucially, diagnostic thresholds were not reported. This, combined with the lack of any reported test of statistical heterogeneity, make it impossible to judge the appropriateness of generating summary estimates of sensitivity and specificity; it should be noted that where diagnostic threshold varies between studies, such summary estimates are not generally considered appropriate.

The authors based their conclusion that MDCT can safely be used to rule out significant stenosis and occlusion upon high summary estimates of negative predictive value. The method used to estimate predictive values was not clear and the CIs around the estimates of sensitivity for stenosis, as well as the lack of clarity on how significant stenosis was defined, mean that these conclusions should be viewed with caution.

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

Practice: The authors stated that cardiac surgeons will soon need to interpret MDCT images as part of their preparation for both primary and re-do coronary bypass grafting procedures.

Research: The authors noted that further research is required to determine the diagnostic accuracy of MDCT in patients with arrhythmias or respiratory disease.

**Bibliographic details**


**PubMedID**

17184705

**DOI**

10.1016/j.athoracsur.2006.08.018

**Indexing Status**

Subject indexing assigned by NLM

**MeSH**

Coronary Angiography; Coronary Artery Bypass; Coronary Stenosis /radiography; Humans; Sensitivity and Specificity; Tomography, X-Ray Computed /methods

**AccessionNumber**

12007000216

**Date bibliographic record published**

31/12/2007

**Date abstract record published**

31/12/2007

**Record Status**

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