Is there an indication for computed tomography and magnetic resonance imaging in the evaluation of coronary artery bypass grafts?

Dikkers R, van der Zaag-Loonen HJ, Willems TP, Post WJ, Oudkerk M

CRD summary
This review concluded that multi-detector computed tomography was superior to magnetic resonance imaging for the noninvasive detection of coronary bypass graft occlusion and stenosis. These conclusions should be interpreted with caution due to the possibility of missing studies, lack of details on study quality, and possible heterogeneity between studies.

Authors' objectives
To evaluate the accuracy of multi-detector computed tomography (MDCT) and magnetic resonance imaging (MRI) for diagnosing bypass graft occlusion and detecting stenosis in patients after a coronary artery bypass graft (CABG).

Searching
MEDLINE and EMBASE were searched to August 2007. The search terms were reported and included a diagnostic filter. The reference lists of original articles, narrative reviews, and editorials were screened and no language restrictions were applied. The review was restricted to published articles.

Study selection
Studies that evaluated the accuracy of MDCT or MRI compared with the reference standard of coronary angiography, for the diagnosis of bypass graft occlusion in CABG patients, were eligible for inclusion. Those that included mixed populations, but reported the results separately for CABG patients were also eligible. All patients in a study were required to have undergone coronary angiography for the study to be included. Studies had to report sufficient data to allow the construction of a two-by-two table of test performance. If insufficient data were reported to assess inclusion, the authors were contacted for further details. Studies that included fewer than 10 patients, those in which the primary aim was the evaluation of a technical or post-processing protocol, and those that used an MRI scanner of less than 1.5 tesla (T), were excluded.

Studies enrolled both symptomatic and asymptomatic patients with arterial or venous grafts of 0 to 100%. The mean age was 65 years, 82% of patients in MDCT studies were male, and 86% of patients in MRI studies were male. All MRI studies used a 1.5T scanner and the MDCT studies used four-, eight-, 16- and 64-detector computed tomography. The mean time after surgery was 21 years (range 1.2 to 10) in the MDCT studies and 4.8 years (range 0.02 to 11) in MRI studies. The mean occlusion rate was 21% (range one to 44) in the MDCT studies and 22% (range zero to 60) in the MRI studies.

Two reviewers independently assessed studies for inclusion.

Assessment of study quality
Study quality was assessed independently by two reviewers, using Quality Assessment of Diagnostic Accuracy Studies (QUADAS) criteria, and disagreements were resolved by arbitration. Studies were assigned a quality score based on the number of items fulfilled.

Data extraction
The data were extracted as two-by-two tables of test performance. Occluded grafts were considered to be positive and open grafts were considered to be negative. Where possible, the data were extracted for all grafts, including those that could not be assessed and these were considered to be negative. The sensitivity, specificity, and diagnostic odds ratios together with their 95% confidence intervals were calculated for each study. Data were extracted for the primary outcome of bypass graft occlusion detection and the secondary outcome of bypass stenosis detection (50% or greater reduction in luminal diameter).
The authors did not state how many reviewers performed the data extraction.

Methods of synthesis
Sensitivity and specificity were pooled using a bivariate model. Heterogeneity was assessed visually using forest plots of sensitivity and specificity, and statistically using the $\chi^2$ and $I^2$ statistics. Publication bias was assessed using funnel plots based on the diagnostic odds ratios.

Results of the review
Forty-seven studies were included, with quality scores ranging from seven to 14 out of 14.

**MDCT** (28 studies, n=1,320 patients): Sensitivity for occlusion detection ranged from 69% to 100%. Summary sensitivity was 96% (95% CI 95 to 97). Specificity ranged from 95% to 100%. Summary specificity was 98% (95% CI 98 to 99). Summary estimates of sensitivity increased slightly with increased MDCT slice; specificity remained the same. Sensitivity for stenosis detection ranged from 33% to 100%. Summary sensitivity was 89% (95% CI 84 to 92; 17 studies). Specificity ranged from 85% to 100%. Summary specificity was 97% (95% CI 96 to 98; 17 studies).

**MRI** (19 studies, n=492): Sensitivity for occlusion detection ranged from 45% to 100%. Summary sensitivity was 81% (95% CI 76 to 86). Specificity ranged from 65% to 100%. Summary specificity was 91% (95% CI 89 to 93). Studies using a magnetic resonance angiography sequence with gadolinium performed better (summary sensitivity 84%, 95% CI 75 to 91; summary specificity 93%, 95% CI 90 to 96; eight studies) compared with other MRI sequences (summary sensitivity 79%, 95% CI 71 to 86; summary specificity 90%, 95% CI 87 to 92; 11 studies). Stenosis was only assessed in two studies. One reported a sensitivity of 86% and specificity of 94% for detection more than 70% lumen reduction. The other reported sensitivity of 62% and specificity of 82% for detecting more than 50% lumen reduction.

Comparison of MDCT and MRI: The bivariate analysis showed that summary sensitivity was significantly lower in MRI studies than in MDCT studies ($p<0.001$). A secondary analysis compared the accuracy of MDCT studies using 16- and 64-slice MDCT with studies of MRI scanners using magnetic resonance angiography with gadolinium and found that accuracy was significantly higher in the MDCT studies ($p<0.001$).

The results of the heterogeneity analysis were not presented.

Authors’ conclusions
MDCT was superior to MRI for the noninvasive detection of coronary bypass graft occlusion and stenosis.

CRD commentary
This review addressed a focused question supported by clearly defined inclusion criteria. Appropriate databases were searched, but the inclusion of a diagnostic filter means that relevant studies may have been missed. The review was restricted to published studies and so there is a possibility of publication bias, the risk of language bias was reduced by the inclusion of studies in any language. Publication bias was assessed, but the methods used were not appropriate for diagnostic studies. Appropriate steps were taken to minimise bias and errors in the selection of studies and assessment of study quality, but it was unclear whether these steps were also taken for data extraction. Study quality was assessed using relevant criteria, but the results of the quality assessment were only reported as summary scores, which has been shown to be inappropriate for QUADAS. The quality and reliability of the included studies therefore remains unclear. Sophisticated methods were used to estimate the summary measures, but the results for the heterogeneity assessment were not reported and the validity of pooling the data is therefore unclear.

The authors’ conclusions were supported by the results of the review, but should be interpreted with some caution due to the possibility of missing studies, lack of details on study quality, and possible heterogeneity between studies.

Implications of the review for practice and research
**Practice:** The authors stated that MRI was no longer the technique of choice for the single indication of bypass graft evaluation. It should only be used in patients with an additional indication for MRI. The accuracy of MDCT for stenosis
detection was not sufficient to warrant its widespread use.

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

Funding
No funding received.

Bibliographic details

PubMedID
19478621

DOI
10.1097/RCT.0b013e3181807a5e

Original Paper URL
http://journals.lww.com/jcat/Abstract/2009/05000/Is_There_an_Indication_for_Computed_Tomography_.aspx

Indexing Status
Subject indexing assigned by NLM

MeSH
Coronary Angiography /statistics & numerical data; Coronary Artery Bypass /statistics & numerical data; Coronary Occlusion /diagnosis /epidemiology; Coronary Stenosis /diagnosis /epidemiology; Humans; Incidence; Magnetic Resonance Angiography /statistics & numerical data; Postoperative Complications /diagnosis /epidemiology; Prognosis; Reproducibility of Results; Sensitivity and Specificity; Tomography, X-Ray Computed /statistics & numerical data; Treatment Outcome

AccessionNumber
12009108105

Date bibliographic record published
10/03/2010

Date abstract record published
28/04/2010

Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.