Meta-analysis: noninvasive coronary angiography using computed tomography versus magnetic resonance imaging

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CRD summary
This review concluded that computed tomography was more accurate than magnetic resonance imaging for ruling out coronary artery disease. This conclusion, and implications for practice, should be viewed with some caution as the evidence available for computed tomography was greater in volume, and considered better quality, compared to magnetic resonance imaging.

Authors' objectives
To compare computed tomography (CT) with magnetic resonance imaging (MRI) techniques for ruling out clinically significant coronary artery disease in adults with suspected or known coronary artery disease.

Searching
PubMed, EMBASE, and Web of Science were searched for studies published in English or German to June 2009. Search terms were reported. Bibliographies of included studies, systematic reviews and meta-analyses were scanned, as were abstracts presented at recent congresses and suggested by an expert reader.

Study selection
Prospective studies that compared the accuracy of CT and MRI for detecting coronary artery disease in adults with suspected or known coronary artery disease, using conventional coronary artery angiography as the reference standard, were eligible for inclusion. Eligible studies had to use a cut off of at least 50% reduction in diameter as a positive result for stenosis. CT scanners had to use at least 12 detector rows, and MRI scanners 3-dimensional sequencing. Sufficient data to construct a 2x2 table of test performance had to be presented.

Where reported, CT studies used scanners with 12, 16, 32, 40, 64 or 320 detector rows, the mean age of participants ranged from 54 to 70 years and proportion males from 27% to 95%. In the MRI studies, all but one used scanners with a 1.5-Tesla magnet, most scans were conducted without contrast, the mean age ranged from 57 to 66 years and the proportion male from 52 to 89%. Study characteristics were available in separate online appendices (accessed February 2010).

Study selection was undertaken by one reviewer.

Assessment of study quality
Study quality was assessed using the 14-criteria QUADAS (Quality Assessment of Diagnostic Accuracy Studies) tool; the criteria relating to differential verification bias and independence of the reference standard were not assessed.

The number of reviewers conducting the quality assessment was not reported.

Data extraction
Data required to construct a 2x2 table of test performance were extracted by two independent reviewers, from which sensitivity and specificity with 95% confidence intervals (CI) were calculated; discrepancies were resolved by discussion or recourse to a third reviewer. Researchers were contacted for missing data.

Methods of synthesis
Mean estimates of sensitivity and specificity with 95% confidence intervals were calculated for each technology. Sensitivity and specificity for CT and MRI were compared using exact binomial rendition of the bivariate mixed-effects regression model. A hierarchical summary receiver operating characteristic curve, with 95% confidence contour ellipsoid, was constructed. Post-test probability curves of coronary artery disease after positive and negative tests were presented. The impact of differences in technology, study quality, patient characteristics and concomitant medications, were investigated. Publication bias was investigated using funnel plots and a regression test for asymmetry.
Results of the review

One hundred and nine studies met the inclusion criteria; 89 studies evaluating CT (n=7,900 participants; range 15 to 360) and 20 studies evaluating MRI (n=1,087 participants; range 10 to 131). Study quality was considered to be poor to moderate, with the quality of MRI studies poorer than that of CT studies. Only two CT and two MRI studies fulfilled all but the availability of clinical data criteria. The avoidance of progression bias and partial verification bias, and the reporting of reference standard details, scored poorly for both technologies.

For CT diagnostic performance, the mean sensitivity was 97.2% (95% CI 96.2 to 98.0) and the mean specificity was 87.4% (95% CI 84.5 to 89.8). For MRI diagnostic performance, the mean sensitivity was 87.1% (95% CI 83.0 to 90.3) and the mean specificity was 70.3% (95% CI 58.8 to 79.7).

When imaging method was added as a covariate to the regression model, CT was statistically significantly more sensitive and specific than MRI; for CT sensitivity was 94.5% (95% CI 91.0 to 98.0) and specificity was 86.1% (95% CI 75.0 to 96.0), for MRI sensitivity was 86.1% (95% CI 79.0 to 93.0) and specificity was 70.8% (95% CI 59.0 to 90.0).

The areas under the summary receiver operating characteristic curves were 0.98 (95% CI 0.96 to 0.99) for CT and 0.89 (95% CI 0.86 to 0.91) for MRI. Results of sensitivity and subgroup analyses, and post-test probability curves, were also presented. There was no evidence of publication bias.

Authors’ conclusions

CT was a more accurate technique than MRI for ruling out coronary artery disease; sensitivity was improved when scanners with at least 16 detector rows were used.

CRD commentary

The authors addressed a clear research question supported by appropriate inclusion criteria. Several relevant sources were searched, and attempts were made to locate unpublished studies. Electronic searches were conducted, without a diagnostic search filter, maximising the potential for retrieving all relevant studies. Only studies in English or German were included, so language bias could not be ruled out. Data extraction was conducted in duplicate, but study selection was undertaken by one reviewer, so selection bias could not be ruled out. Studies stating that data were collected retrospectively were excluded, but 38 included CT studies (43%) and 10 included MRI (50%) studies did not report the direction of data collection. Study quality was assessed using appropriate criteria, although the number of reviewers performing the quality assessment was not reported.

The results for each quality criterion for each study was available in an online appendix (accessed February 2010); the overall quality of the evidence was relatively poor. The methods of synthesis seem appropriate.

Although the authors’ conclusion reflects the evidence presented, the conclusion and implications for practice should be viewed with some caution as the evidence available for CT was greater in volume, and considered better in quality, compared to MRI.

Implications of the review for practice and research

Practice: The authors stated that CT should be the foremost noninvasive alternative to coronary artery angiography for detecting and ruling out coronary artery stenosis in selected patient populations.

Research: The authors stated that randomised studies are required to assess the potential for the use of CT in triage as a means of positively altering management and outcomes in patients with suspected coronary artery disease. The authors also recommended that future research should be reported in accordance with the STARD (Standards for Reporting of Diagnostic Accuracy) guidelines, and that the QUADAS checklist should be used to design studies in order to avoid biases.

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