Meta-analysis of comparative diagnostic performance of magnetic resonance imaging and multislice computed tomography for noninvasive coronary angiography


CRD summary
This review evaluated the relative accuracy of magnetic resonance imaging (MRI) and multislice computed tomography (MSCT) in the evaluation of patients with coronary artery disease. The authors' conclusion, that MSCT has a significantly higher accuracy than MRI, should be interpreted with extreme caution given the limited literature search, lack of a quality assessment and limitations in the statistical analyses.

Authors' objectives
To review the accuracy of magnetic resonance imaging (MRI) and multislice computed tomography (MSCT) for the detection of significant coronary artery lesions.

Searching
MEDLINE was searched from January 1990 to January 2005; the keywords were reported. A number of cardiology and radiology journals were handsearched for the same time period. The reference lists from cited manuscripts were screened for additional studies. Abstracts, reviews and non-English language studies were excluded, as were studies that were subsets of published studies.

Study selection
Study designs of evaluations included in the review
The authors did not specify any inclusion criteria relating to the study design.

Specific interventions included in the review
Studies of MRI and/or MSCT were eligible for inclusion. MRI data were either acquired during breath holds, or a 3-dimensional (3D) navigator technique was used. The MRI techniques employed were gradient echo, spin echo, steady-state free precession, turbo flash echo and turbo flash field echo. MSCT was either 4, 8 or 16 slice.

Reference standard test against which the new test was compared
The studies had to include conventional invasive angiography (CAG) as the reference study. Angiography criteria used to define coronary artery disease were either occlusion, or stenoses of >30%, >50% or >70% based on quantitative or visual analysis.

Participants included in the review
Studies of patients with known or suspected coronary artery disease (CAD) were eligible for inclusion. Where reported, the proportion of men ranged from 50 to 96%, the mean age ranged from 54 to 71 years, and the prevalence of CAD ranged from 50 to 100%.

Outcomes assessed in the review
The studies had to report sufficient data to calculate sensitivity and specificity on a segmental basis to be included.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
The authors did not state that they assessed validity
Data extraction
The authors did not state how many reviewers performed the data extraction. Data on the number of true positives, false positives, true negatives and false negatives were extracted from each publication. When papers reported the results of multiple observers, data from the observer with the highest accuracy were used for the analysis. The sensitivity and specificity, along with their 95% confidence intervals (CIs), were calculated for each included study.

Methods of synthesis
How were the studies combined?
The pooled sensitivity and specificity, together with their 95% CIs, were calculated by adding the numbers of true positives, false positives, true negatives and false negatives across studies. Summary diagnostic odds ratios and their 95% CIs were calculated using a random-effects inverse variance approach. Only data with negative and positive study findings were included for this analysis. Pooled summary data for CAD incident cases/denominators of negative and positive studies were also calculated. The effect sizes for MSCT and MRI were compared using analysis of variance techniques.

How were differences between studies investigated?
A chi-squared test for heterogeneity was performed. The relationship between accuracy and disease prevalence was investigated by meta-regression analysis. A univariable meta-regression was used to estimate the influence of specificity on CAD prevalence. A multivariable regression analysis was also performed; this included variables for gender and age. The sensitivity and specificity were compared for intermediate- and high-risk groups using analysis of variance techniques. The average sensitivity and specificity for intermediate- and high-risk groups were compared for MSCT and MRI using a general linear model weighted by average sample size.

Results of the review
Twenty-eight studies of MRI (n=903) and 25 studies of MSCT (n=1,300) were included in the review. One study evaluated both techniques.

MRI 1.5 tesla (T), 3D-navigator technique (21 studies): the sensitivity ranged from 38 to 88% and the specificity from 62 to 100%. The pooled sensitivity and specificity were 73% (95% CI: 70, 76) and 85% (95% CI: 84, 86), respectively.

MRI, 2D breath hold (5 studies): the sensitivity ranged from 56 to 90% and the specificity from 82 to 92%. The pooled sensitivity and specificity were 80% (95% CI: 74, 86) and 89% (95% CI: 85, 93), respectively.

MRI, 3D breath hold (5 studies): the sensitivity ranged from 60 to 87% and the specificity from 82 to 97%. The pooled sensitivity and specificity were 78% (95% CI: 71, 85) and 91% (95% CI: 89, 93), respectively.

MRI, 3 T (1 study): the sensitivity was 82% and the specificity was 89%.

MSCT (24 studies): the sensitivity ranged from 66 to 98% and the specificity from 75 to 99%. The overall pooled sensitivity and specificity were 85% (95% CI: 83, 87) and 95% (95% CI not reported), respectively. The average proportion of studies with diagnostic image quality was 87% (95% CI: 86, 88). This varied depending on the number of slices used: it increased from 78% with 4-slice systems to 96% with 16-slice systems.

The analysis of variance showed a significantly higher odds ratio for MSCT (16.9, 95% CI: 11.0, 26.1) compared with MRI (6.4, 95% CI: 5.0, 8.3) (p<0.0001). Based on meta-regression analysis, an inverse relationship between specificity and CAD prevalence was observed for MSCT (p=0.056). No such relationship was observed for MRI (p=0.55).

Authors' conclusions
MSCT currently has a significantly higher accuracy to detect or exclude significant coronary heart disease.

CRD commentary
This review addressed a clear question that was supported by well-defined inclusion criteria. The literature search
covered only one electronic database, excluded non-English language studies, and made no attempt to identify unpublished data. It is therefore possible that important studies might have been missed and the review may be subject to language and publication bias. Very few details of the review process were reported, thus it was not possible to ascertain whether appropriate steps were taken to minimise bias and error. Since no formal assessment of quality was undertaken, it is not possible to comment on the validity of the results of the included primary studies.

The statistical analysis undertaken was limited and could have been greatly improved by the use of accepted methods for meta-analysis of test accuracy studies. Although the authors stated that a test for heterogeneity was performed, the results of this were not reported. Given the wide range in estimates of sensitivity and specificity in the primary studies, some further consideration of heterogeneity was required. A bar chart showing the summary sensitivity and specificity for MRI and MSCT was reported in the paper, but a receiver operating characteristic (ROC) plot together with summary ROC curves would have been more informative plot; this would have given a visual analysis of heterogeneity and also allowed a visual comparison of the accuracy of the two techniques. Given the heterogeneity between the studies, the analysis comparing the accuracy of the two techniques is questionable. Where possible, it is always preferable to rely on direct rather than indirect comparisons. One study appeared to evaluate both techniques, thus enabling a direct comparison between them, but this was not considered in the analysis. Interestingly, in this study, sensitivity was higher for MSCT in comparison with MRI but specificity was lower. This contrasts with the authors' conclusion that MSCT has both higher sensitivity and specificity than MRI. Based on the above limitations, in particular in the analysis undertaken, the authors' conclusions should be interpreted with extreme caution.

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

Practice: The authors stated 'the emergence of noninvasive diagnostic angiography by MSCT will grant the opportunity to obtain anatomic information about the coronary atherosclerotic process at a preclinical stage on a large scale'.

Research: The authors stated 'the presence of CAD can be excluded with high accuracy such that the use of MSCT as a first-line evaluation tool could now be tested prospectively in selected subgroups'.

**Funding**

Netherlands Heart Foundation, grant number 2002B105.

**Bibliographic details**


**PubMedID**

16442907

**DOI**

10.1016/j.ahj.2005.03.022

**Indexing Status**

Subject indexing assigned by NLM

**MeSH**

Coronary Angiography; Coronary Stenosis /diagnosis /radiography; Humans; Magnetic Resonance Imaging /standards; Odds Ratio; Tomography, X-Ray Computed /methods /standards

**AccessionNumber**

12006000855

**Date bibliographic record published**

Database of Abstracts of Reviews of Effects (DARE)
Date abstract record published
31/07/2007

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.