Meta-analysis: diagnostic performance of low-radiation-dose coronary computed tomography angiography

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CRD summary
The authors concluded that low-dose coronary computed tomography angiography matched the sensitivity of catheter-based angiography, had low radiation exposure and was a potentially valid alternative to catheter angiography for triaging symptomatic patients with clinical suspicion of coronary artery disease. Generalisability may be limited and potential harms of imaging tests required further research. The authors’ conclusions are likely to be reliable.

Authors’ objectives
To assess the diagnostic performance of low dose coronary computed tomography (CT) angiography in ruling out coronary artery disease in symptomatic adults.

Searching
MEDLINE, EMBASE, BIOSIS Previews, CINAHL, The Cochrane Library, Web of Knowledge, Faculty of 1000 Medicine, CAB Abstracts and Zetoc were searched without language restrictions from the earliest possible date to October 2010. Search terms were reported. Reference lists of retrieved studies were handsearched. Field experts were contacted.

Study selection
Studies on the diagnostic performance of multi-detector row CT scanners with at least 64 detectors using a low-radiation-dose and prospective electrocardiography (ECG) gating compared with catheter angiography (reference standard) were eligible for inclusion. Eligible patients were those with clinical suspicion of symptomatic coronary artery disease. Segmental analyses were included if the 15-segment scheme proposed by (or adapted from) the American Heart Association was used.

Half of the included studies were conducted at the same study centre. A large proportion of studies reported on single-source 64-slice CT. Other studies used dual-source 64-slice CT, single-source 320-slice CT, single- or dual-source 128-slice CT and single-source 256-slice CT. The average radiation dose in low-dose coronary CT angiography was 2.7mSv (millisieverts). Where multiple cut-off points were presented, the adopted definition of a positive result was a coronary lumen diameter stenosis of greater than 50%. Adverse events were evaluated. All included patients had sinus rhythm. Some patients received β-receptor antagonists to achieve the target heart rate for CT scanning. The mean age of patients was 63.4 years. Mean body mass index (BMI) was 26.5kg/m². Mean prevalence of coronary artery disease was 60.1%.

Four reviewers selected studies for inclusion in the review.

Assessment of study quality
Study quality was assessed using the QUADAS tool.

Two reviewers independently carried out the quality assessment. Disagreements were resolved with the involvement of a third reviewer.

Data extraction
Data were extracted to enable calculation of diagnostic performance measures (sensitivity and specificity), along with 95% confidence intervals (CI). Positive and negative likelihood ratios were calculated. Authors were contacted for missing data.

Two reviewers extracted data. Disagreements were resolved with the involvement of a third reviewer.
Methods of synthesis
Diagnostic performance measures and 95% CIs were pooled in a random-effects meta-analysis and summary receiver operating curves (SROC) were presented. The primary analysis used patient-level data; additional analyses were conducted at the segment and vessel levels.

Statistical heterogeneity was assessed using the $Q$ and $I^2$ statistics. Potential sources of heterogeneity were explored. Sensitivity analyses was carried out to investigate the influence of study location and differential coding of non-diagnostic images. Publication bias was assessed using Egger's test.

Results of the review
Sixteen studies (n=960) were included in the review. Methodological quality was considered to be satisfactory; most studies fulfilled most of the 12 quality criteria.

Coronary CT angiography was associated with high sensitivity and specificity and demonstrated comparable diagnostic performance to the reference standard. At the patient-level (12 studies), pooled sensitivity was 1.00 (95% CI 0.98 to 1.00) and specificity was 0.89 (95% CI 0.85 to 0.92). There was no statistical heterogeneity. Sensitivities were similarly high at the vessel level (0.97, 95% CI 0.95 to 0.98; 13 studies) and segment level (0.91, 95% CI 0.86 to 0.95; 13 studies). The highest pooled specificity was at the segment level (0.96, 95% CI 0.94 to 0.97). Statistically significant heterogeneity was found between vessel-level and segment-level analyses.

Positive and negative likelihood ratios were reported in the paper. BMI and coronary artery disease prevalence were associated with variations in diagnostic performance. Sensitivity analysis showed no material difference in outcome. There was no evidence of publication bias.

An analysis of adverse events was not possible due to the low number of studies that provided data (three studies).

Authors' conclusions
Low-dose coronary CT angiography matched the sensitivity of catheter-based angiography, had low radiation exposure and was a potentially valid alternative to catheter angiography for triaging symptomatic patients with a clinical suspicion of coronary artery disease. Generalisability may be limited due to the small number of included studies and over-representation of those conducted in a single study centre. The potential harms of imaging tests are not well-evaluated.

CRD commentary
The research question was well-defined and supported by reproducible inclusion criteria. The search strategy included several relevant data sources and included sufficient attempts to minimise language and publication biases. The review process was well-reported and demonstrated sufficient efforts to minimise errors and bias. A relevant quality assessment tool was applied and the results of this indicated the reliability of included studies. Study characteristics were presented clearly, the chosen method of synthesis was justifiable and explorations of statistical heterogeneity and potential influences on diagnostic performance were carried out.

This was a well-conducted review. The authors' conclusions are likely to be reliable.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors stated that multilocation studies were needed to assess how low-dose coronary CT angiography can be used to change practice and improve outcomes in patients with suspected coronary artery disease. More research was needed on the potential harms of this imaging test.

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