Dual-source computed tomography angiography for diagnosis and assessment of coronary artery disease: systematic review and meta-analysis

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CRD summary
This generally well conducted and clearly reported review concluded that dual-source computed tomography angiography had a high diagnostic accuracy for significant coronary artery disease which was relatively robust to elevated heart rates. These conclusions are likely to be reliable. The authors suggest further large scale confirmatory studies before their results are applied in clinical practice.

Authors' objectives
To assess the diagnostic accuracy of dual-source computed tomography (CT) in the diagnosis of coronary artery disease.

Searching
MEDLINE, Web of Knowledge, EMBASE, BIOSIS, Cochrane Central Register of Controlled Trials (CENTRAL), Cochrane Database of Systematic Reviews, DARE and HTA databases were searched from January 2005 to March 2011 for studies published in English, German or French. Search terms were reported. The authors stated that they used appropriate methodologic filters. Bibliographies of reviews and included studies were screened for additional articles.

Study selection
Studies that assessed diagnostic accuracy of dual-source CT coronary angiography in consecutive patients with suspected or known coronary artery disease were eligible for inclusion. Included studies were required to perform invasive coronary angiography as the reference standard used to confirm diagnosis in all participants. Significant coronary artery disease (positive test result) was defined as at least one significant stenosis (≥50% reduction in luminal diameter) per patient or segment. Included studies were required to report sufficient data to populate 2x2 contingency tables (numbers of true and false positive and negative test results)

Studies that assessed in-stent restenosis, studies of patients who had received a heart transplant and studies with duplicate inclusion of patients from other studies were excluded.

Mean age of study patients ranged from 58 to 71 years (median 63 years). The proportion of male participants ranged from 57% to 85% (median 69%). Mean heart rate ranged from 56 to 86.4 beats per minute (median 64 beats per minute). Most studies did not use pre-scan beta-blockers in any patient. Most studies enrolled patients with suspected coronary artery disease, known coronary artery disease or both who had been scheduled for invasive coronary angiography. Three studies included patients evaluated before valve surgery. All except two of the included studies used 64-slice dual-source CT (Somatom Definition; Siemens Medical Solutions, Forchheim, Germany); the other studies used 128-slice dual-source CT. Most studies were performed with retrospectively ECG-gated scan; five studies prospectively used a ECG-triggered scan. Most included studies reported both per patient and per segment data.

Two reviewers independently assessed studies for inclusion. Any disagreements were resolved by consensus or arbitration.

Assessment of study quality
The methodological quality of included studies was assessed using the 11-item version of the QUADAS tool recommended by the Cochrane Collaboration.

Two reviewers independently assessed study quality. Any disagreements were resolved by consensus or arbitration.

Data extraction
Data were extracted on arteries examined, beta-blockers before scanning, retrospective or prospective ECG-gated scanning and the absolute numbers of true and false positive and negative test results (per patient and per segment).
Authors were contacted for clarification where necessary. Two reviewers independently extracted data. Any disagreements were resolved by consensus or arbitration.

**Methods of synthesis**
A bivariate random-effects model was used to generate pooled estimates of sensitivity and specificity, with 95% confidence intervals (CIs), for per patient and per segment data. Hierarchical summary receiver-operating characteristic (HSROC) curves were generated.

To investigate possible sources of heterogeneity, meta-regression was performed by adding covariates to the bivariate random-effect mode; covariates included patient characteristics (mean age, proportion of male patients and mean heart rate), sample size, use of pre-scan beta-blocker, prospective versus retrospective ECG gating, Agatston score, blinding of tests interpreters, prevalence of coronary artery disease, proportion of non-assessable segments, exclusion versus inclusion of non-assessable segments in the accuracy analysis and qualitative versus quantitative assessment of invasive coronary angiography.

**Results of the review**
Twenty-five studies (2,508 participants, range 30 to 444) were included in the review. Differential and partial verification biases and incorporation bias were avoided in all studies. Eighty per cent of studies reported blinded interpretation of the index test and reference standard.

The pooled sensitivity for per patient detection of significant coronary artery disease was 99% (95% CI 97% to 99%) and the pooled specificity was 89% (95% CI 84% to 92%) based on data from 24 studies. Use of prospectively ECG-triggered scanning was associated with a significant increase in specificity (p=0.01); no other covariate showed a significant effect.

The pooled sensitivity for per segment detection of significant coronary artery disease was 94% (95% CI 92% to 96%) and the pooled specificity was 97% (95% CI 96% to 98%), based on data from 24 studies. None of the covariates investigated showed a significant effect on sensitivity or specificity.

Similar sensitivity and specificity estimates were reported for assessment of specific arteries (left anterior descending, left circumflex, left main and right coronary artery).

Values were also reported for positive and negative likelihood ratios and diagnostic odds ratios.

**Authors' conclusions**
Dual-source CT angiography had a high diagnostic accuracy for significant coronary artery disease which was relatively robust to elevated heart rates.

**CRD commentary**
This was a generally well conducted and clearly reported review. Inclusion criteria were clearly stated, the review process included measures to minimise error and bias throughout and the methodological quality of included studies was assessed and reported. Robust meta-analytic methods were used to produce summary estimates. Between-study heterogeneity was investigated. The literature searches included some language restrictions and the authors stated that they used appropriate methodological filters (Cochrane guidance suggests that there are no appropriate methodological filters for test accuracy studies) so it was possible that some relevant studies were omitted.

The estimates of test accuracy seem likely to be reliable. The authors suggest that further large-scale confirmatory studies are needed before their results are applied in clinical practice.

**Implications of the review for practice and research**
**Practice**: The authors stated that the negative predictive value of dual-source CT was sufficient to justify stopping further investigation in patients with low to intermediate pre-test probability of disease who had a negative dual-source CT result.

**Research**: The authors stated that large-scale multicenter studies were needed before generalising their results to real-world practice. They noted a need for studies to assess whether dual-source CT may provide an alternative to
pharmacological stress testing using single photon emission CT for functional assessment.

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