Diagnostic accuracy of transesophageal echocardiography, helical computed tomography, and magnetic resonance imaging for suspected thoracic aortic dissection: systematic review and meta-analysis

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CRD summary
The article reported a well-conducted systematic review assessing the accuracy of transoesophageal echocardiography, helical computed tomography and magnetic resonance imaging for diagnosing thoracic aortic dissection (in comparison with findings at surgery, autopsy or angiography). The authors concluded that all three imaging modalities are equally reliable for confirming or ruling out thoracic aortic dissection; this conclusion accurately reflects the data presented.

Authors' objectives
To systematically review the accuracy of transoesophageal echocardiography (TEE), helical computed tomography (CT) and magnetic resonance imaging (MRI) for the diagnosis of thoracic aortic dissection.

Searching
MEDLINE (January 1980 to August 2005) and the Cochrane Library (Issue 3, 2005) were searched, and the reference lists of published reports and reviews were checked. Only articles reported in the English language were eligible for inclusion in the review.

Study selection
Study designs of evaluations included in the review
Only prospective studies were eligible for inclusion.

Specific interventions included in the review
Studies were included if they assessed the accuracy of at least one imaging technique (TEE, CT or MRI) for the diagnosis of thoracic aortic dissection. The authors defined aortic dissection as 'the presence of two vascular lumens separated by an intimal flap within the aorta'.

Reference standard test against which the new test was compared
The included studies were required to report the reference standard used to diagnose thoracic aortic dissection; no further restrictions on reference standard were made. The authors defined the reference standard for thoracic aortic dissection as surgical, autopsy or angiographic findings.

Participants included in the review
Studies of patients with suspected thoracic aortic dissection were eligible for inclusion. Studies that addressed thoracic aortic disease in general were excluded.

Outcomes assessed in the review
Studies were included if 2x2 contingency tables were reported or could be derived from the published data. The sensitivity and specificity, along with 95% confidence intervals (CIs), were calculated and reported for each included study.

How were decisions on the relevance of primary studies made?
Two reviewers independently selected reports for inclusion.

Assessment of study quality
The quality assessment considered the application of blinding, consecutive recruitment of the participants, and single
Data extraction
Two reviewers independently extracted data on participant and study characteristics, criteria for the diagnosis of aortic dissection, reference standard, onset and type of dissection, system specific settings, and absolute numbers of true-positive, false-positive, true-negative and false-negative results.

Methods of synthesis
How were the studies combined?
Pooled estimates of sensitivity, specificity, positive and negative likelihood ratios, and the diagnostic odds ratio (DOR) were calculated using a random-effects model and weighting by inverse variance; summary estimates were presented with their 95% CIs. Summary receiver operating characteristic (ROC) curves, constructed using the method of Moses et al., were also presented.

Publication bias was assessed using a funnel plot and by using the Kendall rank correlation coefficient to estimate the correlation between sample size and relative risk (correlation would be strong if not many small studies with null results were published). Significant publication bias was defined as a P-value of less than 0.10.

How were differences between studies investigated?
Between-study heterogeneity was assessed using the chi-squared test (significant heterogeneity was defined as P<0.10). The threshold effect (the extent to which the DOR is dependent upon the diagnostic threshold applied) was assessed by using the summary ROC equation to test for a significant relationship between sensitivity and specificity.

Results of the review
A total of 16 studies (n=1,139) were included. Ten studies (n=630) assessed the diagnostic accuracy of TEE, 3 studies (n=117) assessed helical CT and 7 studies (n=392) assessed MRI. Three studies assessed more than one imaging technique.

TEE (10 studies): the pooled estimates of sensitivity and specificity were 98 (95% CI: 95, 99) and 95 (95% CI: 92, 97), respectively. The pooled estimates of positive and negative likelihood ratios were 14.1 (95% CI: 6.0, 33.2) and 0.04 (95% CI: 0.02, 0.08), respectively. The pooled estimate of DOR was 6.1 (95% CI: 5.0, 7.2). Chi-squared tests indicated the presence of significant between-study heterogeneity for specificity and positive likelihood ratio.

Helical CT (3 studies): the pooled estimates of sensitivity and specificity were 100 (95% CI: 96, 100) and 98 (95% CI: 87, 99), respectively. The pooled estimates of positive and negative likelihood ratios were 13.9 (95% CI: 4.2, 46.0) and 0.02 (95% CI: 0.01, 0.11), respectively. The pooled estimate of DOR was 6.5 (95% CI: 4.4, 8.7). Chi-squared tests indicated the presence of significant between-study heterogeneity for sensitivity.

MRI (7 studies): the pooled estimates of sensitivity and specificity were 98 (95% CI: 95, 99) and 98 (95% CI: 95, 100), respectively. The pooled estimates of positive and negative likelihood ratios were 25.3 (95% CI: 11.1, 57.1) and 0.05 (95% CI: 0.03, 0.10), respectively. The pooled estimate of DOR was 6.8 (95% CI: 5.5, 8.0). Chi-squared tests indicated no significant between-study heterogeneity.

There was no evidence of a threshold effect for any of the imaging techniques assessed.

The funnel plot and Kendall correlation coefficient suggested the absence of publication bias.

Authors’ conclusions
The three imaging techniques assessed were equally reliable for confirming or ruling out thoracic aortic dissection.

CRD commentary
This systematic review addressed a clearly stated and clinically relevant question, and appropriate inclusion criteria were specified. The search strategy used to identify relevant studies was somewhat limited in its scope and this, combined with the restriction to English language publications, might have resulted in the omission of some relevant data. Relevant details of the included studies were reported clearly and in full, and the authors described the methods used to minimise the introduction of error or bias during the review process. Some relevant aspects of the methodological quality of the included studies were assessed and the results of this assessment were reported, though not considered in the data synthesis.

The methods used to synthesise the data were clearly described and broadly appropriate, with the following caveats: some data sets showed evidence of statistically significant heterogeneity, limiting the value or reliability of pooled estimates; given the absence of evidence for threshold effects, the presentation of summary ROC curves does not add to the pooled estimates since the data may be assumed to represent variation around a point estimate rather than following the underlying ROC curve for the test; weighting by inverse variance when pooling the DOR is problematic in that the DOR is related to variance. In general, this was a well-conducted and clearly reported study and the authors’ conclusions follow from the data presented.

Implications of the review for practice and research
Practice: The authors stated that all three imaging techniques are equally reliable for confirming or ruling out thoracic aortic dissection. They further stated that their meta-analysis was unable to determine the role of any of the three imaging techniques in assessing other important clinical factors (presence of branch vessel or coronary artery involvement, presence of aortic valve insufficiency) that influence surgical decision making. The authors stated that clinicians should take into account the availability of imaging tests and the variation in expertise between hospitals when considering which test to order.

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

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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.