Computed tomography for detecting left atrial thrombus: a meta-analysis

CRD summary
This review concluded that computed tomography showed good accuracy in detecting left atrium and left atrial appendage thrombus and should be considered the foremost noninvasive alternative to transoesophageal echocardiography. The authors acknowledge that their results should be interpreted with caution; this cautionary message seems appropriate.

Authors' objectives
To evaluate the accuracy of computed tomography (CT) for detecting left atrium and left atrial appendage thrombus in transient ischaemic attack and stroke.

Searching
PubMed, Web of Knowledge and The Cochrane Library were searched without language restrictions to June 2012; search terms were reported. Reference lists from relevant studies were also searched for additional papers.

Study selection
Prospective studies were eligible for inclusion if they investigated the diagnostic accuracy of multi-detector CT (with at least 16 slice scanners) in patients with suspected left atrium and left atrial appendage thrombus. Transoesophageal echocardiography was the reference standard. Studies had to use pre-specified definitions for left atrium and left atrial appendage thrombus for CT and transoesophageal echocardiography. There had to be sufficient data reported to construct 2x2 tables of test performance.

Eight studies recruited patients with atrial fibrillation and one recruited patients with recent stroke, so all participants were at a high risk for thrombus formation. All studies used contrast-enhanced CT to detect left atrium and left atrial appendage thrombus, and used the same definitions for left atrium and left atrial appendage thrombus for both CT and transoesophageal echocardiography. Most of the studies used a 64-slice CT scanner, and 5 or 7MHz transoesophageal echocardiography. Mean participant age ranged from 56 to 64 years, and the proportion of men ranged from 65 to 82%.

The authors stated that two reviewers conducted the searches, but it was unclear whether the application of the inclusion criteria was conducted in duplicate.

Assessment of study quality
Study quality was assessed using the 14-point QUADAS tool; the authors did not state how many reviewers assessed quality.

Data extraction
Data were extracted by two independent reviewers to construct 2x2 tables of test performance. Sensitivity, specificity, positive and negative likelihood ratios (LR+/-) and the diagnostic odds ratio were calculated.

Methods of synthesis
Pooled estimates of sensitivity and specificity with 95% confidence intervals were calculated, with studies weighted by sample size; the model used was not reported. Pooled estimates of LR+, LR-, and the diagnostic odds ratio were calculated using a random-effects DerSimonian and Laird model. Heterogeneity was assessed using the χ² and I² statistics; I² greater than 50% was considered significant. Subgroup analyses were used to investigate the impact of study design and test-related factors. Summary receiver operating characteristic curve were produced, from which the area under the curve was derived; the model used was not reported. Publication bias was assessed using a funnel plot and the Egger’s test.

Results of the review
Nine studies met the inclusion criteria (1,646 patients; range 51 to 402); all were single-centre prospective cohort
studies. Of the nine studies, all recruited a representative patient spectrum, used an acceptable reference standard, avoided partial and differential verification bias and avoided incorporation bias. Approximately 80% avoided progression bias, 65% blinded interpreters of the index test, 55% blinded interpreters of the reference standard and 80% reported uninterpretable results and explained withdrawals.

For the detection of left atrium and left atrial appendage thrombus using CT, overall sensitivity was 81% (95% CI 70 to 90%), specificity was 90% (95% CI 88% to 91%), LR+ was 6.24 (95% CI 4.05 to 9.63), LR- was 0.22 (95% CI 0.08 to 0.59), the DOR was 26.44 (95% CI 11.97 to 58.41), and the AUC was 0.93 (standard error ±0.02). Heterogeneity was substantial for both sensitivity and specificity (I² was 79.5% for sensitivity and 90.4% for specificity). Subgroup/sensitivity analyses showed that studies using a dual source CT had a better sensitivity, LR- and DOR compared to other types of CT scanners. Results for different study designs and quality were also presented. There was evidence of potential publication bias.

Authors’ conclusions
CT showed a good diagnostic accuracy in detecting left atrium and left atrial appendage thrombus with high sensitivity and specificity. Therefore, CT should be considered the foremost noninvasive alternative to transoesophageal echocardiography for detecting left atrium and left atrial appendage thrombus.

CRD commentary
The review addressed a clear question supported by reproducible inclusion criteria. Several relevant sources were searched without language restrictions, but unpublished studies were not specifically sought. Data extraction was conducted in duplicate; it was unclear whether similar methods to reduce error and bias were used during study selection and the assessment of study quality.

Appropriate criteria were used to assess study quality; the results were only reported in summary with no weighting of importance of criteria used to determine overall quality for the sensitivity analyses. Over half of the studies did not blind interpreters of index tests and/or the reference standard; this could lead to overestimations of accuracy. This seemed to be confirmed in the sensitivity analyses, where studies that met less than 10 items of QUADAS had better estimates of sensitivity, LR+, LR- and diagnostic odds ratio than those that met over 10. Summary estimates of sensitivity and specificity were derived using separate meta-analyses; this could also lead to an overestimation accuracy, especially where there was substantial clinical heterogeneity. The model used to produce the Summary receiver operating characteristic curves was not reported, but it appeared to be the Moses-Littenberg model; more robust models were available that could provide pooled estimates of sensitivity and specificity whilst maintaining the intra-study relationship of these measures.

The authors acknowledge that their results should be interpreted with caution due to the high degree of clinical heterogeneity; this cautionary message seems appropriate.

Implications of the review for practice and research
Practice: The authors stated that CT could be used as an alternative modality for detecting thrombus in selected patients with stroke or atrial fibrillation. They also state that given the increased radiation exposure of CT compared to transoesophageal echocardiography, further development of a system with a lower radiation exposure dose for use in clinical radiology would be necessary.

Research: The authors stated that randomised studies at the patient level were needed to address the potential use of CT in detecting left atrium and left atrial appendage thrombus.

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