Intracranial aneurysms in patients with subarachnoid hemorrhage: CT angiography as a primary examination tool for diagnosis; systematic review and meta-analysis

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CRD summary
This review concluded that computed tomographic angiography had a very high diagnostic value for detection of ruptured intracranial aneurysms in patients with subarachnoid haemorrhage. The conclusions should be interpreted with caution due to the possibility of missing studies, lack of details on study quality and unclear generalisability of the review findings.

Authors' objectives
To calculate the sensitivity and specificity of computed tomographic (CT) angiography for the diagnosis of cerebral aneurysms in patients with acute subarachnoid haemorrhage at presentation.

Searching
MEDLINE and EMBASE were searched from 1997 to September 2009 for published studies that included an abstract. Search terms were reported and included a diagnostic filter. Reference lists of retrieved studies were screened. No language restrictions were applied.

Study selection
Studies that evaluated the accuracy of CT angiography for the diagnosis of cerebral aneurysms in patients with subarachnoid haemorrhage were eligible for inclusion. Where studies also included patients with other other diagnosis, data had to be available separately for patients with subarachnoid haemorrhage. All patients had to undergo a reference standard of selective cerebral angiography, surgery, endovascular treatment or autopsy. Studies had to include at least 20 patients and provide sufficient data to construct a 2x2 table of test performance.

Included studies were prospective and retrospective and some enrolled consecutive patients. Most studies used four CT detector rows and some used eight, 16 or 64 rows.

Two reviewers independently selected studies for inclusion.

Assessment of study quality
Two reviewers independently assessed study quality using the 14-item QUADAS tool. Studies were assigned a score from zero to 14 based on the number of items fulfilled. Disagreements were resolved through consensus.

Data extraction
Data were extracted to populate 2x2 tables of test performance on a per patient basis and these data were used to calculate sensitivity and specificity together with 95% confidence intervals (CIs). Patients who did not receive a reference standard were excluded from the analysis.

The authors did not state how many reviewers performed the data extraction.

Methods of synthesis
Summary sensitivity and specificity, together with 95% CIs, were estimated using the bivariate random-effects model. Summary receiver operating characteristic (SROC) curves were estimated using the same model. Forest plots were constructed to display individual study and summary estimates of sensitivity and specificity, together with 95% CIs. Heterogeneity was assessed using the $I^2$ and $Q$ statistics. Publication bias was assessed using a funnel plot. Subgroup analyses were used to investigate the effects of study design, study quality, reference standard and prevalence of ruptured aneurysms.
Results of the review
Fifty studies (n=4,097 participants, range 21 to 336) were included. QUADAS scores ranged from 7 to 14 out of 14. Forty-two studies reported data on both sensitivity and specificity and were included in the analysis.

Sensitivity ranged from 88% to 100% with moderate heterogeneity (I^2=54%). Summary sensitivity was 98% (95% CI 97% to 99%). Specificity ranged from 50% to 100% with low heterogeneity (I^2=19%).

Summary specificity was 100% (95% CI 97% to 100%). When the analysis was restricted to studies that used a 16- or 64-detector row CT scanner, heterogeneity was reduced to 15% and the summary estimate of sensitivity remained the same.

Summary estimates of sensitivity and specificity did not differ according to study design (non-consecutive versus consecutive patients), quality score, reference standard or prevalence of ruptured aneurysms; heterogeneity was reduced for some of these analyses.

Authors' conclusions
CT angiography had a very high diagnostic value for the detection of ruptured intracranial aneurysms.

CRD commentary
The review addressed a clear question. Inclusion criteria were defined. The literature search was restricted to two databases, used a diagnostic filter and only published studies with abstracts were eligible, so relevant studies may have been missed. Publication bias was assessed in the review, but the methods used were not appropriate for diagnostic data. Appropriate steps were taken to minimise bias and errors during study selection and quality assessment; it was unclear whether such steps were also taken when extracting data.

Study quality was assessed using appropriate criteria, but results were presented only as summary quality scores with no discussion of individual items fulfilled; therefore, the quality of the included studies was unclear. Only limited study details were presented in tables and this made it difficult to determine the generalisability of the review findings. Statistically robust models were used to pool results. Heterogeneity was investigated. It would have been informative to investigate the one or two studies that showed much lower estimates of specificity than the other studies.

The authors' conclusions are supported by the data, but should be interpreted with some caution due to the possibility of missing studies, lack of details on study quality and unclear generalisability of the review findings.

Implications of the review for practice and research
Practice: The authors stated that multidetector CT angiography can be used as a primary examination tool in the diagnostic work-up of patients with subarachnoid haemorrhage. They suggested that selective cerebral angiography can be omitted where CT angiography results were positive and that negative CT angiography results should be confirmed with a second re-evaluation by a radiologist; at that point a negative CT angiography result should be accepted as the final diagnosis.

Research: The authors stated that this meta-analysis should be updated when further data become available and that further research was required into whether these methods and information improved decision making. They stated that their recommendations for clinical practice should be assessed using further prospective data collection.

Funding
None stated.

Bibliographic details
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.