The diagnostic accuracy of computed tomography angiography for traumatic or atherosclerotic lesions of the carotid and vertebral arteries: a systematic review


CRD summary
This well-conducted review assessed the accuracy of computed tomography angiography (CTA) for imaging carotid and vertebral arteries. It found that CTA is both a sensitive and specific imaging technique for identifying severe atherosclerotic stenosis and occlusion of the carotid arteries. There was insufficient evidence to determine the accuracy of CTA in the setting of blunt or penetrating trauma.

Authors' objectives
To determine the diagnostic accuracy of computed tomography angiography (CTA) for atherosclerotic, penetrating and blunt lesions in the carotid and vertebral arteries.

Searching
MEDLINE and EMBASE were searched from 1992 to 2002, as preliminary work had revealed no relevant evaluations of cerebrovascular CTA prior to 1992. The bibliographies of identified papers were screened for additional studies. Full details of the search strategy were reported in the paper. No language restrictions were reported.

Study selection

Study designs of evaluations included in the review
Studies that included at least 10 patients were eligible for inclusion.

Specific interventions included in the review
Studies of CTA used to image the carotid or vertebral arteries were eligible for inclusion. Studies of non-traumatic aneurysm or tumour were excluded. The majority of the included studies used single-slice helical scanner technology and an acquisition slice thickness usually ranging from 2 to 3 mm.

Reference standard test against which the new test was compared
Studies that used digital subtraction angiography (DSA) or surgical findings as the reference standard were eligible for inclusion.

Participants included in the review
Studies that reported primary data on humans were eligible for inclusion. The studies focused on atherosclerosis, penetrating neck injuries, suspected blunt injuries or other aetiology (e.g. spontaneous arterial dissections, carotid cavernous fistulae and mixed aetiology).

Outcomes assessed in the review
The studies had to report sufficient data to construct a 2x2 table of test performance.

How were decisions on the relevance of primary studies made?
A radiologist and a methodologist independently screened abstracts for relevance. Full-text articles of potentially relevant studies were obtained and re-evaluated by two reviewers. Any disagreements were resolved through consensus of study team members.

Assessment of study quality
The studies were assessed for quality according to a 14-point checklist which assessed items on: study design, patient filtering, consecutive enrolment, patient cohort, verification bias, workup bias, diagnostic review bias, test review bias, clinical review bias, observer variability, treatment paradox, equivocal findings and diagnostic criteria. The studies were
assigned a score from 0 to 1, based on the total number of positive responses divided by the maximum possible positive responses. Atherosclerosis studies that scored less than 0.50 on the quality assessment were excluded from the quantitative analysis. Three reviewers independently scored each study for methodological quality and assigned a score of 0 to 1. To obtain the maximum possible score, all reviewers had to affirm all criteria.

Data extraction
A surgeon, a radiologist and a methodologist independently extracted the data. Each reviewer extracted data onto a standardised form. One reviewer extracted non-English language studies with the help of an interpreter or dictionary. For studies that reported results according to the NASCET stenosis criteria, the authors abstracted data where 70 to 99% stenosis and occlusion were defined as positive and 0 to 69% as negative. If more than one observer read the CTA, consensus interpretations were extracted; where no consensus was reported, only results for the first observer were extracted. One set of data were abstracted per artery wherever possible.

Methods of synthesis
How were the studies combined?
A crude fixed-effect pooling of data was used to summarise sensitivity and specificity.

How were differences between studies investigated?
The diagnostic threshold effect was tested for by examining the correlation between sensitivity and specificity using the Spearman rank test, where a coefficient of less than -0.4 was considered to indicate an important threshold effect. The authors inspected the data for clinical or methodological differences leading to heterogeneous study findings. Some differences between the studies were discussed in the 'Results' section of the review.

Results of the review
Forty-three studies (n=1,877) were included in the review.

CTA for detection of atherosclerosis (n=30).

The quality score ranged from 0.12 to 0.74. Fifteen of the 19 high-quality studies, reporting 22 comparisons between CTA and DSA, provided data at the relevant diagnostic thresholds and were included in the meta-analysis. There was little correlation between sensitivity and specificity (P=0.29), while a visual inspection of forest plots suggested no other important source of inter-study heterogeneity. The sensitivity of CTA was greater than 85% in all studies and the median sensitivity was 97%. Pooled sensitivity was 95% (95% confidence interval, CI: 91, 97). Specificity was greater than 90% for severe stenosis and occlusion. The median specificity was 97%. The pooled specificity was 98% (95% CI: 96, 99).

CTA following blunt cervical trauma (n=2).

One study reported a sensitivity of 47% (95% CI: 23, 72) to detect carotid artery injuries and 53% (95% CI: 34, 72) to detect vertebral artery injuries. Specificity was high (greater than 99%). The second study reported a sensitivity of 68% (95% CI: 45, 86), but specificity was poorer at 67% (95% CI: 45, 84).

CTA for penetrating neck trauma (n=2).

Both studies suggested high sensitivity for this type of injury, with both reporting 100% specificity.

CTA for other aetiologies (n=8).

The results for these studies were not reported in detail.

Authors' conclusions
CTA is both a sensitive and specific imaging technique for identifying severe atherosclerotic stenosis and occlusion of
the carotid arteries. However, there is currently insufficient high-quality evidence to accurately estimate the sensitivity and specificity of CTA in the setting of blunt or penetrating trauma.

CRD commentary
This was a well-conducted and clearly reported review. The review question was explicit and supported by clearly defined selection criteria. Details of the review process were reported and included appropriate steps to minimise bias. The searches, while appearing adequate, might have benefited from further attempts to locate unpublished data, so it is possible that the review’s findings may be subject to publication bias. A detailed quality assessment was undertaken and incorporated into the synthesis of the results. Adequate details of the studies were tabulated clearly. The methods used to pool the studies were appropriate given the limited heterogeneity in the study results. The authors’ conclusions are supported by the results presented.

Implications of the review for practice and research
Practice: The authors stated that the data suggest that CTA is accurate enough to play an important role in imaging prior to carotid endarterectomy.

Research: The authors stated that further studies on the accuracy of CTA in penetrating and blunt cerebrovascular injuries are needed.

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