Diagnostic performance of computed tomography angiography in peripheral arterial disease: a systematic review and meta-analysis


CRD summary
The authors concluded that, compared with intra-arterial digital subtraction angiography, computed tomography angiography was an accurate modality to detect lower extremity peripheral arterial disease in patients with intermittent claudication, although methodological concerns within the included studies meant that definitive conclusions could not be drawn. This was a well-conducted review and the authors’ cautious conclusion is likely to be reliable.

Authors' objectives
To determine the accuracy of computed tomography (CT) angiography for assessing lower extremity peripheral arterial disease.

Searching
MEDLINE (January 1966 to August 2008), EMBASE (January 1980 to August 2008) and the Database of Abstracts of Reviews of Effects (DARE) were searched, without language restriction, for relevant studies to include in the review. Search terms were reported. Reference lists of all retrieved papers and relevant systematic and narrative reviews were also searched for additional studies.

Study selection
Studies comparing multidetector CT angiography with intra-arterial catheter angiography or digital subtraction angiography as the reference standard, including at least 10 patients with intermittent claudication or critical limb ischaemia, were eligible for inclusion in the review. Included studies had to report stenosis over 50% (diseased) or arterial occlusion. Data had to be presented in 2x2 or 3x3 contingency tables, or be sufficient to allow their construction. Studies of CT angiography performed as follow-up after lower extremity revascularisation were excluded. Sensitivity and specificity were the primary outcomes of interest. All included studies divided the vascular tree into segments. The median CT angiography slice thickness was 2.0 mm (range 0.75 mm and 5.0 mm). Various contrast media, concentrations and amounts were used. Axial images were used in all studies; other image reconstructions and numbers of observers were detailed in the paper.

The majority of included patients had intermittent claudication and less than half were classed as diseased. A high proportion was male (range 54% to 96%) and their mean age ranged from 53 to 69 years.

Two reviewers selected studies for inclusion in the review and discrepancies were resolved by discussion.

Assessment of study quality
Study quality was assessed by two independent reviewers using a points system in the QUADAS (Quality Assessment of Diagnostic Accuracy Studies) tool, which uses 14 criteria to assess the quality of diagnostic studies. The authors defined the representative patient spectrum as a cohort including both patients with claudication and critical limb ischaemia. The optimal time interval between CT angiography and reference standard was 30 days or less. Blinding in the interpretation of the index and reference tests was also assessed, as was the presence of clinical information.

Data extraction
Data were extracted or calculated to populate contingency tables for the entire vascular tree (from abdominal aorta to ankles) and (where data were available) by anatomic region (aortoiliac, femoropopliteal and tibial arteries). To distinguish between stenosis and occlusion, 3x3 contingency tables were constructed for each arterial segment and graded into three categories according to the degree of stenosis. Raw data were used to calculate the mean of both data sets where necessary and data were combined for different patient groups prior to analysis. Data extraction culminated in the calculation of summary estimates and 95% confidence intervals (CI) for sensitivity and specificity.
Data were extracted independently by two reviewers and discrepancies were resolved by discussion.

Methods of synthesis
Summary estimates for sensitivity and specificity for the entire vascular tree, and for each anatomic region, were calculated using bivariate models using either random-effects or fixed-effect models, depending on the level of heterogeneity measured by the $I^2$ statistic. Sub-group analyses were carried out to explore the influence of patient disease status (intermittent claudication or critical limb ischemia), study design (prospective or retrospective), the number of multidetector CT slices and study quality. Publication bias was examined in a funnel plot and by Egger’s regression test.

Results of the review
Twenty diagnostic cohort studies (11 prospective; seven retrospective; two unclear) were included in the review (957 patients; median sample size 33). Overall study quality was considered to be moderate (the median study quality was 11 points; range 6 to15 points) and publication bias was detected ($p=0.05$).

Entire vascular tree (18 studies): Results for the detection of occlusion or stenosis greater than 50% using CT angiography were 95% for sensitivity (95% CI: 92, 97) and 96% for specificity (95% CI: 93, 97). Sub-group analysis found that studies performed on a 16-slice or 64-slice multidetector CT scan were significantly more accurate than those on a 2-slice or 4-slice scan ($p=0.002$). High levels of heterogeneity were found in this analysis.

Per segment for each anatomic region: For aortoiliac arteries (five studies) the summary estimates were 96% for sensitivity (95% CI: 91, 99) and 98% for specificity (95% CI: 95, 99). For femoropopliteal arteries (five studies) the summary estimates were 97% for sensitivity (95% CI: 95, 99) and 94% for specificity (95% CI: 85, 99). For distal runoff in the tibial arteries (six studies) the summary estimates showed 95% sensitivity (95% CI: 85%, 99%) and 91% for specificity (95% CI: 79%, 97%). One study provided results for the femoral artery up to and including the tibial artery with 98% sensitivity and 96% specificity. High levels of heterogeneity were reported throughout the analyses.

CT angiography correctly diagnosed occlusion in 94% of segments, detected more than 50% stenosis in 87% of segments, and designated a segment without a significant stenosis in 96% of segments. Underestimation of occlusion was found in 6% of segments (5% were detected as more than 50% stenosis). Understaging occurred in 9% and overstaging in 4% of segments, although the text (cited here) and abstract percentages differed in this respect.

Authors’ conclusions
Compared with intra-arterial digital subtraction angiography, CT angiography was an accurate modality to assess the presence and extent of lower extremity peripheral arterial disease in patients with intermittent claudication, although definitive conclusions could not be drawn.

CRD commentary
This review addressed a clear research question and was supported by detailed inclusion criteria for all aspects except study design. The search strategy appeared to include some relevant sources and efforts were made to minimise language bias. However, the authors did not appear to search for unpublished studies, and the impact of this was borne out in the detection of publication bias. Validity assessment was performed using an appropriate tool for diagnostic studies; the findings were clearly presented and used in the interpretation of results. The review process was carried out with good measures to minimise errors and bias throughout. The authors acknowledge several limitations of the review and their cautious conclusion is likely to be reliable.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors stated that randomised trials were needed to compare the effectiveness and costs of CT angiography and digital subtraction angiography.
Funding
Not stated.

Bibliographic details

PubMedID
19176443

DOI
10.1001/jama.301.4.415

Indexing Status
Subject indexing assigned by NLM

MeSH
Angiography, Digital Subtraction /instrumentation; Arterial Occlusive Diseases /radiography; Confounding Factors (Epidemiology); Diagnosis, Differential; Humans; Ischemia /etiology; Leg /blood supply; Peripheral Vascular Diseases /radiography; Predictive Value of Tests; Publication Bias; Research Design; Sensitivity and Specificity; Tomography, X-Ray Computed

AccessionNumber
12009102565

Date bibliographic record published
31/03/2009

Date abstract record published
29/04/2009

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.