Summary receiver operating characteristic curves as a technique for meta-analysis of the diagnostic performance of duplex ultrasonography in peripheral arterial disease

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Authors' objectives
To summarise and compare the diagnostic performance of duplex ultrasonography and colour-guided duplex ultrasonography in the evaluation of peripheral arterial disease (PAD).

Searching
MEDLINE was searched from 1984 to 1994 for publications in the English language only; the search terms were listed in the text. Additional references were obtained from the bibliographies of review articles and original papers.

Study selection
Study designs of evaluations included in the review
No inclusion criteria relating to study design were specified and the authors did not provide details of the study designs included.

Specific interventions included in the review
The included studies had to evaluate the ability of duplex ultrasonography or colour-guided duplex ultrasonography to detect or exclude a significant lesion, defined as stenosis of 50 to 99%, or an occlusion.

Reference standard test against which the new test was compared
Studies using contrast angiography as the reference standard were eligible for inclusion.

Participants included in the review
Studies of patients with PAD of the lower limbs were eligible for inclusion. The analysis was limited to aortoiliac and femoropopliteal segments because only two studies reported the results of infrapopliteal arteries.

Outcomes assessed in the review
Studies where the data to populate a 2x2 table were available, or were derivable from the data presented, were eligible for inclusion.

How were decisions on the relevance of primary studies made?
The authors do not state how the papers were selected for review, or how many of the reviewers performed the selection.

Assessment of study quality
For each included study, data were collected on the blinding of those interpreting the index and reference standard tests, and the possibility of verification bias. Data were also collected on missing observations, defined as the difference between the number of theoretically available segments (number of limbs multiplied by the number of segments per limb) and the number visualised at both ultrasound and angiography. The authors do not state how the papers were assessed for validity, or how many of the reviewers performed the validity assessment.

Data extraction
A standardised form was used to extract data on the study populations, including the mean age, percentage of females, clinical indications and anatomic sites studied. Data were also extracted on other study features such as angiographic technique used, independent reading of the angiograms, independent interpretation of duplex results, missing observations and the possibility of verification bias.
Methods of synthesis
How were the studies combined?
The performance characteristics of duplex and colour-guided duplex ultrasonography were presented as summary receiver operator characteristic (sROC) curves.

How were differences between studies investigated?
Threshold heterogeneity was examined; heterogeneity of threshold values resulted in the choice of sROC curves to combine primary studies. The effect on the results of a number of potential sources of heterogeneity (including various aspects of participant characteristics and imaging technique, blinding, missing observations and verification bias) were examined; these were entered as covariates in univariate regression analyses.

To assess between-study variation within the group of studies evaluating one test, the 95% confidence intervals for the difference of the log transformations of the true-positive and false-positive rates were constructed for each study using an equation for asymptotic variance. To determine the contribution of each individual study, a sensitivity analysis was performed by repeating the analysis multiple times, each time omitting one study from the entire group of studies.

Results of the review
Fourteen studies were included; 8 evaluated duplex ultrasonography (n=341) and 6 reported on colour-guided duplex ultrasonography (n=272).

A high level of diagnostic performance was demonstrated for both duplex ultrasonography alone and colour-guided duplex ultrasonography. The regression analysis indicated that the diagnostic performance of colour-guided duplex ultrasonography is superior to that of duplex scanning alone (p=0.022). Differences in the case-mix of the study population and study features did not affect the results. Furthermore, the sensitivity analysis did not reveal a strong effect of any single study on the results.

Authors' conclusions
For aortoiliac and femoropopliteal arteries, the addition of colour flow imaging to duplex scanning improves diagnostic performance in evaluating PAD.

CRD commentary
The review addressed a clear research question that was well defined by appropriate inclusion criteria. The literature search involved only one electronic database and was restricted to English language papers; relevant published data may therefore have been excluded. No attempt to locate unpublished literature was reported, although this issue was addressed in the discussion. There was little information in connection with decisions to select relevant studies, nor was there any description of how the data extraction was validated. It is therefore difficult to assess the extent to which defects in the review methodology may have impacted on the results.

The methods used to combine the groups of studies evaluating duplex ultrasonography and colour-assisted duplex ultrasonography were appropriate and clearly described. However, the main conclusion of the review is based upon an indirect comparison between these two groups of studies; none of the studies involved a direct comparison of the two different methods of ultrasound. This approach is highly problematic: given the small sample sizes involved and the poor reporting of primary studies (discussed in some detail by the review authors), it is highly unlikely that either the study populations or the conduct of the reference standard test were the same for the two groups (assumptions necessary to validate the use of an indirect comparison). The main conclusion of the review should therefore be viewed with considerable caution.

Implications of the review for practice and research
Practice: The authors made no recommendations for practice.

Research: The authors made no recommendations for future research. There is, however, a clear need for direct
comparison studies evaluating the performance of both duplex and colour-guided duplex ultrasonography against the reference standard of angiography.

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