Carotid ultrasound screening for coronary heart disease: results based on a meta-analysis of 18 studies and 44,861 subjects

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CRD summary
The authors concluded that neither carotid plaque nor intra-media thickness had sufficient accuracy for detection of coronary heart disease to be a worthwhile screening test. These conclusions were supported by the results, but should be interpreted with caution due to the possibility of missed studies, lack of a validity assessment and considerable heterogeneity between studies.

Authors' objectives
To assess the accuracy of ultrasound screening based on the carotid artery intima-media thickness (IMT) and carotid plaque in identification of individuals with coronary heart disease.

Searching
MEDLINE and EMBASE were searched to March 2008. Search terms were reported. Reference lists of relevant studies and reviews were screened. The review was restricted to studies published in English.

Study selection
Diagnostic case-control or cohort studies that assessed carotid ultrasound intima-media thickness or presence of carotid plaque were eligible for inclusion. Cases were required to be patients with a confirmed coronary heart disease event (death or myocardial infarction) or symptoms of ischaemic chest pain (angina) supported by a confirmed coronary artery stenosis of at least 50% on a coronary angiogram. Control patients were unaffected individuals from the general population or patients who underwent coronary angiography with normal coronary arteries. Studies of less than 20 affected or unaffected patients were excluded. Studies in which controls were patients with ischaemic chest pain and mild coronary artery disease were excluded.

The proportion of men in included studies ranged from 39% to 100%. Mean age ranged from 44 to 73 years. Intra-media thickness was defined as the mean and/or maximum of left and right common carotid artery. Plaque was defined as greater than 1mm to 2.5mm. Coronary heart disease was defined based on death or myocardial infarction or as angina supported by angiographic stenosis.

The authors did not state how many reviewers assessed studies for inclusion.

Assessment of study quality
The authors did not assess study quality.

Data extraction
Data were extracted on arithmetic mean intima-media thickness values and standard deviations in individuals with and without coronary heart disease; these measures were log transformed. The detection rate (equivalent to sensitivity), false positive rate (1 - specificity) and positive likelihood ratio were estimated.

The authors did not state how many reviewers extracted data.

Methods of synthesis
Random-effects models that used inverse-variance weighting were used to estimate summary intima-media thicknesses in individuals with and without coronary heart disease and summary detection rate and false positive rates together with 95% confidence intervals (CI). Heterogeneity was assessed using Cochran's Q-test. Meta-regression was used to investigate the effects of age, differences in methods used to measure intima-media thickness, definition of plaque, study design, coronary heart disease outcome and the proportion of men. Sensitivity analysis was conducted by removal
of each study individually from the meta-analysis.

Results of the review
Eighteen studies (n=44,861, which comprised 2,920 with coronary heart disease and 41,941 without) were included. Six studies used a diagnostic cohort design and 12 were diagnostic case-control studies.

Carotid intima-media thickness (18 studies): The summary intima-media thickness was 0.92mm (95% CI 0.83 to 1.01) in individuals with coronary heart disease and 0.76mm (95% CI 0.68 to 0.84) in individuals without coronary heart disease. There was significant heterogeneity in both measures (p<0.001). Results were similar when stratified according to study design. Intima-media thickness increased with age by 1.4% per year (95% CI 0.7 to 2.1). None of the other variables investigated were associated with intima-media thickness. At a false positive rate of 30% the detection rate was 65%. The summary positive likelihood ratio was 2.2 (95% CI 1.9 to 2.5).

Plaque (eight studies): The summary detection rate was 62% (95% CI 52% to 72%). The summary false positive rate was 30% (95% CI 24% to 37%). There was significant heterogeneity in both measures (p<0.001). Results were similar when stratified according to study design. Presence of plaque increased with age by about 1.5% per year (95% CI 0.3 to 2.8). None of the other variables investigated showed significant associations with the presence of plaque. The summary positive likelihood ratio was 2.1 (95% CI 1.6 to 3.4).

Authors' conclusions
Neither carotid plaque nor intima-media thickness had a coronary heart disease screening performance that was sufficiently discriminatory between affected and unaffected individuals to be a worthwhile screening test.

CRD commentary
The review addressed a clear objective supported by inclusion criteria defined in terms of index test, reference standard and population. The review was restricted to studies published in English and so there was a possibility of language and publication bias. Details of the review process were lacking and so it was not possible to determine whether appropriate steps were taken to minimise bias and errors in the review process. Study quality was not formally assessed and so the reliability of the included studies was unclear. Methods used to pool studies were adequate; however, presence of significant heterogeneity meant that the summary measures should be interpreted with extreme caution. The authors' conclusions were supported by the results presented, but should be interpreted with caution due to the possibility of missed studies, lack of a validity assessment and considerable heterogeneity between studies.

Implications of the review for practice and research
Practice: The authors stated that the screening performance of carotid ultrasound was not sufficient to be a worthwhile screening test.

Research: The authors stated that further research was required to determine the screening performance of other tests alone and in combination with carotid ultrasound.

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