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REVIEW

Transcranial Doppler Ultrasound Detection of Microemboli as a Predictor of Cerebral Events in Patients with Symptomatic and Asymptomatic Carotid Disease: A Systematic Review and Meta-Analysis

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WHAT THIS PAPER ADDS

This paper updates the 2009 meta-analysis performed by King and Markus in terms of included papers and methodology. This is particularly important given the establishment of antiplatelet therapy during the intervening period and publication of several important studies reporting use of transcranial Doppler ultrasound.

Objective: Identification of patients who will benefit from carotid endarterectomy is not entirely effective, primarily utilising degree of carotid stenosis. This study aimed at determining if microembolic signals (MES) detected by transcranial Doppler ultrasound (TCD) can provide clinically useful information regarding stroke risk in patients with carotid atherosclerosis.

Methods: A meta-analysis of prospective studies was performed. Three analyses were proposed investigating MES detection as a predictor of: stroke or TIA, stroke alone, and stroke or TIA but with an increased positivity threshold. Subgroup analysis was used to compare pre-operative (symptomatic or asymptomatic) patients and peri- or post-operative patients.

Results: Twenty-eight studies reported data regarding both MES status and neurological outcome. Of these, 22 papers reported data on stroke and TIA as an outcome, 19 on stroke alone, and eight on stroke and TIA with increased positivity threshold. At the median pre-test probability of 3.0%, the post-test probabilities of a stroke after a positive and negative TCD were 7.1% (95% CI 5—10.1) and 1.2% (95% CI 0.6—2.5), respectively. In addition, the sensitivities and specificities of each outcome showed that increasing the threshold for positivity to 10 MES per hour would make TCD a more clinically useful tool in peri- and post-operative patients.

Conclusion: TCD provides clinically useful information about stroke risk for patients with carotid disease and is technically feasible in most patients. However, the generally weak level of evidence constituting this review means definitive recommendations cannot be made.

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INTRODUCTION

Management of patients with internal carotid artery stenosis is founded on statistical evidence provided by three trials: the North American Symptomatic Carotid Endarterectomy Trial (NASCET), the European Carotid Surgery Trial (ECST), and the Veterans Affairs Cooperative Study (VACS). All used degree of internal carotid artery stenosis as the indicator of stroke risk.[1] Results showed definitive benefit for carotid surgery in symptomatic patients with a 70% or greater stenosis.[2] This forms the basis of current clinical recommendations; however, not all of these patients will benefit from surgical intervention. Improved quantification of an individual's risk of future stroke would allow better patient selection for intervention.

First established in 1982,[3] transcranial Doppler ultrasound (TCD) is an imaging technique used to detect the presence of small particles which may dislodge from an atherosclerotic plaque and flow into cerebral vessels. These microemboli reflect ultrasound more effectively than the surrounding cells, giving a characteristic high intensity short

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duration signal on TCD. It is proposed that the presence of microemboli indicates an unstable or 'vulnerable' carotid plaque, which may lead to rupture, thrombus formation, or occlusion of the carotid artery resulting in a stroke.[4] Data suggest that microembolic signals (MES) recorded by TCD correlate with stroke risk. A potential link between the two has been known about for a long time, resulting in a significant amount of data. None of the studies performed so far have been definitive and therefore summation of the available evidence by meta-analysis will provide a better picture of the current evidence on the degree of correlation between MES on TCD and stroke risk. A formal meta-analysis was performed based on Cochrane methodological standards.

A common criticism of TCD is that increased temporal bone thickness inhibits scanning in a certain proportion of patients. Therefore, incidence of this also was investigated in the papers selected for meta-analysis.

Objectives

The objectives of this review were to determine the prognostic accuracy for stroke and/or TIA of MES recorded by TCD ultrasound in patients with carotid atherogenic disease, and to determine the feasibility of TCD ultrasound in patients with carotid disease by quantifying the temporal bone window availability in studies selected for the primary objective.

MATERIALS AND METHODS

Ethical approval was not required. The review was conducted in accordance with PRISMA and Cochrane reporting guidelines.

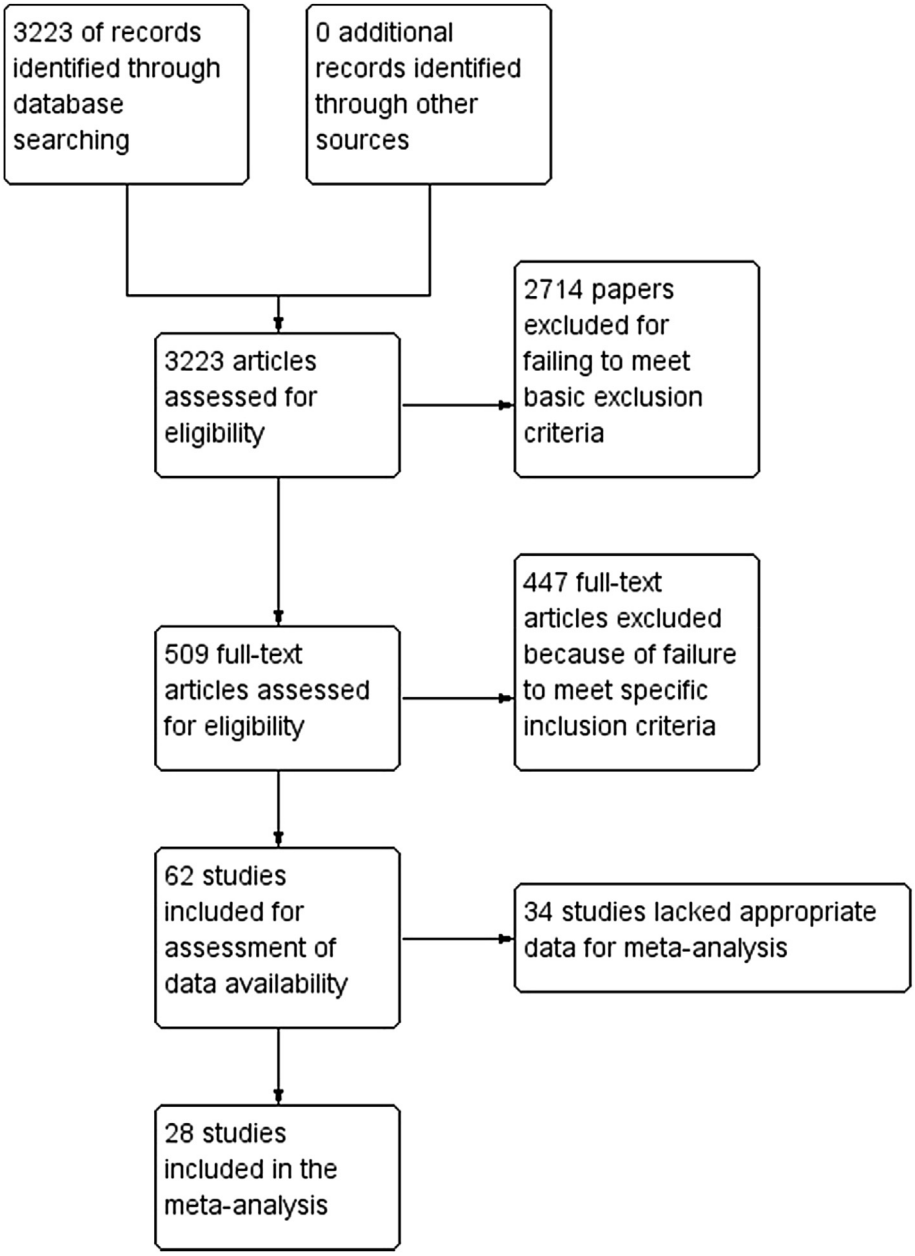

Figure 1. Flow diagram representing study selection process.

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