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Carotid ultrasound in primary and secondary prevention of stroke



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ABSTRACT

Imaging methods play an important role in management of patients with acute stroke or chronic cerebrovascular disease. Carotid ultrasound is a widely used method, thanks to its nonvasivity and wide accessibility. This review article deals with indications for carotid ultrasound examination in primary and secondary prevention. It presents current criteria for carotid stenosis assessment: calculation of the percentage of the stenosis, velocity criteria and the morphology of the plaque. Also accuracy of the method is analyzed. In conclusion, carotid ultrasound is a reliable diagnostic tool that has an important role in the diagnosis and grading of the carotid stenosis.

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Epidemiology

Cardiovascular diseases are the leading cause of death and morbidity throughout the western world [1]. Although in the developed countries cardiovascular disease-related mortality is apparently declining, the incidence still remains high. Striking regional differences exist even among European countries where the incidence of stroke per 100,000 inhabitants ranges from 77 in Scotland to 407 in Hungary [2]. Unfortunately, the statistics does not seem to cover the final count of affected individuals. According to Bryan [3], the prevalence of silent cerebral infarction for age group 55–64 years can be as high as 11%, increasing further to 43% in people over 85 years of age. These data suggest there may be even more asymptomatic than symptomatic patients who further proceed to clinically overt recurrence of the disease or silently turn to other consequences (e.g. vascular dementia).

Because of the extensive population impact, no wonder preventive measures are being taken. The opportunity to define the possible culprit vessel stenosis is attractive, and therefore different imaging modalities are used to screen the patients. Carotid ultrasound is cheap and widely accessible modality used. The following review deals with indications and benefits of this method in practice.

Primary prevention

In primary prevention the carotid ultrasound is used not only to diagnose the carotid disease, but also to estimate the risk of atherosclerosis progression in general [4]. Being non-invasive and easily available, carotid ultrasound is an excellent tool in primary prevention, where it is used in two indications. The first and most important indication is a suspected carotid stenosis. This suspicion can arise under many clinical conditions that are summarized in Table 1.

The second indication is to precisely evaluate the risk of atherosclerosis progression in general rather than detecting a carotid stenosis. The European Guidelines on cardiovascular disease prevention [5] suggest that imaging methods for atherosclerotic burden are relevant especially in individuals with moderate risk to further distinguish their cardiovascular risk. For instance, patients, whose cardiovascular risk is intermediary according to the Score tables, could be reclassified to a higher risk category based on a positive result, and appropriate medical treatment would be initiated. In the absence of an atherosclerotic plaque the intima-media thickness (IMT) is usually used for risk assessment. Carotid IMT has been consistently associated with stroke and coronary artery disease [6]; however, large meta-analysis using data from 14 population-based cohorts [7] suggested that its clinical usefulness may be limited: the improvement in prediction of first myocardial infarction or stroke was only minor when added to the Framingham Risk Score (net reclassification improvement 0.8%). Therefore, the clinical utility of IMT measurements in addition to the traditional risk factors is yet to be determined. The IMT measurement has also its limitations: the IMT is usually measured in the common carotid artery because of its easier accessibility to detailed

Table 1 – Indication of carotid ultrasound in primary prevention – suspected carotid stenosis.

Carotid bruit
Syncope
Vertigo, dizziness
Subclavian steal syndrome
Cerebral atherosclerosis diagnosed by other methods
Retinal artery occlusion
Sudden visual loss
Transient visual loss – amaurosis fugax
Visual disturbances
Abnormality of gait – if not of musculoskeletal or peripheral neural origin
Transient paralysis of limb
Injury to the carotid region

depiction, but the atherosclerotic plaques occur earliest in the bulb [8]. This technical issue may be partially responsible for the limited value of IMT in risk prediction. In a meta-analysis by Inaba [9] it was found that the presence of carotid plaque had a significantly higher diagnostic value for the prediction of future myocardial infarction compared to IMT. New 3D ultrasound techniques have the ability to directly measure total plaque volume and total plaque area, with especially total plaque volume being shown to be superior over IMT in cardiovascular risk prediction [10]. Though the exact role of these new modalities in the risk assessment remains to be established, it is probable they will earn their position in the cardiovascular risk assessment in the future.

Whether all patients in the high risk category should routinely undergo carotid ultrasound still remains a matter of debate. Based on updated evidence [11], the U.S. Preventive Services Task Force reaffirmed its previous recommendation against screening for asymptomatic carotid artery stenosis in the general population [12]. The current discussion in primary prevention is more concerned with the question of what is the right treatment for asymptomatic carotid stenosis. In the initial studies on asymptomatic carotid stenosis, ACAS [13] and ACST [14], treatment of stenosis $\geq 60\%$ with CEA (carotid endarterectomy) apparently reduced the risk of a stroke within the next 5 years to a half (from 12% to 6%, including perioperative risk). However, these studies were conducted in 1990s before the high-potency statin therapy was introduced. Based on these results, current ESC Guidelines on the diagnosis and treatment of peripheral artery diseases [15] state that in asymptomatic patients with carotid artery stenosis $\geq 60\%$, CEA should be considered under the conditions that perioperative risk for stroke and death is less than 3% and the patient's life expectancy exceeds 5 years. However, the same guidelines conclude that the benefit of revascularization in addition to optimal medical treatment should be reassessed under current conditions (especially optimal medical therapy).

Secondary prevention

The approach to secondary prevention, e.g. in patients who have suffered stroke or transitory ischemic attack (TIA), is better defined. Those patients who are referred to the hospital with acute symptoms within the time window eligible for acute revascularization usually undergo immediate imaging

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