

# Ultrasound Criteria for Diagnosis of Carotid Artery Atherosclerosis

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## Abstract

Atherosclerosis is a complex, systemic, multifactorial, and multistage disease with numerous risk factors that predispose and trigger the process of atherogenesis. The well-known ARIC study demonstrated that intima-media thickening (IMT) of the common carotid artery greater than 0.9 mm is significantly associated with an increased risk of cardiovascular complications, even in the absence of symptoms.

**Keywords:** Atherosclerosis, carotid artery, ultrasound.

## Introduction

Carotid artery atherosclerosis is a major cause of ischemic stroke, which remains the leading cause of disability and mortality worldwide. According to the World Health Organization, more than 13 million strokes occur annually, of which approximately 5.5 million are fatal (WHO, 2021). In Uzbekistan, statistics are equally alarming: according to the Ministry of Health, stroke is the third leading cause of death, with a prevalence of 80-120 cases per 100,000 population, with an increasing trend in recent years (Shokirova et al., 2022). According to Majidova E.N. et al. (2019), approximately 60,000 stroke cases are registered annually in Uzbekistan, representing 164 cases per 100,000 population. Moreover, cardiovascular diseases firmly occupy a leading position in terms of incidence, mortality, and patient disability, both in Uzbekistan and worldwide.

Atherosclerosis is a complex, systemic, multifactorial, and multistage disease with numerous risk factors that predispose and trigger the process of atherogenesis. Smoking is the most dangerous, but researchers also note

the influence of lipid metabolism disorders, diabetes, obesity, arterial hypertension (AH), physical inactivity, significant dietary irregularities, hereditary predisposition, elevated blood fibrinogen, homocysteine, and other pathological processes and conditions (Shishkina V.S., 2011; Chechetkin A.O., Druina L.D., Evdokimenko A.N. et al., 2017; Pogorelova O.A., Tripoten M.I., Guachaeva D.A. et al., 2017). According to the WHO, atherosclerosis is a combination of various pathological changes in the inner lining of arteries (deposition of lipids, complex carbohydrates, fibrosis, accumulation of blood components, calcium salts, and concomitant changes in the media). Over a long period of time, atherosclerosis progresses without any specific clinical picture, with the gradual development of chronic cerebrovascular insufficiency and, as a consequence, cognitive impairment of varying severity (Kukharchuk V.V., Tararak E.M., 2010; Tekoeva A.R., 2011; Howard D., van Lammeren G., Rothwell P. et al., 2015).

One of the most informative, safe, and accessible methods for early diagnosis and assessment of stenosis is

ultrasound, including B-mode, color duplex scanning (CDS), and spectral Doppler. The well-known ARIC study demonstrated that intima-media thickening (IMT) of the common carotid artery greater than 0.9 mm is significantly associated with an increased risk of cardiovascular complications, even in the absence of symptoms (Howard et al., 2013). IMT measurement and detection of subclinical atherosclerosis can be effectively used for early risk stratification in patients with cardiovascular risk factors.

### Purpose of the study

Evaluation of the diagnostic effectiveness of ultrasound techniques (B-mode, color Doppler and spectral Doppler) in the comprehensive detection of structural and hemodynamic changes in the carotid arteries.

### Methods

A prospective study of 88 patients with suspected carotid atherosclerosis was conducted over a follow-up period of 2023–2024. The mean age was  $59.3 \pm 6.8$  years. The control group included 20 clinically healthy volunteers

without signs of atherosclerosis. Ultrasound examinations were performed on a MyLabSIGMA system (ESAOTE, Italy) using a 5–7 MHz linear transducer. B-mode was used to assess intima-media thickness (IMT) and vessel wall structure, color doppler imaging (CDS) was used to identify plaques, determine their echogenicity, contours, and extent, and spectral Doppler ultrasonography was used to quantify blood flow and calculate the degree of stenosis.

### Results

The use of grayscale imaging facilitated the early detection of IMT thickening before plaque formation. Color duplex scanning accurately localized the stenosis and assessed its severity. Spectral Doppler imaging effectively measured blood flow velocity, allowing us to confirm the severity of hemodynamic disturbances. IMT changes and atherosclerotic plaque formation were most frequently detected at the bifurcation of the common carotid artery.

With high stenosis (more than 70%), hypoechoic and heterogeneous plaques with impaired laminar blood flow predominated. The table presents the parameters in the study and control groups.

Table

Comparative characteristics of the indicators of both groups

Parameter	Main group (n=100)	Control group (n=30)	Reliability (p)
Age	88,3± 6,	53,8 ±7,2	0,06
Male	66%	50%	0,21
Average IMT (mm)	1,15 ± 0,18	0,68 ± 0,11	< 0,05
Presence of atherosclerotic plaques (%)	75%	0%	< 0,05
Average stenosis (%)	38,6 ± 16,5	0%	< 0,001
Hemodynamic impairment (%)	57%	0%	< 0,01

### Conclusion

The combined use of ultrasound techniques (B-mode, color Doppler, and Doppler) offers high sensitivity and specificity in the diagnosis of carotid atherosclerosis. These techniques not only detect early signs of vascular changes but also risk stratify patients based on the degree of stenosis, making them indispensable in clinical practice.

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