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### PREVENTIVE STRATEGIES FOR ISCHEMIC STROKE IN STENOTIC LESIONS OF CEREBRAL ARTERIES

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#### Abstract

Ischemic stroke remains one of the leading causes of mortality and long-term disability worldwide. Among the most significant risk factors for its development are stenotic lesions of the carotid arteries caused by atherosclerosis or structural vascular abnormalities. The present prospective study evaluated predictors of

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ischemic stroke in patients with dyscirculatory encephalopathy and carotid artery pathology of different etiologies. The study included 80 patients who were followed for 12 months. Participants were divided into two groups: Group I (n = 50) consisted of patients with transient ischemic attacks associated with atherosclerotic carotid artery stenosis, whereas Group II (n = 30) included individuals with structural carotid artery abnormalities such as kinking and coiling. Neurological examinations, clinical assessments, duplex ultrasonography of brachiocephalic arteries, and the ABCD3 risk scoring system were used to evaluate stroke risk and vascular status. The findings demonstrated that patients with atherosclerotic carotid stenosis had a significantly higher risk of ischemic stroke compared with individuals with structural arterial deformities. Duplex ultrasound proved to be a highly effective diagnostic tool for detecting hemodynamic disturbances and vascular morphology changes. The results highlight the importance of early vascular screening and risk assessment in preventing ischemic stroke.

**Keywords:** Ischemic stroke, carotid stenosis, duplex ultrasound, arterial kinking, arterial coiling, ABCD3 risk score, cerebrovascular disease.

### Аннотация

В рамках настоящего наблюдательного исследования, продолжавшегося на протяжении одного года, были обследованы 80 пациентов с диагнозом дисциркуляторной энцефалопатии, у которых выявлены стенозирующие изменения сонных артерий различной природы. Участники были распределены на две подгруппы: Первая группа (n=60) включала пациентов с транзиторными ишемическими атаками (ТИА), развившимися на фоне атеросклеротического сужения сонных артерий. Вторая группа (n=40) состояла из больных с ТИА на фоне анатомических деформаций сонных артерий, таких как кингкинг и койлинг. Статья представляет собой анализ

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динамики и прогностических критериев вероятности развития ишемического инсульта у данной категории больных в течение 12 месяцев. Для оценки рисков использовались шкала ABCD3 и результаты дуплексного ультразвукового исследования экстракраниальных отделов артерий.

**Ключевые слова:** ультразвуковое дуплексное сканирование, койлинг, кинкинг, шкала ABCD3, ишемический инсульт, цереброваскулярные патологии.

### Annotatsiya

Ushbu ilmiy tadqiqotda uyqu arteriyalarida yuzaga kelgan turli xil kelib chiqishli (genezli) stenozlovchi (toraytiruvchi) shikastlanishlar mavjud bo'lgan va discirkulyator ensefalopatiya tashxisi qo'yilgan 80 nafar bemor 12 oy davomida kuzatildi. Ishtirokchilar ikki guruhga ajratildi: I guruh: uyqu arteriyalarida ateroskleroz fonida rivojlangan discirkulyator ensefalopatiya va tranzitor ishemik hujum (TIA) bo'lgan 60 nafar bemorlar. II guruh: uyqu arteriyalarida patologik deformatsiyalar (kinking va coiling) mavjud bo'lgan 40 nafar bemorlar. Maqolada 1 yillik kuzatuv natijalari asosida magistral arteriyalardagi aterosklerotik torayishlar va patologik o'zgarishlar fonida ishemik insult rivojlanish ehtimolini ABCD3 baholash shkala va dupleks skanerlash diagnostika usuli yordamida baholash natijalari keltirilgan.

**Kalit so'zlar:** duplex UZI, coiling, kinking, ABCD3 shkala, ishemik insult, uyqu arteriyasi, prognozlash.

### Introduction

Ischemic stroke represents one of the most serious neurological disorders and remains a major public health concern. According to global epidemiological data, stroke ranks among the leading causes of mortality and permanent disability,

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significantly affecting the quality of life of affected individuals and placing a considerable burden on healthcare systems. Atherosclerotic stenosis of the carotid arteries is widely recognized as one of the primary etiological factors contributing to cerebral ischemia. In addition to atherosclerosis, structural abnormalities of the carotid arteries, including kinking and coiling, may also disrupt normal cerebral circulation and predispose individuals to transient ischemic attacks and ischemic stroke. The pathogenesis of ischemic stroke in patients with carotid artery pathology is complex and multifactorial. Progressive lipid accumulation within the arterial wall, inflammatory processes, and fibrous tissue proliferation contribute to the formation of atherosclerotic plaques. These plaques may narrow the vascular lumen, alter blood flow dynamics, and increase the risk of thromboembolic events. Structural vascular deformities such as kinking (sharp angulation of the artery) and coiling (loop-like elongation of the vessel) are additional abnormalities that can influence cerebral perfusion. These deformities may lead to turbulent blood flow, impaired hemodynamics, and episodic reductions in cerebral blood supply. Early detection of these vascular abnormalities plays a crucial role in preventing ischemic stroke. Duplex ultrasonography has become one of the most widely used non-invasive imaging techniques for evaluating the structure and hemodynamic properties of carotid arteries. When combined with clinical risk assessment tools such as the ABCD3 score, it provides valuable information for predicting stroke risk and guiding preventive strategies.

### **Aim of the Study**

The objective of the present study was to identify predictive factors for the development of ischemic stroke in patients with carotid artery stenosis of different etiologies and to evaluate the effectiveness of duplex ultrasonography and ABCD3 scoring in stroke risk assessment.

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### Materials and Methods

A total of 80 patients diagnosed with dyscirculatory encephalopathy associated with carotid artery pathology were enrolled in this prospective study. All participants were monitored for a period of 12 months.

Patients were divided into two groups based on the type of vascular pathology:

**Group I (n = 50):** Patients with dyscirculatory encephalopathy and transient ischemic attacks associated with atherosclerotic carotid artery stenosis.

**Group II (n = 30):** Patients with structural abnormalities of the carotid arteries, including kinking and coiling.

Comprehensive neurological examinations and clinical evaluations were performed at baseline, at 6 months, and at 12 months. Stroke risk was assessed using the **ABCD3 scoring system**, which evaluates age, blood pressure, clinical features, duration of symptoms, diabetes, and recurrence of transient ischemic attacks. Additionally, all patients underwent **duplex ultrasonography of the brachiocephalic arteries**, which allowed assessment of arterial morphology, blood flow velocity, degree of stenosis, and presence of hemodynamic disturbances. Statistical analysis included evaluation of demographic characteristics, clinical manifestations, neurological findings, and stroke risk scores.

### Results

#### Demographic Characteristics

The mean age of patients in **Group I** was  $53.5 \pm 1.4$  years, with **63.5% males** and **36.5% females**. In **Group II**, the mean age was  $51.4 \pm 1.5$  years, including **66.7% males** and **33.3% females**. The demographic characteristics of the two groups were comparable, allowing reliable comparison of clinical outcomes.

**Clinical Symptoms.** The most frequently reported subjective symptoms included headache, tinnitus, dizziness, and memory impairment. Headache was observed in more than 90% of patients in both groups. Patients with arterial deformities

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demonstrated a slightly higher prevalence of vestibular symptoms, including dizziness and balance disturbances. Memory decline and cognitive impairment were also commonly reported, particularly among patients with chronic cerebral hypoperfusion.

### Neurological Findings:

Neurological examination revealed several characteristic abnormalities in both groups.

\*Common findings included:

\*Central facial nerve palsy

\*Hypoglossal nerve dysfunction

\*Hyperreflexia

\*Pathological reflexes

\*Vestibulo-ataxic syndrome

\*Nystagmus

\*Cognitive decline

Vestibulo-ataxic syndrome was more frequently observed in patients with structural arterial deformities, suggesting a stronger association with vertebrobasilar circulation disturbances.

### ABCD3 Risk Score Analysis:

The ABCD3 scoring system demonstrated progressive increases in stroke risk during the follow-up period.

#### Group I

At baseline:

26% high risk (6 points)

35.3% moderate risk (5 points)

38.6% low risk

After 12 months:

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48.1% high risk

35.5% moderate risk

16.6% low risk

The average ABCD3 score in this group was  $5.1 \pm 0.11$ , and the incidence of ischemic stroke reached **17.4%**.

### Group II

At baseline:

24.4% high risk

33.1% moderate risk

43.1% low risk

After 12 months:

39.3% high risk

36.1% moderate risk

25.1% low risk

The average ABCD3 score was  $4.2 \pm 0.25$ , and the incidence of ischemic stroke was **9.2%**.

### Duplex Ultrasound Findings:

Duplex ultrasonography revealed various morphological and hemodynamic abnormalities in the brachiocephalic arteries.

In **Group I**, the most common findings included:

Atherosclerotic plaques

Significant arterial stenosis

Reduced blood flow velocity

Turbulent flow patterns

In **Group II**, structural abnormalities such as arterial elongation, kinking, and coiling were identified. These deformities caused episodic hemodynamic disturbances and positional changes in cerebral blood flow.

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### Discussion:

The findings of this study confirm that stenotic lesions and structural deformities of the carotid arteries play a crucial role in the development of ischemic stroke. Atherosclerotic stenosis represents not only a mechanical obstruction to blood flow but also a potential source of emboli. Instability of atherosclerotic plaques may lead to thrombus formation and subsequent embolization into cerebral arteries.

In contrast, vascular deformities such as kinking and coiling primarily affect cerebral circulation through hemodynamic mechanisms. Changes in head position or fluctuations in arterial pressure may significantly alter blood flow through the deformed vessel segment.

Turbulent blood flow within these abnormal segments may also contribute to endothelial dysfunction and increased thrombogenic potential.

The results also highlight the importance of the **ABCD3 risk assessment system** as a practical tool for predicting stroke risk in patients with transient ischemic attacks and carotid artery pathology.

Furthermore, duplex ultrasonography proved to be a valuable non-invasive diagnostic technique for evaluating both structural and functional aspects of cerebral circulation.

Importantly, the study demonstrated that clinical symptoms do not always correlate with the severity of vascular pathology. In some cases, patients with mild symptoms may still exhibit significant hemodynamic disturbances.

This finding underscores the necessity of instrumental diagnostic methods for early detection and prevention of cerebrovascular complications.

### Conclusion:

1. Atherosclerotic stenosis and structural deformities of the carotid arteries (kinking and coiling) are major risk factors for the development of ischemic stroke.

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2. Patients with atherosclerotic carotid stenosis demonstrated a higher stroke risk compared with individuals with structural arterial abnormalities.
3. The ABCD3 risk scoring system is an effective tool for identifying patients at high risk of ischemic stroke.
4. Duplex ultrasonography of the brachiocephalic arteries plays a crucial role in the early detection of vascular abnormalities and in monitoring disease progression.
5. Individuals over the age of 50 should undergo duplex ultrasound examination of the brachiocephalic arteries at least twice per year for early detection and prevention of ischemic stroke.

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