BILATERAL DOLICHOARTERIOPATHY OF THE INTERNAL CAROTID ARTERY. SURGICAL TREATMENT OF CEREBROVASCULAR DISORDERS IN PATIENTS WITH COMBINATION OF COMORBID DISEASES

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Abstract: *the approach to surgical treatment of symptomatic bilateral dolichoarteriopathy of the internal carotid artery (DICA) remains an unresolved problem today. The purpose of this paper is to compare the methods of reconstruction of the stage-by-stage surgical treatment of bilateral DICA, depending on the type of deformity. In the study, we performed a retrospective and prospective analysis of the surgical treatment of patients with bilateral DICA. 138 reconstructive surgeries for DICA were performed. The most common combination of comorbid diseases in patients operated on for DICA was arterial hypertension with transient ischemic attacks and diabetes mellitus. A high correlation was observed in diabetic patients with arterial hypertension and transient ischemic attacks. Staged surgical treatment of hemodynamically significant bilateral DICA allows obtaining positive dynamics of the neurological status in patients with restoration of adequate blood flow according to internal carotid artery (ICA).*

Keywords: *dolichoarteriopathy, internal carotid artery, stroke, comorbid diseases.*

ДВУСТОРОННЯЯ ДОЛИХОАРТЕРИОПАТИЯ ВНУТРЕННЕЙ СОННОЙ АРТЕРИИ. ХИРУРГИЧЕСКОЕ ЛЕЧЕНИЕ ЦЕРЕБРОВАСКУЛЯРНЫХ НАРУШЕНИЙ У БОЛЬНЫХ С СОЧЕТАННЫМИ КОМОРБИДНЫМИ ЗАБОЛЕВАНИЯМИ

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Аннотация: *тактика хирургического лечения симптоматической двусторонней долихоартериопатии внутренней сонной артерии (ДВСА) на сегодняшний день остается нерешенной проблемой. Цель данной работы - сравнить методы реконструкции при поэтапном хирургическом лечении двусторонней ДВСА в зависимости от вида деформации. В исследовании проведен ретроспективный и проспективный анализ хирургического лечения пациентов с двусторонней ДВСА. Выполнено 138 реконструктивных операций по поводу ДВСА. Наиболее частым сочетанием коморбидных заболеваний у больных, оперированных по поводу ДВСА, была артериальная гипертензия с транзиторными ишемическими атаками и сахарным диабетом. Высокая корреляция отмечена у больных сахарным диабетом с артериальной гипертензией и транзиторными ишемическими атаками. Этапное оперативное лечение гемодинамически значимой двусторонней ДВСА позволяет получить*

положительную динамику неврологического статуса у больных с восстановлением адекватного кровотока по данным внутренней сонной артерии (ВСА).

Ключевые слова: *долихоартериопатия, внутренняя сонная артерия, инсульт. коморбидные заболевания.*

Introduction. Surgical treatment of patients with pathology of brachiocephalic vessels, which lead to disorders of cerebral circulation, prevents the development of disabling and fatal complications. [1] The prevalence of bilateral dolichoarteriopathy of the Internal Carotid Artery (DICA) in the general population, according to different authors, ranges from 10 to 40%. [2,3] It is known that the first attempt to resect the carotid arteries for DICA was made by Hsu and Kistin back in 1956, but then the surgeons failed [4]. Since then, the tactics of surgical treatment has been improved many times. However, today doctors do not have a single tactic for treating this pathology, and the discussion continues about which method is considered the most effective.

Purpose of the study. To compare the effectiveness of staged surgical treatment of bilateral DICA in various types of deformity.

Materials and methods. We performed a retrospective and prospective analysis of the surgical treatment of patients with bilateral DICA. The study period was 7 years (from 2012 to 2020). The patients' medical histories and the results of 138 reconstructive surgical interventions for DICA in patients with cerebrovascular insufficiency - CVI (cerebrovascular insufficiency) of varying severity were studied. It was revealed that bilateral DICA was diagnosed in 38 patients. Of these, 8 people had only one operation, on one side. Due to the fact that at the time of the operation there were no clinical pathological signs on the collateral side. In the present study, the case histories and results of surgery were analyzed in 30 patients with bilateral DNAA who underwent 60 staged surgeries. At the first stage, surgical treatment was first performed, on the one hand, at the second stage, on the opposite side (for example, first on the left, then on the right). First of all, the vessels were operated on from the side where the hemispheric symptoms were more pronounced. If the hemispheric symptoms were equally pronounced on both sides, then the choice of the side of the operation was determined by the peak linear blood flow velocity (PBV) in the area of the ICA flexure. The intervals between two stage operations ranged from 35 to 248 days, with an average interval of 45.8 days. The mean age of the patients was 61.7 years, 16 women (53.3%) and 14 men (46.7%). All operated patients underwent diagnostics and treatment under uniform standardized conditions in the Department of Vascular Surgery (National Scientific Center of Oncology and Transplantology, Nur-Sultan). Operations to correct tortuosity were performed by certified vascular surgeons with sufficient experience in the treatment of pathology of the internal carotid artery.

When determining the type of deformation of the ICA (internal carotid artery), we used a classification in which its three types are presented: 1) tortuosity - C- and S-shaped elongation or waviness of the course of the ICA; 2) bend - at an angle of 90 °, 3) crimp - elongation or redundancy of the ICA, leading to an annular configuration. All patients with DICA underwent duplex ultrasound scanning (USD) of the brachiocephalic arteries. Hemodynamic parameters in the cerebral arteries were determined using transcranial dopplerography. The functional state of the circle of Willis was assessed by the results of compression tests with external clamping of the carotid artery (Matas test). Also, patients before and after surgery underwent computed tomography (CT) of extra- and intracranial arteries with contrast. With the help of computer post-processing of CT images using 3D reconstruction, the features of the anatomical course of the vessels, their relationship with the paravasal structures (the level of CCA bifurcation in relation to the mandibular angle) were assessed (Figure 1).

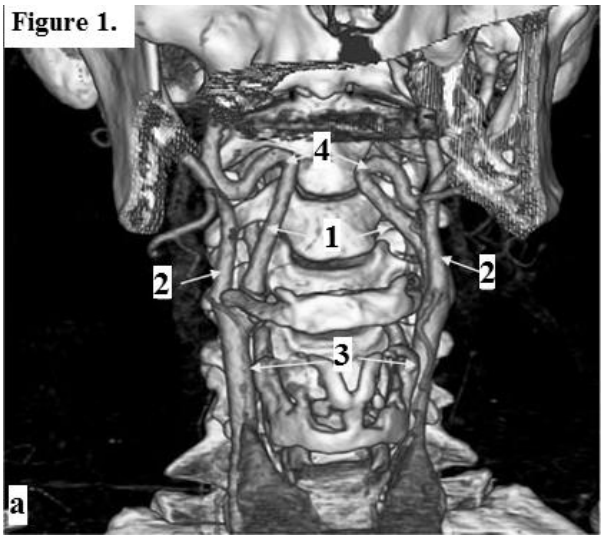

Fig. 1. CT of extracranial arteries with contrast enhancement (3D reconstruction). 1 - internal carotid artery; 2 - external carotid artery; 3 - common carotid artery; 4 - deformed portion of the ICA

In accordance with the CVI classification (A.V. Pokrovsky, 1978), cohorts with the following diseases were identified:

- Arterial hypertension (AH) was detected in 70% of patients;
- 50% of patients had a history of transient ischemic attacks (TIA);
- 30% have symptoms of chronic CVI;
- 20% have type 2 diabetes mellitus (T2D);
- 20% have had a stroke and residual neurological symptoms;
- 20% - ocular ischemic syndrome was detected.

At the same time, high polymorbidity was observed in combination with comorbidity. The most frequent combination of comorbid diseases was as

follows: AH+ TIA+T2D. A fairly high correlation was noted in patients with transient ischemic attacks. The strongest correlation was determined between diabetes mellitus and arterial hypertension, which is quite often observed in diabetic patients, as well as in cases of prediabetes and overweight. [5]

Depending on the choice of reconstructive technique, patients were divided into 3 groups.

Group 1 (n-8) - patients who underwent CCA resection on both sides with end-to-end anastomosis and reduction of the CCA bifurcation - type 1 (Figure 2);

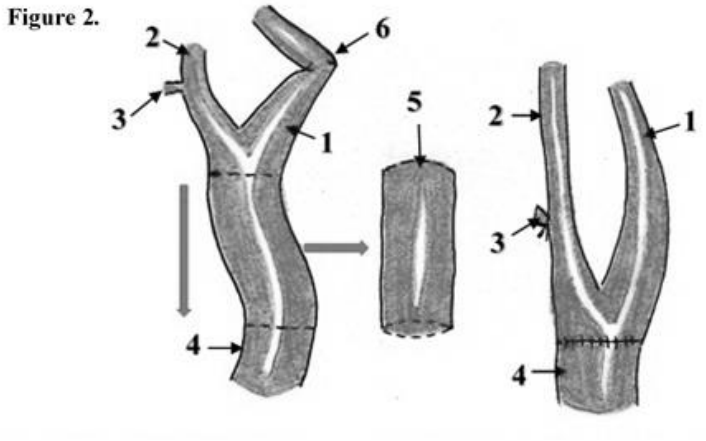

Fig. 2. CCA resection with end-to-end anastomosis and bringing down the CCA bifurcation. 1 - internal carotid artery; 2 - external carotid artery; 3 - superior thyroid artery; 4 - common carotid artery; 5 - resected part of the common carotid artery; 6 - deformed portion of the ICA (kinking)

Group 2 (n-11) - patients who underwent dissection of the ICA on both sides with resection, redressing and reimplantation into the extended native vascular bed - type 2 (Figure 3);

Figure 3.

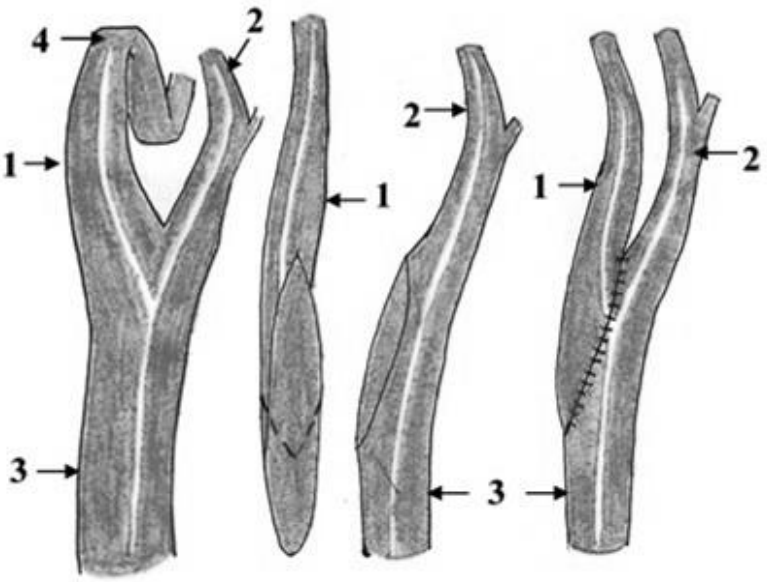

Fig. 3. Cutting of the ICA on both sides with redressing and reimplantation into the dilated native vascular bed 1 - internal carotid artery; 2 - external carotid artery; 3 - common carotid artery; 4 - deformed portion of the ICA (tortuosity)

It should be noted that in patients with coiling after cutting off the ICA, before straightening and forming an anastomosis, the ICA was rotated around the axis by 180° to exclude torsion of the artery (Figure 4).

Figure 4.

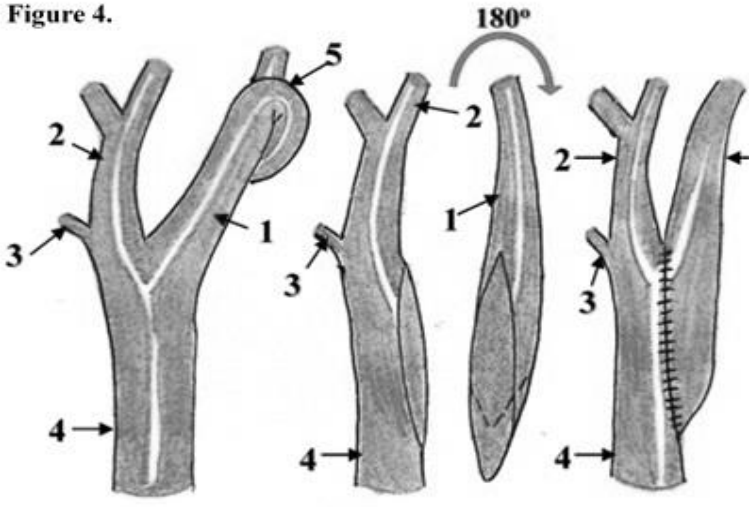

Fig. 4. Cutting off the ICA with resection, redressing, 180° rotation, and reimplantation into the dilated native vascular bed. 1 - internal carotid artery; 2 - external carotid artery; 3 - superior thyroid artery; 4 - common carotid artery; 5 - deformed portion of the ICA (koiling)

Group 3 (n-11) - patients who, on the one hand, underwent type 1 reconstruction, on the other hand, type 2 reconstruction.

After surgery, the follow-up period ranged from 14 to 67 months. When analyzing the results, it was revealed that transient ischemic attacks were stopped with an efficiency of 100% in all three groups. In group 1, three patients with stage CVI-III showed relief of cerebral symptoms. In group 2, improvement was also achieved in two patients with stage CVI-III. In group 3, four patients showed regression of the clinical picture of stage CVI-III. One patient of the 1st group with a history of ischemic stroke was transferred to the group of patients with stage III CVI; two patients out of three in the 2nd group were transferred to the stage III CVI group. Two patients with CVI-IV stage from the 3rd group were transferred to the group of patients with stage III CVI. There were no strokes or deaths in all three groups during the observation period. In patients of all 3 groups, a significant improvement was noted in the form of a decrease in LVBF (linear velocity of blood flow) in the area of the reconstructed deformity. Thus, from the initial values of 2.137±0.143 m/s, the LVBF values decreased to 0.842±0.087 m/s ($p<0.05$) in the 1st group; from 2.135±0.129 m/s to 0.825±0.057 m/s ($p<0.05$) in the 2nd group; from 2.130±0.149 m/s to 0.805±0.083 m/s ($p<0.05$) in the 3rd group. After surgical correction of ICA, the laminar type of blood flow was determined in 8 patients of the 1st group. In 1 patient of the 2nd group and 1 person of the 3rd group, a turbulent type of blood flow was detected on one side.

Conclusions. The most common combination of comorbid diseases in patients operated on for DICA was arterial hypertension with transient ischemic attacks and diabetes mellitus. A high correlation was observed in diabetic patients with arterial hypertension and transient ischemic attacks. Staged surgical treatment of hemodynamically significant bilateral DICA allows obtaining positive dynamics of the neurological status in patients with restoration of adequate blood flow according to ICA.

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