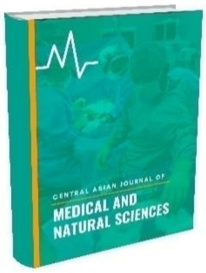
CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES



Volume: 04 Issue: 02 | Mar-Apr 2023 ISSN: 2660-4159

http://cajmns.centralasianstudies.org

Principles of Revascularization in Treatment of Large and Giant Cerebral Aneurysms

1. **Khamdamov Shohjahon Shuhrat O'g'li**
2. **Ruzikulov Makhmudjon Mazhidovich**
3. **Adilov Yusufbek Xasan O'g'li**

Received 2nd Jan 2023,
Accepted 3rd Feb 2023,
Online 7th Apr 2023

[1] Tashkent Pediatric Medical Institute, Tashkent, Uzbekistan

[2] Republican Specialized Scientific and Practical Medical Center of Neurosurgery, Tashkent, Uzbekistan

[3] City Children's Surgical Clinical Hospital N2, Tashkent, Uzbekistan

Abstract: Over the past decades, the interest of neurosurgeons in extra-intracranial anastomoses has increased significantly, especially in the context of their use in the treatment of large and giant aneurysms. The development of microsurgical techniques and neuroanesthetic techniques, adequate selection of patients for surgery, achievements in neuroradiology and monitoring of cerebral blood flow are prerequisites for the improvement of revascularization surgery. The development of competitive endovascular methods of treatment, in turn, pushes neurosurgeons to improve the microneurosurgical technique of revascularization and develop new approaches to the treatment of intracranial aneurysms. In this review, we present the principles of cerebrovascular anastomosis surgery in the treatment of large and giant aneurysms used in our clinic.

Key words: large and giant intracranial aneurysms, microneurosurgical treatment, endovascular treatment, cerebrovascular anastomosis surgery.

Introduction

Arterial aneurysms of the brain remain one of the complex and urgent problems of modern neurosurgery. A special group of arterial aneurysms are giant aneurysms. Statistics on the incidence of aneurysms reported in the medical literature that are based on autopsy series, retrospective clinical studies or randomized trials, all of which have a certain sampling error. Large and giant aneurysms of the ICA are often combined with aneurysms of other localization and form bilaterally ("mirror" aneurysms). This group of cerebral aneurysms is an extremely difficult task in terms of microsurgical treatment [3,5,7].

According to J. Anson, the incidence of giant aneurysms among all patients with aneurysms is 3-13.5% [9]. In the study by W. Stebbens, on the basis of 3500 autopsies, 128 aneurysms were identified, which of 8 (6.2%) aneurysms were over 3 cm in diameter, in a similar study by McCormick (1673 autopsies) - 9 (4.7%) had a giant size [12]. In 1969, Morley and Barr described a clinical series (658 patients) in which 28 (4.3%) patients had giant aneurysms, for the first time denoting their size as "2.5 cm or more", which met the criteria adopted in the International Cooperative study of aneurysms [17]. Later, the classification of aneurysms by M. Yazargil, described in the monograph Microsurgery in 1969, became commonly used in addition to giant aneurysms, large aneurysms 1.5-2.5 cm in diameter were identified. Both groups are often considered together by neurosurgeons, because they differ slightly from each other in terms of surgery [10].

Rupture of cerebral aneurysms is one of the leading causes of non-traumatic intracranial hemorrhages. The size of saccular aneurysms usually ranges from 5 to 15 mm, however, in some patients, aneurysms of large (from 16 to 25 mm) and giant (more than 25 mm) sizes can be detected [12]. The incidence of giant aneurysms is 2–13% of all cerebral aneurysms [2,6]. One of the first clinical manifestations of giant aneurysms are symptoms of intracranial hemorrhage in the apoplectiform course of the disease; focal symptoms prevail in pseudotumorous or embolic variant of the disease [2,3,5,7]. The clinical course of large and giant aneurysms is represented by intracranial hemorrhages, in 65-85% of cases, compression of brain structures, ischemic complications associated with thrombus formation and occlusion of the carrier vessel and perforators, episodes of thromboembolism [5,7]. Up to 80% of patients in whom giant aneurysms showed any symptoms and were not operated on die within a few years from the onset of the disease due to rupture of the aneurysm or due to an increase in the volume impact of giant aneurysms on the surrounding structures of the brain, as well as due to ischemic complications [7]. Mortality in the conservative treatment of giant aneurysms located in the vertebrobasilar region and manifesting symptoms of mass formation reaches 100% [6,25]. After surgery for giant aneurysms, mortality is about 10–13% [2,5,20].

Revascularization strategy

The indication for creating anastomoses in the surgery of large and giant aneurysms is primarily the potential risk of occlusion of the carrier vessel during clipping. In these situations, anastomosis can provide adequate distal blood flow. The key to success in determining indications for anastomosis is the correct selection of patients who have intolerance to vessel occlusion and the risk of developing neurological symptoms. In our opinion, test occlusions, which make it possible to determine the risk of developing acute ischemia, are not very informative in relation to delayed circulatory disorders. After the balloon occlusion technique was introduced into clinical practice in 1974 [6], the development of this area led to the development of new techniques, such as perfusion magnetic resonance imaging (MRI), perfusion computed tomography (CT), and electrophysiological monitoring. However, the use of these techniques is not always available and significantly complicates the interpretation of the results. Unsatisfactory results of these tests necessitate an anastomosis to protect the distal blood flow.

Classification of anastomoses

There are two main categories of anastomoses: extra-intracranial and intra-intracranial. Also, based on the type of the main operation, they can be divided into: 1) replacement (for example, to replace the ICA, which will be occluded for certain reasons); 2) protective (in case of occlusion of the carrier vessel during aneurysm reconstruction); 3) restorative (anastomoses between the superficial temporal artery (PVA) and the middle cerebral artery (PVA-MCA in the case of Moyamoya disease). Anastomoses can be divided into occlusive (temporary occlusion of the donor and recipient vessel) and non-occlusive. An example of the latter are anastomoses, superimposed using the ELANA technique (eximer laser-assisted nonocclusive anastomosis) [8-10].In addition, anastomoses are divided according to the volume of blood flow: low-flow (less than 25 ml/min), medium-flow (25-70 ml/min) and high-flow (more 70 ml/min). of the radial artery are used as high-flow, providing perfusion needs exceeding 70 ml/min Based on this, we consider it more rational to divide the anastomoses into two groups according to the volumetric blood flow velocity: low-flow (less than 70 ml/min) and high-flow (more than 70 ml/min).

In recent decades, the in situ revascularization technique has become widespread, including: 1) anastomoses (PICA—PICA, MCA—MCA, VMA—VMA); 2) reanastomoses (end-to-end anastomosis after aneurysm resection); 3) reimplantation (anastomoses "end to side", for example, the PICA into the vertebral artery). The main advantage of the in situ technique is the absence of additional vessels during anastomosis, which significantly reduces the risk of leakage or thrombosis. The trend towards the development of in situ technique is obvious, and in the near future this will make it possible to operate on aneurysms that were previously considered inoperable [5].

Aneurysm occlusion technique

After the anastomosis has been made, large and giant aneurysms can be excluded from the bloodstream using various techniques. Among them: temporary distal-proximal occlusion (trapping), neck reconstruction and clip application with possible resection of the aneurysm base to reduce the mass effect. In this case, the previously applied protective anastomosis provides distal perfusion. After successful aneurysm clipping, the anastomosis can be remained open or occluded at the end of the procedure if blood flow is fully restored after reconstruction and clipping. Over time, the anastomosis most often cannot compete with healthy vessels and thromboses spontaneously. In rare cases, one application of a protective anastomosis is sufficient for complete thrombosis of the aneurysm, apparently due to the redistribution of blood flow. In the presence of a protective anastomosis, both proximal and distal occlusion of the carrier vessel can be performed safely. Although proximal aneurysm occlusion still fills retrogradely through the anastomosis, this redistribution of blood flow almost always leads to thrombosis of the aneurysm and its exclusion from the blood flow. However, the formed thrombus is not stable and can cause distal embolism with the development of ischemic strokes. The larger the aneurysm, the greater the likelihood that proximal vessel occlusion will retain retrograde filling despite thrombosis, as well as the associated with risks of subarachnoid hemorrhage (SAH). Distal occlusion is unacceptable, as a sharp jump in intraluminal pressure increases the risk of aneurysm rupture. Thus, the most appropriate strategy for the surgical treatment of large and giant aneurysms is a combination of distal-proximal occlusion of the carrier vessel (trapping) and anastomosis. In addition to the immediate cessation of blood flow, trapping turns the aneurysm out of the bloodstream without the risks of embolism described above, and also allows resection of the aneurysm body in the event of a pronounced mass effect. However, this method also has its limitations, mainly in relation to small perforating arteries arising from the aneurysmal segment of the carrier vessel. Changes in neurophysiological parameters during trapping may indicate the presence of functionally significant perforators extending from the aneurysm; therefore, temporary trapping is recommended at the initial stage. The presence of these perforators is also indicated by persistent retrograde bleeding during resection of the aneurysm body after trapping. The presence of functionally significant perforators extending from the aneurysm is a contraindication for the use of the trapping technique. In these cases, proximal occlusion of the carrier vessel after anastomosis, aneurysm resection, and vessel reconstruction can be used. An increase in the number of cases of continued growth of giant aneurysms after endovascular trapping, in our opinion, indicates an underdiagnosis of small perforators arising from giant aneurysms.

Discussion

Since the first imposition of cerebrovascular anastomosis in 1967, such operations have become part of the arsenal for the treatment of large and giant aneurysms, tumors, ischemic circulatory disorders, and congenital vascular anomalies. In 1982, a multicenter international study was conducted on the effectiveness of extra-intracranial anastomoses (EICMA) compared with medical therapy for ischemia. There was no statistically significant difference between these treatments [1]. Despite significant shortcomings in the planning of the study, its results had an extremely negative impact on the fate of EICMA, causing a radical decrease in interest in reconstructive surgery and as a result, a decrease in the number of neurosurgeons actively practicing and developing this branch of vascular neurosurgery.

The cumulative lifetime risk of rupture of giant aneurysms is likely close to 100%. Even almost completely thrombosed aneurysms often continue to grow in size, and the strategy of monitoring these patients is extremely risky. According to recent studies [2, 3, 5, 13] conducted in large neurovascular centers, most patients with large and giant aneurysms have favorable results of surgical treatment. At the same time, in 25—45% of cases, the postoperative result is unsatisfactory (Rankin score ≥3), which for some may be an argument in favor of conservative treatment, especially in patients without significant neurological deficits. However, the high risk of SAH and the generally aggressive course of the disease justify the operative risks. With the development of endovascular techniques, it became possible to treat this pathology more effective and safe way. The choice of technique depends on the traditions of the center and the experience of neurosurgeons, but the final positive result is most important, whatever method is used. In this article, we present an example of an extra-intracranial microanastomosis in a patient with a giant aneurysm of the cavernous section of the right ICA.

Patient T., 45 years old. According to the patient and relatives, over the past few months, gradually increasing headache bothered, mainly in the right eye, double vision appeared. With the above complaints, she was hospitalized to our clinic for examination and surgical treatment.

Condition upon admission of moderate severity. Neurological examination revealed clear consciousness, no meningeal syndrome. Moderate cerebral symptoms in the form of headache, mainly in the area of the right eye, paresis of the right abducens nerve. MSCT angiographic examination of the brain revealed a round volumetric formation in the projection of the right ICA (giant aneurysm of the right ICA with deformity of the sella turcica on the right (Fig. 1). MRI of the brain and MRI angiography (see Fig. 2) revealed a giant non-thrombosed aneurysm of the right ICA size 30×27×43 mm with deformity of the sella turcica and compression of the chiasm The diagnosis was confirmed by cerebral angiography (Fig. 3).

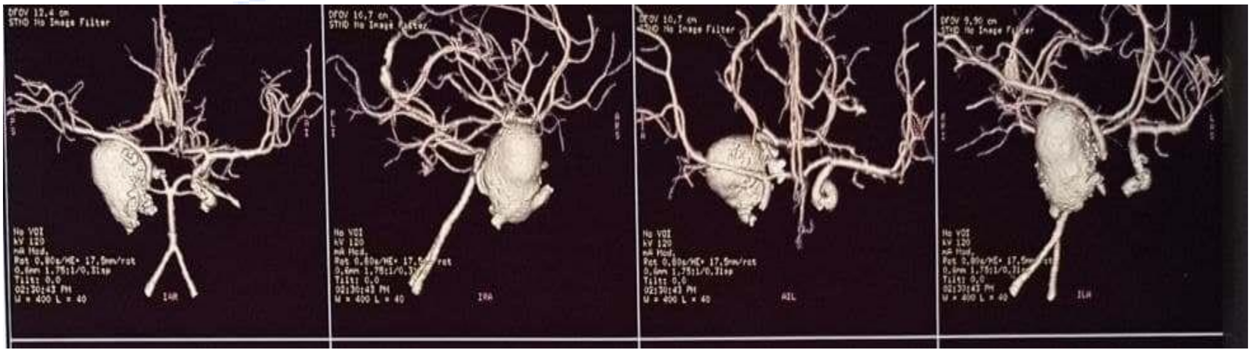


Figure 1. MSCT angiography of the brain. Giant aneurysm in the cavernous part of the ICA.

Figure 2. MRI of the brain. Giant aneurysm of the right ICA measuring 30×27×43 mm with deformity of the sella turcica and compression of the chiasm.

Figure 3. Selective cerebral angiography. Giant saccular aneurysm of the cavernous segment of the internal carotid artery on the right.

Taking into account the location of the aneurysm in the cavernous part of the ICA, its gigantic size and volume effect on the surrounding structures, as well as the absence of the increase in neurological deficit and the absence of changes during the Matas test, the patient decided to perform an extra-intracranial microanastomosis using a section of a branch of the superficial temporal artery, then endovascular deconstructive exclusion of an aneurysm of the right internal carotid artery with detachable microcoils.

Treatment

Under general intubation anesthesia, the frontal and parietal branches of the superficial temporal artery were isolated. Then performed osteoplastic trepanation in the right fronto-temporal region. The dura mater (DM) is not tense, distinctly pulsates. After opening the DM with a transsylvian approach, an approach was made to the M3-M4 segment of the right MCA, it was isolated and mobilized. A micro-anastomosis was placed between the M3-M4 segment of the right MCA and the right ECA, followed by endovascular deconstructive exclusion of the aneurysm of the right internal carotid artery with detachable microcoils (Fig. 4.).

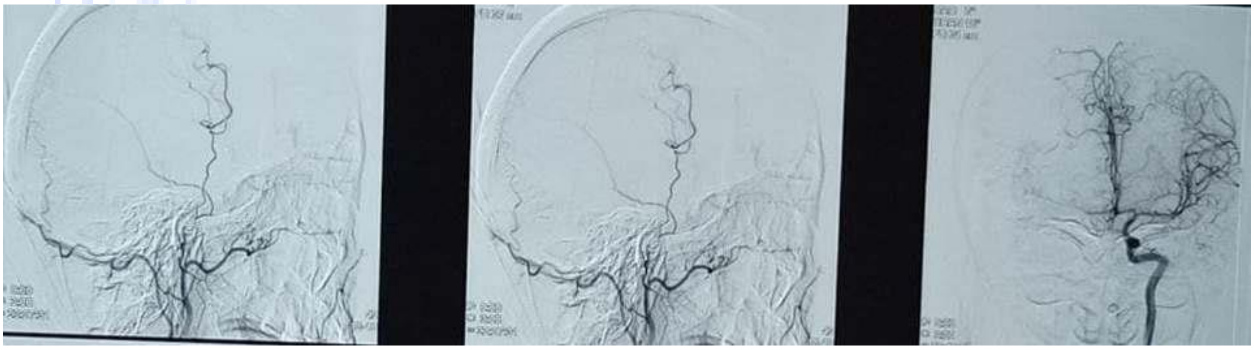


Figure 4. Selective cerebral angiography. Condition after endovascular deconstructive exclusion of an aneurysm of the right internal carotid artery with detachable microcoils. Control angiography of the right external carotid artery, left ICA, and left vertebral artery showed satisfactory blood supply to the branches of the right MCA and ACA. After the operation, the patient was taken to the intensive care unit. After the patient came out of drug sedation, her consciousness was clear, meningeal and focal symptoms were not detected.

Conclusion

In our clinic, up to 50-60 aneurysms are operated annually, of which about 25 are large and giant. In all of these cases, already at the initial stage, we consider the need for anastomosis, especially in patients with symptomatic test occlusion and if there are doubts about the safety of the carrier vessel during clipping. Active international cooperation and exchange of experience, compilation of an international data bank of large and giant aneurysms, development of training laboratory centers and logistical accessibility of treatment are integral parts of future treatment regimens for such a contingent of patients.

Reference

1. Krylov V.V. Surgery for cerebral aneurysms. M 2011; 2: 396-431.
2. Pilipenko Yu. V., Eliava, Sh.Sh., Yakovlev, S. B., Belousova, O. B. et al. Analysis of complications of surgical treatment of cerebral aneurysms in patients operated on in the late posthemorrhagic period. // Question. neurosurgery. – 2014. № 78(2) –C. 32-39
3. Abdulrauf S.I., Cantando J.D., Mohan Y.S. et al. EC-IC bypass for giant ICA aneurysms. In: Cerebral revascularization. Techniques in extracranial-tointracranial bypass surgery. Ed. I. Saleem. Abdulrauf: Elsevier Saunders 2011; 231—245.
4. Amin-Hanjani S. Cerebral revascularization: extracranial-intracranial bypass. NeurosurgSci 2011; 55: 2: 107—116.
5. Brinjikji W., Cloft H.J., Fiorella D., Lanzino G., Kallmes D.F. Estimating the proportion of intracranial aneurysms likely to be amenable to treatment with the pipeline embolization device. J NeurointervSurg 2011; 2.
6. Eddleman C.S., Hurley M.C., Bendok B.R., Batjer H.H. Cavernous carotid aneurysms: to treat or not to treat? Neurosurg Focus 2009; 26: 5: E4: 1—10.
7. Iwaisako K., Toyota S., Ishihara M. et al. Intracerebral Hemorrhage Caused by Ruptured Intracavernous Carotid Artery Aneurysm. Neurol Med Chir (Tokyo) 2009; 49: 155—158.
8. Fuentes S, Levrier O, et AL: Giant fusiform intracranial A2 aneurysm: endovascular and surgical treatment // J. Neurosurg. 101: 704—704. — 2004.
9. Fukamachi A., Hirato M., Wakao T., Kawafuchi J. Giant serpentine aneurysm of the posterior cerebral artery // Neurosurgery. — Vol. 11,
10. Hauck E.F., Welch B.G., White J.A. et al. Stent/coil treatment of very large and giant unruptured ophthalmic and cavernous aneurysms. SurgNeurol 2008; 71: 1: 19—24.
11. Youmans neurological surgery. Fifth edition.Volume 2. Giant aneurysms. G. Michael Lemone et al. 1087-1088. Elsevier 2004
12. Zanaty M., Jabbour P. M., BouSader R., Chalouhi N., Tjoumakaris S., Rosenwasser R. H., Fernando Gonzalez L. Intra-aneurysmal thrombus modification after flow-diversion // J ClinNeurosci.– 2015. – T. 22, № 1. – C. 105-110.