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Research Article

The use of endovascular thrombectomy among the patients with acute ischemic stroke caused by the occlusion of large cerebral vessels

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ABSTRACT.
The standard of treatment of the patients with acute ischemic stroke within the "therapeutic window" is systemic thrombolysis. However, there are many contraindications and limitations of this method of treatment use. An alternative is endovascular thrombectomy, and a number of large studies showed that such treatment is most effective to improve functional and clinical outcomes at the "proximal" lesion of large vessels. The article analyzed the literature on the largest studies related to endovascular thrombectomy. The endovascular treatment of group of patients with ischemic stroke was performed due to the occlusions of large cerebral vessels. The technique of various types of endovascular thrombectomy performance is described: aspirational and mechanical one. The effectiveness and complications of endovascular thrombectomy were analyzed. The obtained results show the reduction in mortality and disability among the patients after endovascular treatment.
Key words. Ischemic stroke, endovascular thrombectomy, hemorrhagic transformation, selective thrombolysis.

INTRODUCTION.

Vascular diseases of brain are an actual medical and social problem. The stroke hits more than 6 million people every year worldwide, and according to the World Health Organization (WHO) the number of deaths from stroke increased from 5.41 million to 6.24 million per year from 2000 to 2015 [1]. The frequency of stroke in the Belgorod region makes 3.42 per 1000 of people [2]. The mortality from stroke among the people of working age increased by more than 30% in Russian Federation over the past 10 years. The annual death rate from stroke in our country makes 175 cases per 100 000 of population. In addition to high mortality, this disease leads to persistent disability - from 15 to 30% of patients with acute cerebrovascular accident (ACVA) remain disabled for life [3,4]. The disability rate after a stroke makes 56-81% on the average in the country. The development of acute cerebral ischemia triggers the cascade of pathological biochemical reactions, resulting in neuron damage and death [5]. One solution to the problem is a rapid and an effective brain reperfusion. Systemic thrombolytic therapy with the use of recombinant tissue plasminogen activator (rt-PA) is the standard for medical care provision, in accordance with the recommendations of the European Stroke Organization (ESO) and the American Heart Association and the Stroke Association (AHA/ASA) it is assigned to patients during the first 4.5 h after the manifestation of neurological symptoms [6]. However, there is a number of limitations and contraindications to the use of this method. The markers of functional well-being and lethality are recanalization indicators, such as the rate of blood flow recovery and the efficiency of a thrombus destruction (removal). With the occlusion of large vessels (internal carotid (BCA), vertebral artery (VA), basilar artery (BA) and middle cerebral artery (MCA)) the recanalization rates are low. Thus, the effectiveness of systemic thrombolysis with the occlusion of ICA is observed in 14% of cases, with MCA occlusion in 55% of cases [7, 8]. Endovascular thrombectomy became an

alternative and complementary method of treatment. The first evidence of endovascular thrombectomy efficiency for the treatment of stroke was a multicenter, randomized clinical trial of endovascular treatment of acute ischemic stroke in the Netherlands (MR CLEAN). Subsequently, other studies emerged that confirmed the advantage of endovascular treatment among the patients with large cerebral vessel occlusion (Table 1) [9-11].

Table 1. The effectiveness of endovascular methods of treatment use

Study name	Number of patients	Frequency of stent-retriever application	Effective reperfusion TICI 2b-3	Clinical outcome mRS 0-2	
				Intervention group	Control group
MR CLEAN	500	81.5%	58.70%	33%	19%
ESCAPE	315	86.1%	72.40%	53%	29%
EXTEND IA	70	100.0%	86%	71%	40%
SWIFT-PRIME	196	100.0%	88%	60%	35%
REVACAST	206	95.1%	65.70%	44%	28%

A rapid recanalization is one of the most important factors of a good clinical outcome among the patients with an acute occlusion of large vessels [12].

The aim of our work is to evaluate the effectiveness of endovascular thrombectomy application among the patients with acute cerebrovascular accident.

Methodology. The study included 45 patients (11 women, 34 men, the mean age made 63 years) with an acute occlusion of brain large vessels, who underwent endovascular thrombectomy. In order to determine the tactics of treatment for all patients, a computed tomography (CT) scan was performed to determine the site of ischemia and to exclude intracerebral hemorrhage. In the absence of a large outbreak of ischemia (no more than 1/3 of the basin), an intracerebral hemorrhage, the patient was transported to the X-ray room. The average time from the onset of neurologic symptoms to endovascular intervention in the carotid basin made 299 minutes. (The shortest time is 1 hour 20 minutes, the maximum one is 48 hours), 1035 min in the vertebrobasilar basin. The average score on NIHSS scale (National Institutes of Health Stroke Scale) was 11.5 points.

21 cases (47%) demonstrated cardioembolic clinical subtype, 20 cases (45%) showed atherothrombotic subtype, 2 cases (4%) showed cryptogenic subtype, 2 cases (4%) demonstrated transient ischemic attack (TIA), accompanied by the occlusion of CMA and VA. Concomitant pathology: acute myocardial infarction in anamnesis among 7, ischemic heart disease among 29, hypertension among 43, hypercholesterolemia among 12, stroke, TIA in history among 5, rhythm disturbances among 21, diabetes mellitus among 6 patients.

In all observations (100%) the ascending aorta is catheterized using femoral access. Using a diagnostic catheter, both common carotid, vertebral arteries are catheterized alternately selectively. A selective angiography of the main arteries of the head was performed in standard projections. The localization of the lesion is presented in Table 2.

Table 2. Lesion localization.

Localization	General carotid artery	ICA			MCA			VA	Combination of basins
		Opening	C7	C4-C1	M1	M2	M1-M2		
Number	2	6	4	7	11	3	5	4	3

Then, the microconductor and the microcatheter were inserted into the distal channel. Recanalization of occlusion with a microconductor was performed, the microcatheter was wound up behind the occlusion zone. In order to assess the passage of the distal channel, angiography was carried out through a microcatheter.

Main part. Aspiration revascularization with Penumbra drug was performed for 9 patients

(20%). The microcatheter and the microconductor were wound up beyond the occlusion zone, the patency of the distal bed was assessed. Then, the aspiration catheter along the axial system was brought to the occlusion zone, the aspiration pump was turned on, thrombectomy was performed. The coaxial system consists of a guide-introducer with a large internal lumen for free passage of an aspiration catheter and the aspiration catheter itself. The use of the coaxial system is necessary to overcome anatomical bends and conduct wide-lumen catheters to the occlusion zone successfully. The mechanical thrombectomy by the stent-retriever Solitaire was used among 36 patients (80%). After the evaluation of the distal bed, along the microcatheter behind the occlusion zone a stent retriever was fed to the distal section of the microcatheter. A microcatheter was pulled down by 2/3 from the stent retriever in 3-5 minutes for better "capture" and the consolidation of the thrombus between the stent cells. We used a Cello hydra-catheter, which was inflated to the diameter of the artery before the removal of a stent retriever for the prevention of distal embolism. Then, the traction of the stent retriever system and microcatheter was performed. After the removal of the stent-retriever, additional aspiration of 10 ml of blood should be performed to prevent distal embolism by a fragmented thrombus. In 11 (24%) observations at the presence of significant stenosis or two-level occlusion, thrombectomy was supplemented with stenting.

The efficacy of endovascular reperfusion therapy was evaluated according to the TICI (The Thrombolysis in Cerebral Infarction) scale: TICI 0 - Absence of restored blood flow; TICI 1 - restoration of blood flow outside primary occlusion, limited filling of distal branches; TICI 2a - restoration of blood flow with incomplete or delayed blood flow for less than 50% of the middle cerebral artery basin; TICI 2 b - restoration of blood flow with incomplete or delayed blood flow for more than 50% of the middle cerebral artery basin; TICI 3 - complete restoration of blood flow with the filling of all distal branches of the middle cerebral artery, including M3 and M4 segments.

Our results: TICI 2b-3 blood flow recovery was achieved among 28 patients (62%), TICI 1-2a blood flow was achieved among 7 patients (16%), the absence of blood flow was observed among 10 patients (22%). 2 patients could not recanalize the occlusion, thrombus aspiration with ADAPT technique (A Direct Aspiration first Pass Technique) was performed: thrombus capture by a negative pressure creation in the aspiration catheter and the catheter traction from the intracranial arteries.

Table 3. Results of endovascular treatment

Restorative blood flow	TICI 0	TICI 1-2a	TICI 2b-3
Number of patients	10 (22%)	7 (16%)	28 (62%)

12 cases (27%) showed distal embolism and mechanical thrombectomy was supplemented with selective thrombolytic therapy using the drug Actilease ® (Boehringer Ingelheim). The dose of the administered drug was no more than 25% of the total permissible dose of thrombolytic - 0.9 mg/kg of the patient's weight. In 4 (8%) cases, dissection was noted: in 2 cases at the place of thrombus extraction, in 2 cases at the edge of the implanted stents. In all cases stent implantation was performed. In 1 case there was a detachment of the stent-retriever.

During the postoperative period, 11 patients (24%) developed hemorrhagic transformation of the ischemic focus in the form of hemorrhagic infarction of 1st and 2nd type according to ECASS. Fatal outcome was observed among 8 (18%) patients, among these patients 3 patients had the hemorrhagic transformation in the form of parenchymal hematoma with the breakthrough of blood into the ventricular system developed, 1 patient had hemorrhagic transformation in the form of parenchymal hematoma of type 1, 4 patients had edema and the dislocation of stem structures.

Summary. Our study shows that endovascular thrombectomy gives a good clinical result: among the patients who left, the NIHSS average score at the discharge made 7 points. Functional independence (0-2 points by Rankin scale) was observed among 28 patients (60%), which

corresponds to the results of such large studies of endovascular intervention during a stroke as SWIFT PRIME, ESCAPE.

CONCLUSIONS.

Endovascular thrombectomy is an effective method of patient treatment with an acute occlusion of large cerebral vessels. During the verification of "proximal" lesions in the time interval up to 4.5 hours, we consider it is expedient to apply the thrombectomy primarily. The application of this method of treatment is also effective at later periods of the therapeutic window.

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