



**EFFECTIVENESS OF HYBRID SURGERY IN THE TREATMENT OF MULTIFOCAL  
ATHEROSCLEROSIS OF LOWER EXTREMITIES**

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**Abstract:** The fight against cardiovascular diseases (CVD), the main cause of which is atherosclerosis, has been and remains a priority health problem not only in some countries, but throughout the world. According to WHO, 10-15% of the world's population suffers from atherosclerosis (Lambert A., 2020). The mortality rate of the population of the Republic of Uzbekistan from cardiovascular diseases in the overall structure is 59.3% (State Statistics Committee of Uzbekistan, 2022). Modern medicine has vast experience in carrying out various vascular interventions, due to which the treatment of patients with this pathology is carried out at a high level. However, peripheral arterial disease is usually a manifestation of systemic atherosclerosis, so morbidity and mortality are closely related to similar indicators in myocardial infarction and stroke.

**Keywords:** Hybrid surgery, multifocal atherosclerosis, atherosclerosis of lower extremity vessels, endovascular surgery

**Introduction.** Endovascular interventions on lower extremity arteries are usually indicated for limb preservation. Angioplasty of short stenoses of the anterior or posterior tibial arteries can be performed together with plastic surgery of the femoral or popliteal arteries. In patients with critical ischemia, especially in the presence of severe concomitant pathology, when it is possible to restore direct arterial blood flow to the foot, there is increasing evidence in favor of recommending the use of angioplasty of the arteries of the lower extremities. The technical success of angioplasty of the arteries of the lower extremities reaches 90%, and the clinical success in some groups of patients approaches 70%. The degree of limb preservation is somewhat higher. Predictors of a good treatment outcome are a small length of the affected segment and a small number of arteries subject to angioplasty. Complications (2.4-17% depending on the definition) can be eliminated using endovascular or surgical techniques, and unsuccessful angioplasty does not prevent bypass surgery. It remains unclear whether angioplasty and stenting are necessary to improve outflow tracts and increase distal patency of proximal angioplasty, stenting or bypass operations in patients with lower limb arterial disease. In multilevel lesions, the adequacy of access tracts (patency of the aortoiliac segment) should be assessed by anatomical data or by direct measurement of blood pressure, and if damage to the access tract is detected, it is necessary to eliminate it first. In some cases, a combined approach is possible: dilation of the proximal lesion with bypass of the distal section. A relatively recent study has revealed a trend towards an increase in the number of combined bypasses (prosthesis + autovein) in combination with distal arteries in patients with severe comorbidities such as diabetes mellitus, renal failure and coronary heart disease; however, the mortality rate remains unchanged. Another large study has shown that gender does not change the number of complications and fatal outcomes in revascularization of lower extremity arteries. For specialists, the issue of deciding on the tactics of surgical treatment for multiple lesions of the lower



extremity arteries is very relevant and requires special attention. Until now, there is no single algorithm for surgical treatment in this category of patients.

**Objective:** To improve the treatment results for multifocal atherosclerosis of the lower extremity vessels.

**Materials and methods.** Our study included 120 patients with multifocal atherosclerotic lesions of the lower extremity arteries who were treated in hospital at the 2nd TMA Clinic and the Republican Specialized Center for Surgical Angioneurology from 2010 to 2024. To achieve the goal of the study and solve the tasks, the following methods were used: general clinical (laboratory, biochemical), instrumental (ultrasound, Doppler, electrocardiographic), radiation (MSCT and MRI), angiographic, special (integrated systems) and statistical research methods. The first group (comparison group) included 70 (100%) patients who underwent traditional reconstructive surgeries on the arteries of the lower extremities in the period from 2010 to 2017. In 11 patients (15.7±4.4%), operations were performed on the carotid arterial pool, in 35 (50.0±6.0%) - on the arteries of the lower extremities due to chronic ischemia, and in 24 (34.3±5.7%) on the arteries of the lower extremities due to thrombosis against the background of arterial stenosis. The second (main) group included 67 (100%) patients who underwent hybrid reconstructive operations on the carotid arteries and arteries of the lower extremities in the period 2018-2024. The first subgroup of the main group consisted of 21 (31.3±5.6%) patients with tandem stenosis of the carotid arteries. The second subgroup included 26 (38.8±5.9%) patients with chronic lower limb ischemia, and the third subgroup included 20 (29.9±5.5%) patients with acute arterial obstruction caused by arterial thrombosis against the background of atherosclerotic lesions.

The average age of patients was 58.9±6.3 years, with the main contingent of patients aged 47 to 77 years. The majority of patients were men - 109 (75.5±3.7%), there were 33 women (24.1±3.7%) (Table 1)

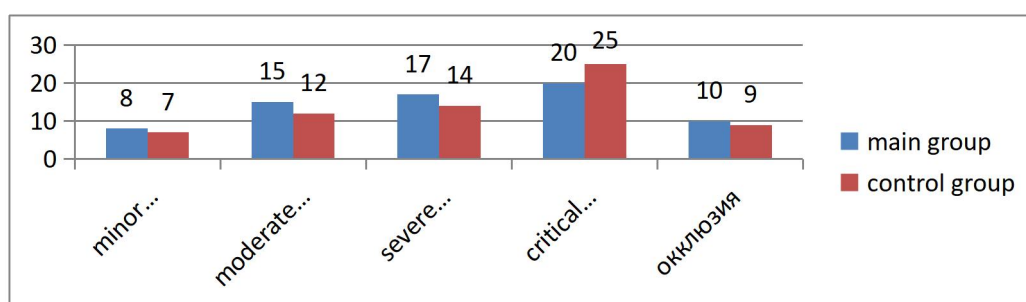
**Table 1**  
**Characteristics of patients by gender and age**

Age, years	Control group, n=70				Main group, n=67			
	male		female		male		female	
	abc	%	abc	%	abc	%	abc	%
Up to 50	3	4,3±2,4	1	1,4±1,4	1	1,5±1,5	-	-
51-60	27	38,6±5,9	8	11,4±3,8	28	41,8±6,1	10	14,9±4,4
61-70	22	31,4±5,6	6	8,6±3,4	19	28,4±5,5	6	9,0±3,5
71-80	2	2,9±2,0	1	1,4±1,4	2	3,0±2,1	1	1,5±1,5
Over 80	-	-	-	-	-	-	-	-

In all patients, the cause of occlusive-stenotic arterial lesions was atherosclerosis, and all hemodynamically significant atherosclerotic lesions were extensive and multilevel. Atherosclerotic lesions were multifocal, significant and insignificant, with lesions of the carotid and coronary vascular basins detected in all 137 patients (100%).

When studying the condition of the carotid arteries, special attention was paid to the degree of stenosis of the artery, the length, ultrasound type and the condition of the surface of the atherosclerotic plaque. To characterize the degree of stenosis, we used the classification of CA stenoses according to Kazanchyan.

**Pic. 1. The degree of occlusive-stenotic lesions of the carotid arteries**



In addition to atherosclerotic lesions, most patients had hypertension, arrhythmic ischemic heart disease, and diabetes mellitus. The nature of the associated diseases is presented in Table 2.

**Table 2.**

**Nature of concomitant diseases**

Associated pathology	Control group n=70		Main group n=67	
	abc.	%	abc.	%
Hypertension	45	64,3±5,8	38	56,7±6,1
Arrhythmic forms of coronary heart disease	10	14,3±4,2	8	11,9±4,0
Chronic pyelonephritis	8	11,4±3,8	7	10,4±3,8
Diabetes mellitus	31	44,3±6,0	32	47,8±6,0
Peptic ulcer of the stomach and duodenum	2	2,9±2,0	1	1,5±1,5
COPD	6	8,6±3,4	7	10,4±3,8

The examination began with a patient interview and objective examination. A carefully collected anamnesis in a patient with multifocal arteriosclerosis suggests multiple cardiovascular lesions and, by facilitating diagnosis, creates a first idea of the underlying pathology. After collecting a detailed anamnesis and determining the course of the disease, simple and understandable examination methods such as palpation and auscultation were first performed. During auscultation, attention was paid to the presence and characteristics of systolic murmur in



the arteries. A hissing sound indicates severe stenosis. To identify asymmetry, blood pressure was always measured on both upper and lower extremities, and the ankle-brachial index (ABI) was also measured.

**Table 3.**

**Clinical symptoms of patients**

Symptoms	Control group n=70		Main group n=67	
	abc.	%	abc.	%
Headaches	26	37,1±5,8	19	28,4±5,6
Dizziness	12	17,1±4,5	13	19,4±4,9
Blurred vision	13	18,6±4,7	10	14,9±4,4
Decreased visual acuity	21	30,0±5,5	19	28,4±5,6
Memory impairment	23	32,9±5,7	22	32,8±5,8
Tinnitus	18	25,7±5,3	13	19,4±4,9
Numbness of half the body and limbs	27	38,6±5,9	23	34,3±5,8
Unsteady gait	11	15,7±4,4	9	13,4±4,2
General weakness	33	47,1±6,0	29	43,3±6,1
Numbness and coldness of the lower limbs	59	84,3±4,4	49	73,1±5,5
Swelling of the lower limbs	36	51,4±6,0	30	44,8±6,1
Pain in the lower limbs when walking	19	27,1±5,4	14	20,9±5,0
Pain in the lower limbs at rest	46	65,7±5,7	45	67,2±5,8
Trophic changes in the lower extremities	9	12,9±4,0	11	16,4±4,6
Increased blood pressure	45	64,3±5,8	43	64,2±5,9
Pain in the heart area	14	20,0±4,8	8	11,9±4,0
Shortness of breath	4	5,7±2,8	3	4,5±2,6

**Results and discussion.** No myocardial complications were observed in the immediate postoperative period, only 1 (2.9%) patient had short-term pain in the heart area, which was relieved with nitro drugs. After reconstructive surgeries on the arteries of the lower extremities, minor ischemic stroke (IS) developed in the immediate period in 4 (11.4%) patients of this subgroup. The cause of IS was arterio-arterial microembolism, which was stopped with medication with neurological regression. Thrombosis of the carotid arteries was not detected.

A positive hemodynamic and clinical effect was noted in 28 (80.0%) patients after surgery in the form of an increase in LBFV on the operated side. Most patients also showed positive dynamics after surgery. In the early postoperative period in this subgroup, good results with regression of ischemia were noted only in 27 (77.1±7.2%) patients, satisfactory results were obtained in 6 (17.1±6.5%) (P<0.001), unsatisfactory in 3 (8.6±4.8%) (P<0.001) patients.



In 4 (11.4%) there was progressive gangrene of the limb, which required its high amputation. In 1 (2.9%) patient, the cause of death was myocardial infarction, and in 2 (5.7%) patients, death occurred on the 7-9th day after high amputation of the lower limb (multiple organ failure). In most patients of the 2nd subgroup, after the operation, positive dynamics were also observed. ABI increased from  $0.39 \pm 0.014$  to  $0.52 \pm 0.019$  ( $P < 0.001$ ).

In the third subgroup, 21 (87.5%) patients were observed in the late postoperative period. After reconstructive surgeries on the arteries of the lower extremities, minor ischemic stroke (IS) developed in 2 (9.5%) patients of this subgroup in the late period. The cause of IS was arterial hypertension against the background of high blood pressure with partial recovery. Myocardial complication was observed only in 1 (4.8%) patient in the form of AMI with a Q wave with stabilization on the control ECG.

In 18 patients (85.7%), a positive hemodynamic and clinical effect was observed after surgery: an increase in LBFV on the operated side. Positive dynamics were also observed in most postoperative patients.

In the late postoperative period, in patients of this subgroup, good results with ischemia regression were noted only in 18 ( $85.7 \pm 7.8\%$ ) patients, a satisfactory result was achieved in 6 ( $28.6 \pm 10.1\%$ ) ( $P < 0.001$ ), an unsatisfactory result - in 2 ( $9.5 \pm 6.6\%$ ) ( $P < 0.001$ ).

In 1 (4.7%), there was progressive gangrene of the limb, which required its high amputation. The cause of death in 1 (4.7%) patient was myocardial infarction. In addition, thrombosis on the operated side was noted in 2 (9.6%) patients. Positive dynamics were also observed in the majority of postoperative patients in subgroup 3 with an increase from  $0.34 \pm 0.013$  to  $0.39 \pm 0.015$  ( $P < 0.05$ ).

**Conclusion.** In patients with multi-stage lesions of the lower limb arteries, surgical correction of only one block almost always does not allow achieving adequate regression of ischemia. However, the expansion of the volume of reconstructive surgeries with simultaneous intervention on the arteries of the aortoiliac and femoropopliteal segments leads to an increase in preoperative complications, especially in patients with multifocal atherosclerosis. The presence of combined comorbidities in this category of patients increases the risk of complications. In this category of patients, only hybrid surgery can achieve adequate revascularization of the limb with minimal risk. Hybrid operations are the method of choice in the surgical treatment of multi-stage atherosclerotic lesions of the arteries. At the same time, hybrid interventions allow simultaneous improvement of both inflow and outflow pathways of blood flow, which is an important point in the treatment of multifocal atherosclerosis.

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