

# Cross-Sectional Autovenous Bypass - Reserve Reconstruction in Patients with High Risk of Amputation and Low Life Expectancy or an Alternative to Conventional Surgery in Chronic Limb Threatening Ischemia

Kuchay AA<sup>1\*</sup>, Lipin AN<sup>1,2</sup>, Gruzdev NN<sup>1</sup>, Borisov AG<sup>1</sup>, Atmatzas AV<sup>1</sup> and Atmatzas KA<sup>1</sup>

<sup>1</sup>Limb Salvage Center, St. Petersburg City Hospital No. 14, St. Petersburg, Russian Federation.

<sup>2</sup>S.M. Kirov Military Medical Academy, St. Petersburg, Russian Federation.

## \*Correspondence:

Dr. Kuchay Arshed Ahmad. MD, MS, PhD. Cardiovascular surgeon, Clinical researcher, Limb Salvage Center, City Hospital no 14. Saint-Petersburg, Russia, Tel: +79522183002.

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## ABSTRACT

**Purpose of the Study:** To evaluate early (complications and major adverse events) and long-term (patency, limb salvage, survival) outcomes in patients with chronic limb threatening ischemia who underwent crossover autovenous bypass surgery.

**Materials and Methods:** A retrospective analysis of the early and long-term results of observation of 28 patients who underwent cross-bypass surgery performed in 2017-2023 was carried out. 100% of bypass operations were performed with autovenous material. High comorbidity (coronary artery disease, arterial hypertension, dyslipidemia, history of myocardial infarction, history of acute stroke, cardiac arrhythmias, diabetes mellitus, obstructive bronchitis, anemia, obesity). Follow-up is 12 months.

**Results:** Early postoperative complications were: 14.3% - wound complications, 3.6% - bleeding, 7.2% - bypass thrombosis, 3.6% - acute cerebrovascular disturbance, 17.9% - high limb amputation (in 4 of 5 observations, revascularization was performed to reduce the level of amputation), 3.6% - death. Results after 12 months were: bypass patency – 82.1%, limb salvage – 71.4%, survival – 89.3%. There were no cases in which critical ischemia of the healthy lower limb developed.

**Conclusion:** Cross-sectional autovenous bypass can be considered by a vascular surgeon both as a backup option in repeated reconstructive interventions on lower limb arteries and as an alternative to traditional anatomic reconstructions. This study demonstrates the low complication rate and good long-term patency of such reconstructions.

## Keywords

Atherosclerosis, Chronic limb threatening ischemia, Extra anatomic bypass, Autovenous vein bypass.

## Relevance

Critical lower limb ischemia (CLI, in modern foreign literature the term Chronic limb threatening ischemia is more common) is an extremely severe manifestation of peripheral arterial diseases.

Due to unfavorable prognosis (according to the literature, the percentage of mortality and the percentage of high amputation within a year from the manifestation of the disease was 22%, and in the remote period - quite disappointing results - the percentage of high limb amputation within 4 years is up to 67.3%, the risk of death of patients within 4 years is up to 63.5%), this condition is isolated by researchers and clinicians in a separate nosology [1].

In CLI, patients often present with multilevel lesions of the lower extremity arteries, including prolonged occlusion of the iliac arteries [1,2]. The vast majority of patients with CLI are polymorbid, and in addition to multifocal atherosclerosis, have concomitant diseases of the cardiovascular, respiratory, and endocrine systems, and cancer is common [1,2-10]. Most studies in iliac artery occlusion recommend performing anatomic reconstructions - balloon angioplasty with/without stenting of iliac arteries, aorto/iliac-femoral bypass [1-5,11-18]. But endovascular option in the treatment of patients with multilevel lesions is not always available due to pronounced calcinosis and prolonged occlusion of the arterial channel. And open anatomical revascularization is often associated with high risks of adverse effects and long duration of intervention, especially in patients with previous reconstructions in this area. Other factors that require caution when performing anatomical reconstructions may include the presence of extensive scarring in the area of surgery, the presence of a possible infectious focus and synthetic prosthesis in the area of future reconstruction, possible previous ligation of native arteries. Due to comorbidity and high perioperative risk, even studies recommending anatomic reconstruction in the aorta-iliac segment retain and recommend the possibility of extra-anatomic bypass for patients in this group [1-5,13,14]. There are also studies suggesting cross-over bypass surgery as primary surgery for unilateral iliac artery occlusion [6-8,15] including for intermittent claudication [9,16-21].

### Aim

To evaluate early (complications and adverse events) and long-term (patency, limb preservation, survival) results in patients with critical lower limb ischemia who underwent cross-sectional bypass surgeries.

### Materials and Methods

A retrospective analysis of early and long-term follow-up results of 28 patients who underwent cross bypass surgeries performed in 2017-2023 in St. Petersburg State Budgetary Institution "City Hospital No. 14".

The study was performed in accordance with the standards of good clinical practice and the principles of the Declaration of Helsinki. Written informed consent was obtained from all patients before inclusion in the study.

### Inclusion Criteria

Patients who underwent extra anatomic (cross-over) bypass with autologous vein to bypass occlusion of iliac arteries (100% of patients with trophic defects of ischemic genesis).

### Exclusion Criteria

Patients with whom contact was lost immediately after discharge from the hospital.

Group characteristics: average age - 63.9 years. Women - 3(10.7%), men - 25(89.3%).

The average period of hospitalization - 41 days, which was due to the need to treat trophic changes on the lower limb suffering from CLTI?

Associated Pathology: CHD (100%), arterial hypertension (95.7%), dyslipidemia (80.4%), myocardial infarction in the history (28.6%), acute cerebral circulatory failure in the history (25%), heart rhythm disorders (50%), diabetes mellitus (25%), COPD (78.2%), anemia (42.9%), obesity (42.9%).

Full perfusion of two lower limbs in these patients was ensured in most cases due to passable (without hemodynamically significant stenosis) iliac arteries on the limb-donor of the inflow artery, which at the time of the study had no symptoms of peripheral arterial disease, or anamnestically there were indications of a mild degree of intermittent claudication (painless walking for a distance of 100 meters or more). In one observation (3.6%), a passable aorto-femoral bifurcation bypass was used, and in one (3.6%), in order to perfuse two limbs from one lumen of the iliac arteries, balloon angioplasty of the iliac arteries was preventively performed on the healthy limb when there was an indication of ligation of the iliac arteries of the limb suffering from CLTI. Level of proximal anastomosis (inflow artery for bypass), N (%) - common femoral artery - 23 (82.1%), deep femoral artery - 2 (7.1%), superficial femoral artery - 2 (7.1%), functioning aorto-femoral bifurcation shunt branches - 1 (3.6%).

Level of distal anastomosis (outflow artery for the shunt), N (%) - contralateral common femoral artery - 6 (21.4%), contralateral deep femoral artery - 12 (42.8%), contralateral superficial femoral artery - 4 (14, 3%), contralateral hamstring artery - 3 (10.7%), contralateral posterior tibial artery - 1 (3.6%), contralateral anterior tibial artery - 1 (3.6%), contralateral femoral-pelvic shunt - 2 (7.1%). 15 patients (53.6%) had a history of interventions on the arteries of the lower limb suffering from CLTI, 10 of them (35.7% of the total group) underwent aorto-femoral bifurcation or linear bypass with a synthetic prosthesis. 100% of the bypass surgeries were performed with autovenous. In 8 cases (28.6%) the in situ vein technique was used, in the remaining 20 (71.4%) - with a reversed vein. Autovenous material used: 21 (75%) - trunk of the great saphenous vein of the limb suffering from CLTI, 4 (14,3%) - small saphenous vein, 2 (7,1%) - trunk of the great saphenous vein of the contralateral lower limb. 13 patients (46,4%) required necrectomy or small amputations during hospitalization. The peculiarity of this group of patients was the high frequency of "non-preserved" feet - in 4 cases (14,3%), due to the lack of possibility to preserve the supportive foot or high risk of sepsis development (the decision was made by a consilium consisting of a multidisciplinary group of specialists), cross bypass surgery was performed in order to reduce the amputation rate. Thus, performing amputation at the level of the tibia in such observations was a success of surgical intervention (in 100% of cases, technical success was achieved - it was possible to heal the wounds of the stump of the tibia with primary tension). A clinical example of such a foot is presented in Figure 1.



**Figure 1:** An example of a foot requiring amputation in patient K., 53 years old, admitted with wet gangrene of the distal parts of the left foot; at the time of admission, sanitation of the necrotic lesion was performed, the possibility of preserving a weight-bearing foot was lost (deep and extensive tissue necrosis, exposure of the articular surfaces of the talus and calcaneus). 6 days after foot resection, revascularization surgery was performed. The photo shows a foot wound on the first day after revascularization. In the presented clinical case, the patient managed to save his knee joint.

Preoperative examination: search for autovenous material was performed sonographically, assessment of steno-occlusive arterial lesions and choice of the method of surgical intervention was performed according to the data of direct subtractive angiography and/or computed tomography with angiocontrast.

Postoperative therapy: within three days - low-molecular heparins (enoxaparin) subcutaneously in prophylactic dose, further - acetylsalicylic acid 100 mg + rivaroxaban 5 mg daily orally for life.

## Results and Discussion

Complications and undesirable effects detected in the early

postoperative period (within 30 days) are presented in Table 1.

Complications/adverse event	Number of observations	%
Wound complications (lymphorrhea, wound suppuration, hematoma)	4	14,3
Major bleeding	1	3,6
Bypass thrombosis	2	7,2
Acute cerebral circulation disorder	1	3,6
Myocardial infarction	0	0
Pulmonary thromboembolism	0	0
High amputation of a lower limb suffering from critical ischemia, among them - cases in which the indication for bypass surgery was to reduce the level of high amputation	5	17,9
High amputation of the lower limb, on the side of which the leading anastomosis was formed, which does not suffer from critical ischemia	4	14,3
High amputation of the lower limb, on the side of which the leading anastomosis was formed, which does not suffer from critical ischemia	0	0
Fatal outcome	1	3,6

**Table 1:** Early postoperative complications.

Long-term results (evaluated after 12 months) demonstrate that the cross-over has good patency rates in the remote period. After hospital discharge, only one bypass occlusion was detected during one year of follow-up (Table 2).

Factor	Number of observations	%
Bypass patency	22	82,1
Preservation/salvage of the limb to which bypass surgery was performed from the contralateral lower limb	20	71,4
Preservation/salvage of the contralateral lower limb (of patients who reached the follow-up period)	25	100
Survival rate	25	89,3

**Table 2:** Long term results after 12 months.

Satisfactory indices of remote patency, limb preservation or salvage, and survival rates after extra anatomic bypasses were revealed, indicating their effectiveness. It should be noted that during the study there were no cases of critical ischemia or amputation of the lower limb, on the side of which the leading anastomosis of the bypass was performed (healthy limb, donor limb) - a factor that most often causes fear of cross-reconstructions among vascular surgeons.

## Conclusion

Cross-over autovenous bypass may be considered by vascular surgeons both as a backup operation in repeated reconstructive interventions on lower limb arteries and as an alternative to traditional anatomic reconstructions. This study demonstrates a low complication rate and good long-term patency of such reconstructions.

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