

Primary Femoro-Popliteal-Tibiofibular Bypass in Patients with Critical Limb Ischemia in the Era of Endovascular Surgery

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ABSTRACT

BACKGROUND: In the majority of patients with critical ischemia in the lower limbs, the findings include the “multi-level” atherosclerotic lesions in the arteries of the femoral-popliteal-tibiofibular segment. The optimal method of re-vascularisation in this cohort of patients is not defined as of today. **AIM:** To evaluate the efficiency of conducting the initial autovenous tibiofibular bypass surgery in case of lesions in the arteries of the femoral-popliteal-tibiofibular segment in patients with critical ischemia of the lower limbs. **METHODS:** The analysis included the results of the initial tibiofibular autovenous bypass surgeries, performed in 112 patients at the Federal State Budgetary Institution “Federal Clinical Center of High Medical Technologies” under the Russian Federal Medical-Biological Agency during the period from 2010 until 2021, of which 25 (22.3%) individuals had the stage III chronic arterial insufficiency in the lower limbs, 87 (77.7%) — stage IV acc. to the Fountain–Pokrovsky classification. The distribution by the atherosclerotic lesion in arteries of the lower limbs with taking into consideration the TASC II classification was the following: type C — in 9 (8.0%), type D — in 103 (92.0%). **RESULTS:** Within the 30 days period, 4 (3.6%) patients have shown the presence of unfavorable cardio-vascular events, 3 (2.7%) cases resulted in the early high amputation. The perioperative mortality rate was 2.7% (n=3). The primary passability of the tibiofibular autovenous bypass was 91%, 76% and 67% in 1, 3 and 5 years, while the secondary passability was 93%, 80% and 71%; the limb survival rate was 98%, 86% and 81.5%; the overall survival of the patients was 88.5%, 81% and 70%, respectively. **CONCLUSION:** The initial tibiofibular autovenous bypass surgeries (bypass first) represent the effective and safe method of surgical treatment for atherosclerotic lesions in the arteries of the femoral-popliteal-tibiofibular segment in patients with critical ischemia of the lower limbs. Open-access surgeries in the era of endovascular surgery can be used as the first line therapy with comparable direct and remote results.

Keywords: critical ischemia of the lower limbs; femoral-popliteal-tibiofibular arterial segment; tibiofibular autovenous bypassing.

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BACKGROUND

The diseases of peripheral arteries are widespread worldwide and affect 113 mln people aged from 40 years and older, of which 42.6% live in the countries with low and medium social-demographic index [1]. The occurrence rate for the diseases of peripheral arteries has increased by 72% during the period from 1990 until 2019, taking into consideration the 45% overall population growth [2, 3]. The five-year cumulative rate of clinical worsening from the asymptomatic disease of peripheral arteries to the intermittent claudication is 7%, while from the

intermittent claudication to critical ischemia in the lower limbs — 21% [4]. As of today, in the whole world, every year approximately 25 000 high amputations of the limbs are carried out for the reason of critical ischemia in the lower limbs, which significantly decreases the life duration in this cohort of patients [5]: the overall mortality level is reaching 15% in 1 year, 24% in 2 years and 43% in 5 years [6]. According to the data from multiple authors, critical ischemia of the lower limbs is associated with the development of cardio-vascular events, including the period of 30 days after re-vascularisation [7–9]. It is undeniable that the

Первичное шунтирование при поражении артерий бедренно-подколенно-берцового сегмента у пациентов с критической ишемией нижних конечностей в эру эндоваскулярной хирургии

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АННОТАЦИЯ

Обоснование. У большинства пациентов с критической ишемией нижних конечностей выявляется «многоэтажное» атеросклеротическое поражение артерий бедренно-подколенно-берцового сегмента. Оптимальный метод реваскуляризации у данной когорты пациентов на сегодняшний день не определен. **Цель** — оценить эффективность выполнения первичного аутовенозного берцового шунтирования при поражении артерий бедренно-подколенно-берцового сегмента у пациентов с критической ишемией нижних конечностей. **Методы.** Проанализированы результаты первичных берцовых аутовенозных шунтирований, выполненных 112 пациентам в ФГБУ ФКЦ ВМТ ФМБА России в период с 2010 по 2021 год, из них 25 (22,3%) человек имели III стадию хронической артериальной недостаточности нижних конечностей, 87 (77,7%) — IV стадию по классификации Фонтейна–Покровского. Распределение по атеросклеротическому поражению артерий нижних конечностей с учётом классификации TASC II было следующим: тип C — у 9 (8,0%), тип D — у 103 (92,0%). **Результаты.** В течение 30-дневного срока у 4 (3,6%) пациентов были выявлены неблагоприятные сердечно-сосудистые события, в 3 (2,7%) случаях выполнена ранняя высокая ампутация. Периоперационная смертность — 2,7% (n=3). Через 1, 3 и 5 лет первичная проходимость берцовых аутовенозных шунтирований составила 91%, 76% и 67%, в то время как вторичная проходимость — 93%, 80% и 71%; показатель сохранения конечности — 98%, 86% и 81,5%; общая выживаемость пациентов — 88,5%, 81% и 70% соответственно. **Заключение.** Первичные берцовые аутовенозные шунтирования являются эффективным и безопасным методом хирургического лечения атеросклеротического поражения артерий бедренно-подколенно-берцового сегмента у пациентов с критической ишемией нижних конечностей. Открытые хирургические операции в эру эндоваскулярной хирургии могут быть использованы в качестве первой линии терапии с сопоставимыми непосредственными и отдалёнными результатами.

Ключевые слова: критическая ишемия нижних конечностей; бедренно-подколенно-берцовый артериальный сегмент; берцовое аутовенозное шунтирование.

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main method for treating the patients with critical ischemia in the lower limbs is the re-vascularisation of the lower limbs [10]. In the majority of such patients, a “multi-level” atherosclerotic lesion is found in the arteries of the femoral-popliteal-tibiofibular segment [11], which is why the issue of selecting the reconstructive interventions as of today remains topical and discussible.

Research aim — to analyze the 12-years experience of performing the initial tibiofibular autovenous bypass surgeries in patients with critical ischemia in the lower limbs at the premises of the Federal State Budgetary Institution “Federal Clinical Center of High Medical Technologies” under the Russian Federal Medical-Biological Agency (FSBI FCC HMT under the Russian FMBA) and to evaluate their efficiency.

METHODS

Research design

Single-center non-randomized retrospective observational research.

Conformity criteria

Inclusion criteria: the presence of critical ischemia in the lower limbs (resting pain or trophic defects in the shin and in the foot); “multi-level” atherosclerotic lesion in the femoral-popliteal-tibiofibular arterial segment; absence of previously conducted surgeries in the ipsilateral limb; the presence of the greater saphenous vein applicable for bypassing.

Non-inclusion criteria: intermittent claudication of the lower limbs; isolated lesions in the shin arteries; absence of at least one passable tibial artery for shaping the distal anastomosis; the presence of a vast trophic defect in the zone of formation of the planned anastomosis.

Research facilities

The examination was carried out at the Vascular Surgery Department of the Center for Cardio-Vascular and Endovascular Surgery of the FSBI FCC HMT under the Russian FMBA.

Research Duration

The research work was carried out for 12 years (during the period from January 2010 until December 2021).

Medical procedure description

During the pre-operative period, all the patients underwent the procedures of measuring the ankle-brachial index, the stratification by the scale of the severity of morphological damage in the tissues of the foot, the perfusion of the lower limbs, the severity of the infectious process (Wound, Ischemia, foot Infection, Wifi, 2014) with further staging the clinical risk of high amputation, as well as the ultrasound examination of the arteries and veins (for the evaluation of the possibilities

of using the greater saphenous vein as the conduit) and the contrasted visualization of arteries (angiography / multispiral computed tomography of vessels, MSCT-AG) of the lower limbs. Further procedures included the modification of risk factors, prescribing or correcting the antihypertensive therapy, the insulin therapy, the intake of statins, of antiaggregants and the anticoagulants.

All the surgical interventions were carried out under the endotracheal anesthesia. In 100% of the cases, the proximal anastomosis with autovenous bypass was formed from the common femoral artery, while for the bypassing artery, any other passable artery with better outflow was used. The vast majority of surgeries was carried out using the *in situ* method, but also the compound and reversed autoveins were used as the conduit (the characteristics of all the tibiofibular autovenous bypass surgeries are provided in table 1).

Statistical analysis

The statistical analysis and data processing were carried out using the Statistica v.10.0 software by StatSoft Inc. (USA) using the parametric (t-Student's test) and the nonparametric (Kaplan–Meier survival analysis) methods. The statistical significance was set as $p < 0.05$.

RESULTS

Research sample (participants)

A total of 112 initial tibiofibular autovenous bypass surgeries were performed in 94 (83.9%) male patients and 18 (16.1%) female patients. The mean age of the patients was 66.3 ± 9.1 years (ranging from 44 to 90 years). Stage III chronic arterial insufficiency of the lower limbs acc. to the classification by Fountain–Pokrovsky was diagnosed in 25 (22.3%) patients, stage IV — in 87 (77.7%). The mean value of the ankle-brachial index before surgical intervention was 0.15 ± 0.08 .

The stratification of the patients using the Wifi scale (2014) with staging the clinical risk of high amputation is provided in table 2. The distribution of patients by the atherosclerotic lesion in the arteries of the

Table 1

Types of tibiofibular bypass surgeries

Type of bypassing	Autovenous conduit, n (%)		
	<i>in situ</i>	reversed	compound
Femoral-anterior tibial	22 (19.6)	2 (1.8)	0 (0.0)
Femoral-fibular	34 (30.3)	7 (6.3)	2 (1.8)
Femoral-posterior tibial	34 (30.3)	3 (2.7)	3 (2.7)
Femoral-tibioperoneal	5 (4.5)	0 (0.0)	0 (0.0)

Table 2

Stratification of patients using the Wifi scale with determining the clinical risk stage for high amputation

Clinical stage	Wifi scale range of values	n (%)
II (low risk)	0-2-0	5 (4.4)
	0-3-0	20 (17.9)
III (medium risk)	1-2-0	6 (5.4)
	1-2-1	8 (7.1)
	1-3-0	19 (17.0)
	1-3-1	28 (25.0)
	2-2-0	9 (8.0)
IV (high risk)	2-2-2	2 (1.7)
	2-3-1	3 (2.7)
	2-3-2	3 (2.7)
	3-3-0	3 (2.7)
	3-3-1	3 (2.7)
	3-3-2	3 (2.7)

lower limbs acc. to the TASC II classification was the following: type C was diagnosed in 9 (8.0%) individuals, type D — in 103 (92.0%). All the patients enrolled into the research had a number of concomitant diseases and past surgical interventions (table 3).

The main research outcome

Within the framework of this scientific research, we have tracked and analyzed the direct (30-days) and the remote (5-years) results of tibiofibular autovenous bypass surgeries.

In 7 (5.9%) cases of initially selected 119 patients for bypass surgeries, the decision was to carry out the hybrid intervention due to the technical failure (conversion). These patients were excluded from the further analysis. The mean value of the ankle-brachial index after the surgical intervention was 0.94 ± 0.16 .

Within the period of 30 days, 4 (3.6%) operated patients were diagnosed with unfavorable cardio-vascular events (three acute myocardial infarctions and a single acute cerebrovascular accident) and in 3 (2.7%) cases, the early high amputation was done. The perioperative mortality was 2.7% (3 patient), the reasons of which became the abovementioned acute myocardial infarctions (2; 1.8%) and an acute cerebrovascular accident (1; 0.9%). Local complications in the area of the postoperative wounds were detected in 11 (9.8%) patients.

The remote results included the primary and the secondary passability, the limb survival and the overall survival. The primary passability of the tibiofibular autovenous bypasses was 91%, 76% and 67% in 1, 3 and 5 years ($p < 0.05$), while the secondary passability of the bypasses — 93%, 80% and 71%,

Table 3

Comorbid disorders in patients with critical ischemia of the lower limbs

Disorders	n (%)
Arterial hypertension	105 (93.8)
Ischemic heart disease	60 (53.6)
Re-vascularisation of the myocardium	18 (16.1)
Atrial fibrillation	13 (11.6)
Past acute cerebrovascular accident	18 (16.1)
Carotid re-vascularisation	14 (12.5)
Diabetes	31 (27.7)
Chronic kidney disease stage III–V	18 (16.1)
Chronic obstructive pulmonary disease	10 (8.9)
Re-vascularisation of the contralateral limb	26 (23.2)

respectively ($p < 0.05$) (Fig. 1, 2). The value of the limb survival parameter among the patients was 98%, 86% and 81.5% in 1, 3 and 5 years ($p < 0.05$) (Fig. 3), the overall survival of the patients — 88.5%, 81% and 70%, respectively ($p < 0.05$) (Fig. 4).

DISCUSSION

During the last 10 years, various international and Russian scientific communities have issued more than 20 consensus documents, related to the problems of treating critical ischemia in patients with atherosclerotic lesions in the arteries of the lower limbs. The successfully conducted arterial reconstructive surgery not only saves the limb and improves the quality of life, but also saves the life of the patient.

The optimal tactics of surgical treatment for the patients with critical ischemia in the lower limbs in cases of multi-level extensive lesions in the

arteries of the lower limbs still remains a topic of multiple research works, including the international randomized multi-center ones (BEST-CLI, BASIL-2) [12, 13]. In recent years, the rates of conducting the endovascular interventions as the strategy of first-line re-vascularisation has significantly increased [14, 15]. Despite this tendency, the results of our research present the convincing data in favor of using the tactics of “bypass first” for the lesions of the arteries in the femoral-popliteal-tibiofibular segment in patients with critical ischemia of the lower limbs. The evaluation of the significance of the strategy for re-vascularisation of the lower limbs in such patients is carried out, generally, by the direct (perioperative) and remote results of reconstructive interventions. In case of the presence of a number of technical possibilities (greater saphenous vein applicable for bypass, passable tibial artery for the formation of the distal anastomosis, absence of vast

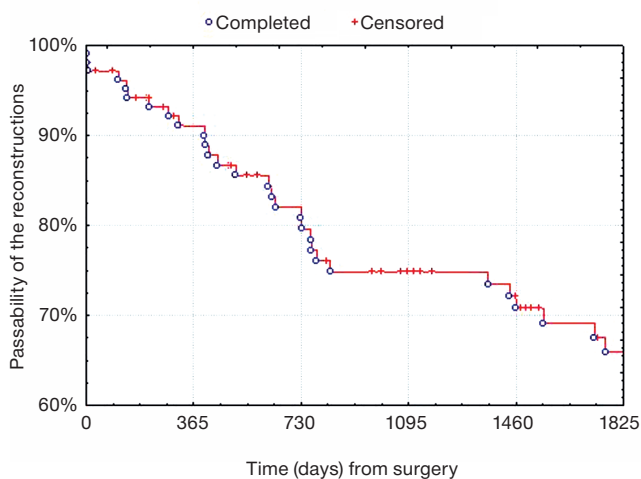


Fig. 1. Remote results: primary passability.

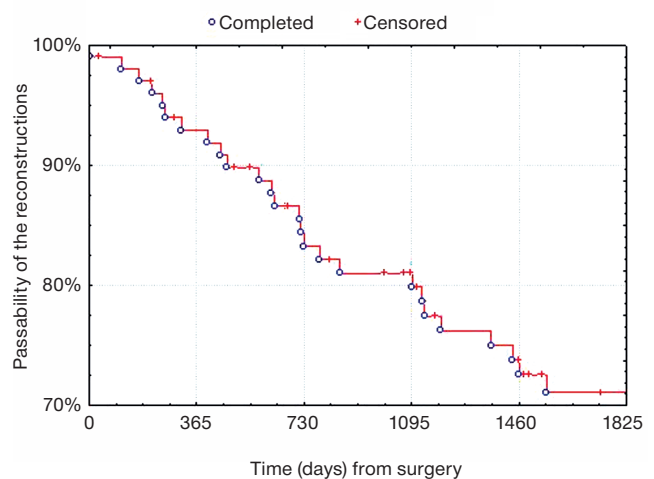


Fig. 2. Remote results: secondary passability.

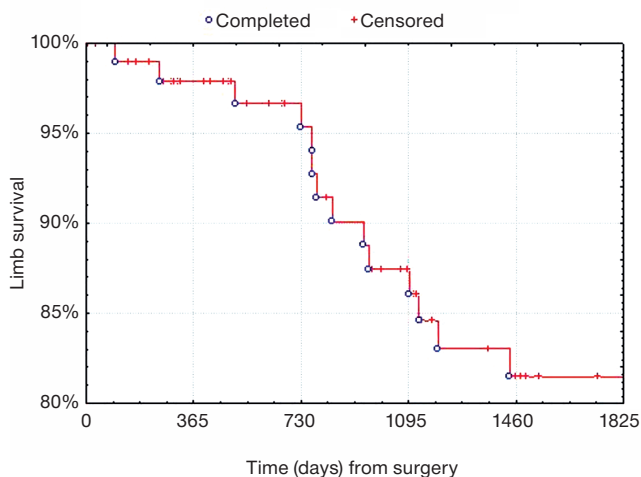


Fig. 3. Remote results: limb survival.

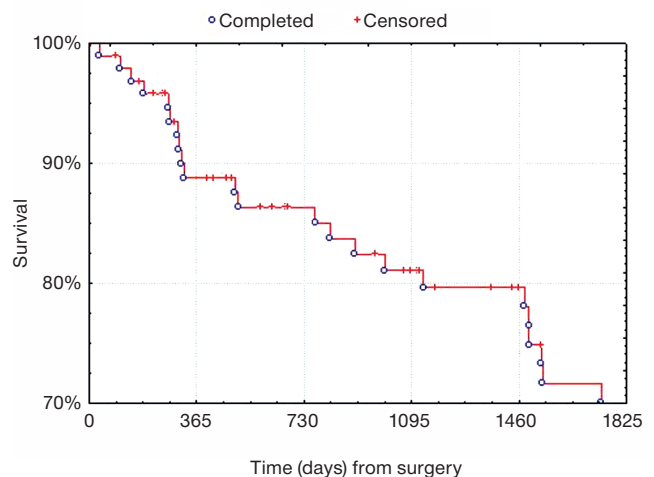


Fig. 4. Remote results: survival.

trophic defects in the zone of the planned anastomosis formation in the shin) practically in all the patients after the femoral-tibiofibular autovenous bypass surgery we managed to achieve the positive result in the early follow-up period.

The perioperative complications in our research have demonstrated the minimal values for 30-days mortality (2.7%), for high amputation (2.7%) and for the unfavorable cardio-vascular events (3.6%). These data are comparable to the ones from the global research works and indicate the high safety of the femoral-tibiofibular bypass surgeries in patients with critical ischemia of the lower limbs. Thus, in the BEST-CLI research [12], in the cohort of patients with the greater saphenous vein applicable for bypass, between the groups of the open-access and the endovascular treatment, no significant differences were demonstrated in 30 days regarding the rates of the main unfavorable cardio-vascular events (4.6% and 3.2%, respectively) and the perioperative mortality (1.7% and 1.3%, respectively). In the well-known Finnvasc register, the 30-days mortality was 3.1%, while the 30-days high amputation rate was 6.3% [16].

High levels of the rate of limb survival and of the overall survival, which were analyzed in our research in the remote period, also correspond to the worldwide research data published in the last several years. Thus, in the BASIL-2 research, the limb survival rate in the group of autovenous bypass surgeries was 80% in 5 years, however, it is worth keeping in mind that more than half of the patients have deceased within this period after the randomization [13]. Among 38 470 patients with critical ischemia of the lower limbs, which underwent the infrainguinal bypassing or endovascular interventions, the evaluation of the 30-days survival rate was 98%, while the 2- and 5-years survival rate — 81% and 69%, respectively [17].

CONCLUSION

The initial tibiofibular autovenous bypass operation (the bypass first surgery) is an effective and safe method of surgical treatment for atherosclerotic lesions in the arteries of the femoral-popliteal-tibiofibular segment in patients with critical ischemia of the lower limbs. In the era of endovascular surgery, open-access surgeries can be used as the first line operations with the comparable direct and remote results.

ADDITIONAL INFORMATION

Author contributions: A.Yu. Burov, E.R. Lysenko, O.G. Gryaznov, performing surgical operations on patients; A.Yu. Burov, general concept, processing and discussion of the study results, writing the

text of the article; E.V. Gulyaeva, R.B. Abasov, search and analytical work, writing the text of the article; K.A. Knyazeva, E.D. Malyutina, performing ultrasound diagnostics on patients in the postoperative period, processing and discussion of the study results; E.R. Islyamov, search and analytical work, processing and discussion of the study results; E.R. Lysenko, general concept, management of patient treatment and discussion of the study results, editing the text. Thereby, all authors provided approval of the version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Ethics approval: All patients signed informed voluntary consent for treatment and surgery, as well as for the use of anonymized health data for scientific purposes. The study was approved by the local ethics committee of the A.I. Burnazyan Federal Medical Biophysical Center of the Federal Medical and Biological Agency of Russia (Protocol No. 123 dated March 26, 2025).

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REFERENCES

1. GBD 2019 Peripheral Artery Disease Collaborators. Global burden of peripheral artery disease and its risk factors, 1990–2019: a systematic analysis for the Global Burden of Disease study 2019. *Lancet Glob Health*. 2023;11(10):e1553–e1565. doi: 10.1016/S2214-109X(23)00355-8
2. Lin J, Chen Y, Jiang N, et al. Burden of peripheral artery disease and its attributable risk factors in 204 countries and territories from 1990 to 2019. *Front Cardiovasc Med*. 2022;9:868370. doi: 10.3389/fcvm.2022.868370 EDN: ABVZUS
3. Roth GA, Mensah GA, Johnson CO, et al. Global burden of cardiovascular diseases and risk factors, 1990–2019: update from the GBD 2019 study. *J Am Coll Cardiol*. 2020;76(25):2982–3021. doi: 10.1016/j.jacc.2020.11.010 EDN: IQJFIO
4. Sigvant B, Lundin F, Wahlberg E. The risk of disease progression in peripheral arterial disease is higher than expected: a meta-analysis of mortality and disease progression in peripheral arterial disease. *Eur J Vasc Endovasc Surg*. 2016;51(3):395–403. doi: 10.1016/j.ejvs.2015.10.022 EDN: CYANPM
5. Simon F, Oberhuber A, Floros N, et al. Pathophysiology of chronic limb ischemia. *Gefasschirurgie*. 2018;23(Suppl 1):13–18. doi: 10.1007/s00772-018-0380-1 EDN: ZMSEOK
6. Fabiani I, Calogero E, Pugliese NR, et al. Critical limb ischemia: a practical up-to-date review. *Angiology*. 2018;69(6):465–474. doi: 10.1177/0003319717739387
7. Anand SS, Caron F, Eikelboom JW, et al. Major adverse limb events and mortality in patients with peripheral artery disease: the COMPASS trial. *J Am Coll Cardiol*. 2018;71(20):2306–2315. doi: 10.1016/j.jacc.2018.03.008 EDN: VTHMBQ
8. Agnelli G, Belch JJ, Baumgartner I, et al. Morbidity and mortality associated with atherosclerotic peripheral artery disease: a systematic review. *Atherosclerosis*. 2020;293:94–100. doi: 10.1016/j.atherosclerosis.2019.09.012 EDN: RDYDUP
9. Van Netten JJ, Fortington LV, Hinchliffe RJ, Hijmans JM. Early post-operative mortality after major lower limb amputation: a systematic review of population and regional based studies. *Eur J Vasc Endovasc Surg*. 2016;51(2):248–257. doi: 10.1016/j.ejvs.2015.10.001

10. Conte MS, Bradbury AW, Kolh P, et al.; GVG Writing Group. Global vascular guidelines on the management of chronic limb-threatening ischemia. *J Vasc Surg.* 2019;69(6S):3S–125S.e40. doi: 10.1016/j.jvs.2019.02.016 EDN: ZWNXMR
11. The TASC Steering Committee; Jaff MR, White CJ, Hiatt WR, et al. An update on methods for revascularization and expansion of the TASC lesion classification to include below-the-knee arteries: a supplement to the inter-society consensus for the management of peripheral arterial disease (TASC II). *J Endovasc Ther.* 2015;22(5):663–677. doi: 10.1177/1526602815592206
12. Farber A, Menard MT, Conte MS, et al.; BEST-CLI Investigators. Surgery or endovascular therapy for chronic limb-threatening ischemia. *N Engl J Med.* 2022;387(25):2305–2316. doi: 10.1056/NEJMoa2207899 EDN: VBMMRU
13. Bradbury AW, Moakes CA, Popplewell M, et al.; BASIL-2 Investigators. A vein bypass first versus a best endovascular treatment first revascularisation strategy for patients with chronic limb threatening ischaemia who required an infra-popliteal, with or without an additional more proximal infra-inguinal revascularisation procedure to restore limb perfusion (BASIL-2): an open-label, randomised, multicentre, phase 3 trial. *Lancet.* 2023;401(10390):1798–1809. doi: 10.1016/S0140-6736(23)00462-2
14. Norgren L, Patel MR, Hiatt WR, et al. Outcomes of patients with critical limb ischaemia in the EUCLID trial. *Eur J Vasc Endovasc Surg.* 2018;55(1):109–117. doi: 10.1016/j.ejvs.2017.11.006 EDN: YDSBZB
15. Uccioli L, Meloni M, Izzo V, et al. Critical limb ischemia: current challenges and future prospects. *Vasc Health Risk Manag.* 2018;14:63–74. doi: 10.2147/VHRM.S125065
16. Biancari F, Salenius JP, Heikkinen M, et al. Risk-scoring method for prediction of 30-day postoperative outcome after infrainguinal surgical revascularization for critical lower-limb ischemia: a finnvasc registry study. *World J Surg.* 2007;31(1):217–225; discussion 226–227. doi: 10.1007/s00268-006-0242-y EDN: PTNLOC
17. Simons JP, Schanzer A, Flahive JM, et al. Survival prediction in patients with chronic limb-threatening ischemia who undergo infrainguinal revascularization. *Eur J Vasc Endovasc Surg.* 2019;58(1S):120–134. doi: 10.1016/j.ejvs.2019.04.009

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