Original Article

Hybrid Revascularization in Treatment of Patients with Multilevel Vascular Lesion of Lower Extremities of Atherosclerotic Genesis

Ahmed Aslanov[1,2*], Rustam Kalibatov[2,3], Oksana Logvina[2], Azamat Batov[1,2], Adam Apikov[1], Liana Kardanova[1,2], Ahmed Kugotov[1,2], Zalim Bakov[4], Zalim Baksanokov[5], Liza Taukenova[2,6], Artur Zhirikov[2,4]

[1]Department of Therapy, Republican Clinical Medical and Surgical Center, Ministry of Health of Kabardino-Balkarian Republic, Nalchik, Russia. [2]Department of Therapy, Faculty of Medicine, Kabardino-Balkarian State University named after Kh. M. Berbekov, Nalchik, Russia. [3]Scientific Department, Ministry of Health of Kabardino-Balkarian Republic, Nalchik, Russia. [4]Department of Therapy, Republican Clinical Multidisciplinary Center of High Medical Technologies, Ministry of Health of Kabardino-Balkarian Republic, Nalchik, Russia. [5]Department of Therapy, Central Hospital of Tersk District, Nalchik, Russia. [6]Department of Therapy, Oncological Dispensary, Ministry of Health of Kabardino-Balkarian Republic, Nalchik, Russia.

Abstract

This study aimed to evaluate the results of "hybrid operations" in patients with multilevel lesions of the lower extremities. For this study, 26 patients who underwent "hybrid operations" from 2023 to 2024 were selected. Ultrasound Dopplerography, ultrasound duplex scanning, and CT angiography were used to study the main arteries of the lower extremities. All patients were divided into two groups. In the first group, the ilio-femoral segment underwent isolated open reconstruction. In the second group hybrid revascularization of the same segment was performed with multilevel lesions of the arteries of the lower extremities. It was found that performing open methods of revascularization of the distal bed is possible only in the presence of adequate outflow through the arteries of the lower leg, which has the advantage of hybrid operations. The traumatism of hybrid operations is less, which is better tolerated by patients with severe concomitant diseases. Notably, hybrid revascularization operations are the method of choice in patients with chronic lower limb ischemia of the IV degree, contributing to faster healing of trophic disorders and preservation of the limb for a longer period.

Keywords: Revascularization, Vascular lesion of lower extremities, Diseases, Operation

Introduction

One of the most difficult and unresolved problems in vascular surgery is the treatment of chronic critical ischemia of the lower extremities (CCILE) [1, 2]. This disease accounts for up to 15-20% of the total number of peripheral artery diseases [3-5].

It should be noted that if adequate treatment is not carried out, then within five years only 30% of patients with CCILE manage to save their limbs [6, 7]. The remaining 52% of patients undergo amputations, and 18% of patients die from complications of CCILE [8-11]. Thus, recent studies revealed that the frequency of CCILE amputation remains high [12]. In European countries, 150 to 280 lower limb amputations per million people are performed annually [13, 14]. At the same time, the number of amputations in people of working age is growing [15, 16].

The disability of the able-bodied population leads to huge costs for the medical and social rehabilitation of such patients [17, 18]. Currently, more than 800 million euros are allocated annually to solve this problem in Europe [19]. At the same time, the costs of hospital treatment of a patient after amputation amount to more than 10 thousand euros per patient [20].

Choosing the optimal treatment method for lower limb ischemia is an urgent task that requires a deep understanding of both open and endovascular therapies [21, 22]. Traditionally, open methods such as aorto-femoral bypass surgery and other surgical interventions are used to restore

Address for correspondence: Ahmed Aslanov, Department of Therapy, Republican Clinical Medical and Surgical Center, Ministry of Health of Kabardino-Balkarian Republic, Nalchik, Russia.
archi4717@yandex.ru

How to cite this article: Aslanov A, Kalibatov R, Logvina O, Batov A, Apikov A, Kardanova L, et al. Hybrid Revascularization in Treatment of Patients with Multilevel Vascular Lesion of Lower Extremities of Atherosclerotic Genesis. Arch Pharm Pract. 2024;15(4):21-4. https://doi.org/10.51847/Dfcf6mz3gd

blood flow [23-26]. However, with the development of technology, endovascular procedures have appeared, for example, angioplasty and stenting [27-29]. In this regard, there is a need for a comparative analysis of these approaches, as well as the effectiveness of their combination.

Thus, this study aimed to evaluate the results of "hybrid operations" in patients with multilevel lesions of the lower extremities.

Materials and Methods

For this study, 26 patients were selected who underwent "hybrid operations" for the period from 2023 to 2024. The operations were performed in the conditions of the vascular surgery department of the local City Hospital. Ultrasound Dopplerography, ultrasound duplex scanning, and CT angiography were used to study the main arteries of the lower extremities [30, 31]. The operations were performed in patients with multilevel lesions of the arteries of the lower extremities with the CCILE clinic and the ineffectiveness of the known methods of direct revascularization [32-34].

All patients were divided into two groups. In the first group, the ilio-femoral segment underwent isolated open reconstruction (25 patients). In the second group hybrid revascularization of the same segment was performed with multilevel lesions of the arteries of the lower extremities (26 patients). By gender, the patients were distributed as follows: 19 (73.1%) patients were men, and 7 (26.9%) were women, which corresponds to recent studies on the correlation between sex and CCILE [35, 36]. The average age of patients was 68.5 ± 4.5 years, with many concomitant diseases, further aggravating the general condition of the patient, and preventing traumatic interventions **(Table 1)**.

Table 1. The structure of concomitant pathology in operated patients

Diseases	Patients with disease, (%)	
	First group	Second group
Bronchopulmonary diseases: Emphysema of the lungs Chronic obstructive pulmonary disease Bronchial asthma	48	53.8
Cardiovascular diseases: Arterial hypertension Coronary heart disease Postinfarction cardiosclerosis Chronic heart failure Atrial fibrillation (permanent form) Heart defects	48	42.3
Kidney and bladder diseases: Chronic pyelonephritis Hydronephrosis Chronic glomerulonephritis Polycystic kidney disease Chronic renal failure Chronic cystitis	64	69.2
Diabetes mellitus	88	88.5
Gastrointestinal diseases: Chronic gastritis Peptic ulcer of the stomach and duodenum Chronic pancreatitis Chronic enterocolitis Chronic hepatitis A, B, C, D	56	73.1
Joint diseases: Arthrosis Arthritis Gonarthrosis Coxarthrosis Bursitis	40	50
Total	100	100

In 15 patients, chronic lower limb ischemia of the III degree was observed, in 11 – IV degree according to the Fontaine-Pokrovsky classification [37]. The following types of isolated open reconstruction of the ilio-femoral segment were performed (n=25):

1. Endarterectomy of the ilioemoral segment + femoral-popliteal bypass surgery – 7 (28%).
2. Profundoplasty + femoral-popliteal bypass surgery – 4 (16%).
3. Profundoplasty + femoral-deep-hip bypass surgery – 5 (20%).
4. Endarterectomy + superficial femoral-tibial bypass surgery – 3 (12%).
5. Endarterectomy of the ilioemoral segment + superficial femoral-tibial bypass surgery with the formation of a fistula in the distal anastomosis area - 2 (8%).
6. Endarterectomy of the common iliac artery + cross femoral-femoral bypass surgery – 1 (4%).
7. Endarterectomy from the distal part of the popliteal artery + femoral-popliteal bypass surgery – 1 (4%).
8. Subclavian-iliac bypass + femoral-popliteal bypass + profundoplasty – 1 (4%)
9. Cross femoral-femoral bypass + femoral-popliteal bypass – 1 (4%).

The results of surgical interventions were evaluated according to the scale of changes in clinical status according to the Russian Society of Angiologists and Vascular Surgeons [38].

The following types of "hybrid operations" were performed (n=26):

1. Stenting of the ilio-femoral segment + femoral-popliteal bypass surgery – 5 (19.2%).
2. angioplasty of the ilio-femoral segment + femoral-popliteal bypass surgery – 5 (19.2%).
3. angioplasty of the ilio-femoral segment + femoral-hip bypass surgery – 4 (15.4%).
4. Endarterectomy of the ilio-femoral segment + stenting – 1 (3.8%).
5. Endarterectomy of the ilio-femoral segment + angioplasty – 2 (7.7%).
6. Stenting of the common iliac artery + cross femoral-femoral bypass surgery – 2 (7.7%).
7. Stenting of the ilioemoral segment + endarterectomy of

the superficial femoral artery - 1 (3.8%).

8. femoral–popliteal bypass surgery + angioplasty of the arteries of the tibia - 1 (3.8%).
9. endarterectomy of the superficial femoral artery arteries + stenting of the anterior tibial artery PBBA – 1 (3.8%)
10. angioplasty of the common iliac artery + thrombectomy from the femoral-popliteal shunt – 1 (3.8%).
11. thrombectomy from the femoral-popliteal shunt + angioplasty of the popliteal artery – 2 (7.7%).
12. Stenting of the ilioemoral segment + thrombectomy from the femoral-popliteal shunt - 1 (3.8%).

Results and Discussion

The results of the evaluation of surgical interventions are presented in **Table 2**.

Table 2. Scale of changes in clinical status

Value	Degree of improvement	Number of patients	
		First group	Second group
+3	Significant improvement	10	16
+2	Moderate improvement	6	8
+1	Minimal improvement	4	0
0	Without changes	0	0
-3	Significant deterioration	5	2

The results of the complication analysis are presented in **Table 3**.

Table 3. Complications in the postoperative period

Complications	Number of patients	
	First group	First group
Shunt thrombosis	2	1
Hematoma	3	1
Lymphorrhea	4	1
Acute myocardial infarction	3	-
Total	12	3

In the immediate postoperative period, on a control angiogram and ultrasound examination, there was an improvement in peripheral hemodynamics. Complete patency of the reconstruction zones was noted as well. A month later, in patients of the first group with chronic ischemia of the III degree, relief of pain syndrome at rest was noted, with an increase in the pain-free walking distance. In the second group, the absence of positive dynamics was noted in 5 patients. In patients with grade IV ischemia in the second group, there was a decrease or relief of pain syndrome, except for two patients, due to the ineffectiveness of balloon angioplasty of the tibial arteries, shunt thrombosis developed, and therefore amputation had to be performed at the level of the lower third of the thigh. No deaths were observed. In patients with grade IV ischemia in the first group, an increase in the clinic of critical ischemia was observed, due to thrombosis of the autovenous shunt and vascular prosthesis in 5 cases. Also in the same group, the operation was complicated by myocardial infarction in three patients, while in group 2 this complication was absent.

Conclusion

1. Performing open methods of revascularization of the distal bed is possible only in the presence of adequate outflow through the arteries of the lower leg, which has the advantage of "hybrid operations".
2. The traumatism of "hybrid operations" is less, which is better tolerated by patients with severe concomitant diseases.
3. Hybrid revascularization operations are the method of choice in patients with chronic lower limb ischemia of the IV degree, which contribute to faster healing of trophic disorders and preservation of the limb for a longer period.
   - complete revascularization of the ischemic limb occurs in one session;
   - open surgery can eliminate inadequate endovascular results and vice versa;
   - potential infectious complications of long-term open intervention or two separate interventions are minimized;
   - reducing the risks of anesthesia complications, especially in high-risk patients;
   - the hospital stay has been shortened;
   - primary patency and secondary patency have the same results as with open surgery.

ACKNOWLEDGMENTS: None
CONFLICT OF INTEREST: None
FINANCIAL SUPPORT: None
ETHICS STATEMENT: All patients signed a volunteer agreement for participation in the experiment. Copies of agreements are available upon request from the corresponding author.

References

1. Alharthi NS. Endocannabinoid system components: A crucial role in the regulation of disease. J Adv Pharm Educ Res. 2022;12(3-2022):72-81.
2. Eltayeb LB. Vancomycin-resistant enterococci (VRE) isolated from hospitalized patients: Molecular characterization of the van B gene. J Adv Pharm Educ Res. 2022;12(3-2022):87-92.
3. Shamaki GR, Markson F, Soji-Ayoade D, Agwuegbo CC, Bamgbose MO, Tamunoinemi BM. Peripheral artery disease: A comprehensive updated review. Curr Probl Cardiol. 2022;47(11):101082. doi:10.1016/j.cpcardiol.2021.101082
4. Criqui MH, Matsushita K, Aboyans V, Hess CN, Hicks CW, Kwan TW, et al. Lower extremity peripheral artery disease: Contemporary epidemiology, management gaps, and future directions: A scientific statement from the American heart association. Circulation. 2021;144(9):e171-91. doi:10.1161/CIR.0000000000001005
5. Gornik HL, Aronow HD, Goodney PP, Arya S, Brewster LP, Byrd L, et al. 2024 ACC/AHA/AACVPR/APMA/ABC/SCAI/SVM/SVN/SVS/SIR/VESS guideline for the management of lower extremity peripheral artery disease: A report of the American college of cardiology/American heart association joint committee on clinical practice guidelines. Circulation. 2024;149(24):e1313-410. doi:10.1161/CIR.0000000000001251

6. Almalki GH, Rabah S, Arafa NM, Bahshwan SM. Immunohistochemical evaluation of the euphorbia inarticulata extract on liver and kidney tissues in hepatocellular carcinoma rats. Pharmacophore. 2022;13(2-2022):33-40.
7. Almourgi MA, Alamri TM, Algashmari AF, Nassir RA, Alharthi AA, Alsharief QF. Prevalence of smokers among gastroesophageal reflux disease patients in western Saudi Arabia region. Pharmacophore. 2022;13(2-2022):96-100.
8. Golledge J. Update on the pathophysiology and medical treatment of peripheral artery disease. Nat Rev Cardiol. 2022;19(7):456-74. doi:10.1038/s41569-021-00663-9
9. Bonaca MP, Hamburg NM, Creager MA. Contemporary medical management of peripheral artery disease. Circ Res. 2021;128(12):1868-84. doi:10.1161/CIRCRESAHA.121.318258
10. Narula N, Olin JW, Narula N. Pathologic disparities between peripheral artery disease and coronary artery disease. Arterioscler Thromb Vasc Biol. 2020;40(9):1982-9. doi:10.1161/ATVBAHA.119.312864
11. Bauersachs R, Zeymer U, Brière JB, Marre C, Bowrin K, Huelsebeck M. Burden of coronary artery disease and peripheral artery disease: A literature review. Cardiovasc Ther. 2019;2019:8295054. doi:10.1155/2019/8295054
12. Campia U, Gerhard-Herman M, Piazza G, Goldhaber SZ. Peripheral artery disease: Past, present, and future. Am J Med. 2019;132(10):1133-41. doi:10.1016/j.amjmed.2019.04.043
13. Bevan GH, White Solaru KT. Evidence-based medical management of peripheral artery disease. Arterioscler Thromb Vasc Biol. 2020;40(3):541-53. doi:10.1161/ATVBAHA.119.312142
14. Mandaglio-Collados D, Marín F, Rivera-Caravaca JM. Peripheral artery disease: Update on etiology, pathophysiology, diagnosis and treatment. Med Clin (Barc). 2023;161(8):344-50. doi:10.1016/j.medcli.2023.06.005
15. De Luca L, Bonaca MP, Magnani G. Antithrombotic strategies for patients with coronary and lower extremity peripheral artery diseases: A narrative review. Expert Rev Cardiovasc Ther. 2020;18(12):881-9. doi:10.1080/14779072.2020.1833719
16. Tang QH, Chen J, Hu CF, Zhang XL. Comparison between endovascular and open surgery for the treatment of peripheral artery diseases: A meta-analysis. Ann Vasc Surg. 2020;62:484-95. doi:10.1016/j.avsg.2019.06.039
17. Nguyen BT, Nguyen TT, Le UT. Nomophobia and stress among Vietnamese high school students in Covid-19 pandemic: A mediation model of loneliness. J Biochem Technol. 2022;13(1-2022):34-40.
18. Kachenkova ES, Zbrueva YV, Tkacheva ES, Pravdov DM, Eremin MV, Romanova AV, et al. Hematological indicators of students who started races. J Biochem Technol. 2022;13(1-2022):7-12.
19. Nash D, McClure G, Mastracci TM, Anand SS. Social deprivation and peripheral artery disease. Can J Cardiol. 2022;38(5):612-22. doi:10.1016/j.cjca.2021.12.011
20. Holder TA, Gutierrez JA, Aday AW. Medical management of peripheral artery disease. Cardiol Clin. 2021;39(4):471-82. doi:10.1016/j.ccl.2021.06.001
21. Alanazi AA, Wajdi FA, Al Issa MS, Fallatah AA, Shaker AO, AlHatim AA, et al. An overview on klinefelter's: Clinical features and management in pediatric population. Int J Pharm Res Allied Sci. 2022;11(1-2022):1-5.
22. Gaikwad SS, Choudhari VP. Efficacy and safety of combination therapy of zinc and silver oxide nanoparticles in streptozotocin-induced diabetic rats. Int J Pharm Res Allied Sci. 2022;11(3-2022):1-0.
23. Cooke JP, Meng S. Vascular regeneration in peripheral artery disease. Arterioscler Thromb Vasc Biol. 2020;40(7):1627-34. doi:10.1161/ATVBAHA.120.312862
24. Allison MA, Armstrong DG, Goodney PP, Hamburg NM, Kirksey L, Lancaster KJ, et al. Health disparities in peripheral artery disease: A scientific statement from the American heart association. Circulation. 2023;148(3):286-96. doi:10.1161/CIR.0000000000001153
25. Athavale A, Fukaya E, Leeper NJ. Peripheral artery disease: Molecular mechanisms and novel therapies. Arterioscler Thromb Vasc Biol. 2024;44(6):1165-70. doi:10.1161/ATVBAHA.124.320195
26. Belyaev NG, Rzhepakovsky IV, Timchenko LD, Areshidze DA, Simonov AN, Nagdalian AA, et al. Effect of training on femur mineral density of rats. Biochem Cell Arch. 2019;19(2):3549-52.
27. Paisley MJ, Adkar S, Sheehan BM, Stern JR. Aortoiliac occlusive disease. Semin Vasc Surg. 2022;35(2):162-71. doi:10.1053/j.semvascsurg.2022.04.005
28. Bierowski M, Galanis T, Majeed A, Mofid A. Peripheral artery disease: Overview of diagnosis and medical therapy. Med Clin North Am. 2023;107(5):807-22. doi:10.1016/j.mcna.2023.05.007
29. Wahyu S, Basoeki AP, Abbas KA. Perioperative anesthetic management in suprarenal pheochromocytoma tumor resection. J Med Pharm Chem Res. 2024;6(9):1274-88. doi:10.48309/jmpcr.2024.447564.1139
30. McDermott MM, Ho KJ, Alabi O, Criqui MH, Goodney P, Hamburg N, et al. Disparities in diagnosis, treatment, and outcomes of peripheral artery disease: JACC scientific statement. J Am Coll Cardiol. 2023;82(24):2312-28. doi:10.1016/j.jacc.2023.09.830
31. Beckman JA, Schneider PA, Conte MS. Advances in revascularization for peripheral artery disease: Revascularization in PAD. Circ Res. 2021;128(12):1885-912. doi:10.1161/CIRCRESAHA.121.318261
32. Manolis AA, Manolis TA, Melita H, Mikhailidis DP, Manolis AS. Low serum albumin: A neglected predictor in patients with cardiovascular disease. Eur J Intern Med. 2022;102:24-39. doi:10.1016/j.ejim.2022.05.004
33. Pasławska A, Tomasik PJ. Lipoprotein(a)-60 years later-what do we know? Cells. 2023;12(20):2472. doi:10.3390/cells12202472
34. Jiwangga D, Mastutik G, Mahyudin F, Meitavany EN, Juliana, Dwipayana MA, et al. In vitro enhancement of chondrogenic and epithelial genes differentiation of human adipose mesenchymal stem cells in decellularized xenograft tracheal scaffold: Implications for tracheal disease management. J Med Pharm Chem Res. 2025;7(3):393-409. doi:10.48309/jmpcr.2025.464103.1301
35. Pabon M, Cheng S, Altin SE, Sethi SS, Nelson MD, Moreau KL, et al. Sex differences in peripheral artery disease. Circ Res. 2022;130(4):496-511. doi:10.1161/CIRCRESAHA.121.320702
36. Divakaran S, Krawisz AK, Secemsky EA, Kant S. Sex and racial disparities in peripheral artery disease. Arterioscler Thromb Vasc Biol. 2023;43(11):2099-114. doi:10.1161/ATVBAHA.123.319399
37. Lee RE, Patel A, Soon SXY, Chan SL, Yap CJQ, Chandramohan S, et al. One-year clinical outcomes of Rutherford 6 chronic limb-threatening ischemia patients undergoing lower limb endovascular revascularisation from Singapore. CVIR Endovasc. 2022;5(1):32. doi:10.1186/s42155-022-00306-1
38. Martem'ianov SV, Uvarov EA, Safonova OV. Assessment of the patient's quality of life in the long-term postoperative period after reconstructions on lower extremity arteries. Angiol Sosud Khir. 2004;10(2):129-35.