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Optimization of surgical treatment for lower extremities and infrarenal aorta atherosclerosis

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Abstract. Background. Atherosclerosis of the infrarenal aorta and lower extremities is a disease caused by hyperlipidemia, arterial hypertension, tobacco smoking, hyperglycemia, metabolic disorders, and physical inactivity. The research aims to optimize surgical treatment and its effectiveness in patients with occlusions of the distal aorta and lower extremities. **Materials and methods.** For patients from the main group, diagnostic and prognostic tactics were used, addressing 18 major risk factors, which allowed to predict the presence or absence of risk for recurrent postoperative thrombosis, which could end in surgery to eliminate thrombosis, amputation, or death. For patients with severe calcification of the arterial wall, an improved surgical technique was used to reduce the rate of significant complications. **Results.** The results of treatment were analyzed in 98 patients with occlusive stenotic lesions of the main arteries as a consequence of obliterating atherosclerosis who were operated by the open method. **Conclusions.** The research outcomes indicated the importance of determining individual risk before surgery, as this allowed for planning the scope of the operation and choose appropriate access. These measures reduced the rate of postoperative complications. In addition, it became possible to gather patients into a group of standard treatment and those who need special monitoring, which improved early postoperative outcomes in the future such as early postoperative mortality and amputation rates. The study also analyzed the importance of active tactics for treating postoperative complications which reduce the risk of complications that lead to reoperation or amputation.

Keywords: arteriosclerosis obliterans; critical ischemia; revascularization; radical surgery; risk factors

Introduction

Atherosclerosis obliterans of the lower extremity vessels in 3–5 % of cases cause aortoiliac occlusive disease (AIOD), which is an occlusive disease of the infrarenal aorta and iliac arteries [1]. In patients over 70 years of age, the incidence of AIOD is 20 %. As a rule, atherosclerotic lesions of the aorta and iliac segments are combined with lesions of the infrainguinal arteries. Areas of occlusive stenotic lesions can be long and short or segmented. They can be single or multiple, affecting not only the aorta but also the iliac arteries and arteries of the lower extremities on one or both sides. Ulceration of atherosclerotic plaques and the presence of severe calcification may be present as features of the atherosclerotic process. Calcifications in the aortoiliac segment significantly worsen the prognosis of treatment, including surgical treatment.

Surgical intervention of this sign is standard, but leads to a significant number of complications, including deaths

and amputations, a meta-analysis that presents the results of surgical treatment of patients with occlusive-stenotic lesions of the aorta, iliac arteries, and lower extremity arteries. Therefore, this clinical situation requires a detailed assessment and a search for the best treatment strategies. According to the current TASC classification, which is described by L. Norgren et al., the division of aortoiliac lesions into areas was introduced, considering the length, degree of occlusion, and degree of damage [2]. Thus, lesions of the infrarenal aorta are divided into lesions of 4 degrees — A, B, C and D. The first two types of cases are subject to endovascular treatment and have a high chance of complete recovery without complications, the latter two have a poor prognosis and should be treated only by open surgery.

Open surgical intervention remains the method of choice for the treatment of long atherosclerotic lesions, since endovascular techniques are less predictable, re-

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quire complex technical conditions and highly specific qualifications and experience of the surgeon, as described in the studies on standardization of the commonly used for occlusive-stenotic lesions in long arterial lesions in TASC and works on modern management in the choice of treatment of this pathology, as well as in works on the prediction of complications [3]. In addition, endovascular surgery is not possible for every anatomic access in cases of calcification [4]. This is evidenced by both meta-analyses and clinical protocols, a meta-analysis that presents the results of surgical treatment of AIOD and infrainguinal arterial lesions [5].

Early postoperative complications, such as anastomotic failure, thrombosis, and bleeding, account for a significant proportion of complications that lead to serious health or life consequences [6]. Evidence of this is available in articles on bypass surgery for stenotic occlusive disease of the aorta, iliac arteries, and lower extremity arteries, as well as in studies analysing the number of complications in the treatment of this pathology and mathematical analyses of this problem [7]. Transabdominal and retroperitoneal access is used to perform reconstructive surgery on the infrarenal abdominal aorta and its branches. It should be noted that open surgical techniques correlate with a higher risk of surgical complications and mortality. One of the reasons for the failure of surgical treatment of aortoiliac lesions is the difficulty of preserving all significant branches of the aortoiliac segment, in particular the mesenteric vessels and vertebral arteries, which leads to ischemia of the corresponding organs [8–10]. In addition to purely surgical problems and types of complications, surgical site infections, which account for 2–14 %, are a major problem, leading to a significant dilemma described in studies analysing the feasibility of radical surgery in various clinical situations and systematic meta-analyses on this issue [11]. In cases where surgical site infections reach the graft site, there is a risk of graft infection, sepsis, and mortality [12].

Many studies are being conducted to make the prognosis of surgical treatment more accurate and to avoid unsatisfactory treatment outcomes. There are no significant data in the world and Ukrainian scientific literature on the prognosis and prevention of complications due to surgery to eliminate embolism of the distal aorta and lower extremity arteries, although the incidence of postoperative thrombosis ranges from 1–3 to 10–25 %, as reported in various sources [13]. The most common causes of thrombosis are deficiencies in the formation of the distal anastomosis, the formation of non-anatomical outflow pathways, or the twisting or overrun of the prosthesis cup. This is complex and poorly predictable, but controllable and correctable when making the right surgical decisions based on timely preoperative and intraoperative assessment. The research aims to predict the probability of rethrombosis in the early postoperative period and to plan surgical intervention, and diagnostic and therapeutic postoperative treatment tactics in such a way as to minimize the likelihood of postoperative rethrombosis. The research objective was to develop an effective set of measures for the prevention of postoperative thrombosis that would not cause significant additional risks of intraoperative and postoperative bleeding.

Materials and methods

The clinical trial was conducted at the Research and Practical Centre of Preventive and Clinical Medicine of the State Administrative Department, where 98 patients with occlusions of the main arteries of the distal aorta were treated with open surgery from 2014 to 2021. Patients were divided into treatment and control groups according to the change in the treatment approach. The control group (comparison group) was treated in 2014–2017, and the main group in 2018–2021. The comparison group included 55 patients (56.12 %) who received a standard set of examinations and treatment (international guidelines ESVS — TASC II 2007) [3]. The main group includes 43 patients (43.88 %), in this group the updated guidelines for the diagnosis and treatment of peripheral arterial disease and the global vascular guidelines for the management of chronic threatening lower extremity ischemia of 2019 were used [12].

Both groups had the same distribution by gender, age, and clinical picture of infrarenal lesions of the aorta and main arteries of the lower extremities. Contraindications to surgical treatment were acute cerebrovascular disorders with severe non-rhotic deficits and heart failure of stage IIB-III, and the patient's general severe somatic condition. The treatment of patients in the main group compared to the control group was characterized by in-depth examination methods and individualized treatment methods. The studies included mandatory CT angiography or subtraction angiography and ultrasound Doppler hemodynamics with options for determining the resistance index, volumetric blood flow, ankle-brachial index, and transcutaneous tissue oxygen tension $TcPO_2$. They were performed on all patients. In addition, an individual choice of reconstructive and restorative operations was applied to the main group based on the above examination methods. The method of choosing surgical tactics was based on the analysis of 18 risk factors for rethrombosis. One of the selected therapeutic methods was developed in the Research and Practical Centre of Preventive and Clinical Medicine of the State Administrative Department — a method of anastomosis in severe calcification of the arterial wall of large arteries (a patent of Ukraine for utility model 130517), which is an important way to perform surgery in this clinical case [1].

In the comparison group, there were 70 (71.42 %) men and 28 (28.58 %) women. In the main group, there were 72 men (73.47 %) and 26 women (26.53 %), respectively. Patients aged 46–76 years in the control sample were 72 %, and in the main group — 74.13 %. In both groups, the right lower limb was more often affected — 60 (61.22 %) patients in the main group, and 57 (58.16 %) in the comparison group. Accordingly, the left — 38 (38.78 %) in the main group and 41 (41.84 %) in the comparison group. To assess the degree of limb ischemia in both groups, Rutherford et al. Classification of Ischemic Lesions was used [14]. There were patients of 4–6 categories: 32 (32.66 %) with category 4, 38 (38.77 %) with category 5, and 28 (28.57 %) with category 6.

All patients underwent preoperative duplex ultrasound scanning of the abdominal aorta, lower extremity arteries, and areas of future reconstruction. The main group also received X-ray contrast angiography or spiral computed tomography with 3D modelling. In the presence of symptoms

of multifocal atherosclerosis, patients also received angiography of the carotid and coronary arteries. These studies determined the localization, degree and nature of stenosis or occlusion, which made it possible to assess the condition of the vessel, coronary vessels, and the degree of compensatory capabilities of the patient and perform the optimal surgical intervention in terms of volume and technical performance. In the preoperative period, the preparatory therapy did not differ depending on the group. Antithrombotic therapy included clopidogrel bisulphate in a dose of 75 mg or acetylsalicylic acid in a dose of 75–100 mg. The basic criterion for this selection was the anatomical classification TASS-II. The standard of treatment for both groups was the so-called “active tactics” — that is, early activation of the patient after surgery, active observation, and the appointment of antibiotic therapy, repeated examinations, and vacuum drainage at the first signs of postoperative local complications.

Results

Patients of both groups (98 patients) were operated on by the open method according to the anatomical segments. Thus, 16 (16.32 %) surgical interventions were performed on the aortoiliac segment, 11 (11.22 %) on the iliofemoral segment, 48 (48.98 %) on the femoral-popliteal segment, 19 (19.4 %) on the popliteal-ankle segment, and 4 (4.08 %) on the ankle segment. In 12 cases, a combined lesion (multi-storey lesion) was diagnosed: in 8 patients, the femoropopliteal segment and the iliac segment were damaged, and in 4 patients, the popliteal segment was damaged simultaneously with the iliac segment. These patients underwent multisegmented surgery under general anaesthesia or spinal anaesthesia with additional sedation. Synthetic prostheses were used to restore revascularization in segments I and II, and synthetic prostheses were also used in segments

III, IV, and V (except for 5 patients who underwent endarterectomy). It was possible to perform thrombectomy and endarterectomy in 5 (5.1 %) patients, and the remaining 93 (94.9 %) underwent bypass surgery. Direct revascularization prevailed in the structure of all surgical interventions. The type of surgical intervention was based on the principles outlined in Table 1.

In patients with calcification of the vascular wall of large arteries, anastomosis was performed according to the developed method of autoarterial duplication from the wall of the large artery simultaneously with the removal of areas of calcification from it. The advantage of this technique was demonstrated by the reliability of allograft attachment and tightness, as well as a lower risk of suture penetration and aneurysms in the thinned wall. During the study, no complications were observed after using the proposed technique of shunt anastomosis in patients with diagnosed arterial wall calcification, which allows further research to continue [11]. It should be noted that autovenous bypass surgery is the best option for treating patients with stenotic lesions of large arterial segments, mainly in the segments below the knee joint cleft. In addition, 12 patients had multilevel occlusive and stenotic pathology (7 patients in the control sample and 5 patients in the experimental sample), which was resolved by a one-stage reconstruction with a combination of allovenous and autovenous bypass surgery. One-stage reconstruction of two vascular segments simultaneously with good results was also successfully performed by combining allovenous and autovenous bypass surgery.

In 10 % of patients, repeat surgeries were performed (13 % in the control group and 7 % in the study group) due to recurrent thrombosis of the revascularized segment, which caused progressive ischemic events. The causes of recurrent thrombosis were technical imperfections in one case, bacterial contamination of the shunt in one case, and impaired

Table 1. Types of open surgical procedures

Regions	Surgeries	Total and per group (main/comp.)	N (%)
Aorto-iliac	1. Aorto-femoral bifurcation allografting. 2. Aortic prosthetics	12 (5/7) 4 (2/2)	16 (16.33)
Iliac-femoral	1. Thrombintomyectomy from the iliac arteries. 2. Retroperitoneal and femoral allografting	2 (1/1) 9 (5/4)	11 (11.22)
Femoral-ankle	1. Endarterectomy from the common femoral artery. 2. Deep plastic surgery with an autovenous patch. 3. Deep plastic surgery with alloplasty. 4. Femoral-femoral augmentation shunt. 5. Femoral and femoral allografting. 6. Femoral-popliteal allografting over the knee joint gap. 7. Femoral-popliteal autovenous bypass over the knee joint gap. 8. Femoral-popliteal allografting under the knee joint crevice. 9. Femoral-popliteal autovenous bypass surgery under the knee joint crevice	5 (2/3) 6 (2/4) 2 (1/1) 5 (3/2) 7 (3/4) 8 (4/4) 6 (2/4) 3 (2/1) 6 (3/3)	48 (48.98)
Sub-ankle-femoral	1. Femoral-proximal iliac bypass surgery. 2. Femoral-distal iliac bypass grafting. 3. Femoral-distal iliac bypass surgery <i>in situ</i>	10 (5/5) 6 (2/4) 3 (3 main)	19 (11.22)
Femoral-foot	1. Popliteal autovenous bypass surgery. 2. Femoral autovenous bypass surgery	3 (1/2) 1 (comparison group)	4 (4.08)
Total		98	98

blood outflow in 8 patients. To avoid complications, patients underwent thrombectomy, autovenous plastic surgery of the distal vessel junction and repeated bypass surgery. Thus, thrombectomy, endarterectomy, and direct revascularization operations were performed in 7 patients of the comparison group, and thrombectomy and femoropopliteal bypass surgery were performed in 3 patients of the main group on different segments. Despite the literature data, no more complications were observed at the access sites for anastomosis. The study data show fairly high efficiency and a low need for early repeated surgical interventions.

After analysing the criteria for the possible occurrence of the occlusion in the early postoperative period based on mathematical logistic regression with heterogeneous variance, it was found that the following factors have a significant effect: the presence of complex anatomical conditions ($\beta = 3.5080$, $p = 0.034$), the presence of two or more multi-storey occlusions ($\beta = 9.0073$, $p = 0.002$), the presence of technical errors in the intervention process ($\beta = 8.0802$, $p = 0.004$), the risk of occlusion significantly increases with increasing lesion length ($\beta = 0.5214$, $p = 0.005$). An increase in the length of the artery lesion for each additional centimetre increases the risk of occlusion by 0.168 times. Thus, in the case of long occlusions in the main group, an autovenous shunt was used as much as possible, and in its absence on the ipsilateral side, the intervention was performed on the contralateral limb. In the absence of an adequate length, an alloautograft was combined.

These results were achieved due to the correct distribution of patients and appropriate clinical tactics. As such, patients with an extremely high risk of anastomotic failure were not enrolled for radical treatment (selection was based on 23 defined risk factors according to a methodology developed at the Research and Practical Centre of Preventive and Clinical Medicine of the State Administrative Department). Patients with high, medium, and low risk of rethrombosis and anastomotic failure underwent thorough staging, determination of concomitant pathology, localization of the thrombosis site, and thrombus size. Thus, it was possible to plan the amount of preparatory therapy, choose the safest surgical strategy, and predict possible complications and how to prevent and treat them. The results on the number of rethrombosis and repeated surgical interventions in the control group are close to the results reported in international clinical sources, the results of treatment of the main group indicate a 30% reduction in the number of repeated operations.

Thus, the method of determining risk factors and planning surgical treatment is accessible, relatively cheap, and promising. The postoperative tactics of active monitoring are also of great importance. Although CT examinations in the early postoperative period still pose significant difficulties, patient monitoring and the use of ultrasound allow timely diagnosis of blood flow disorders and the onset of rethrombosis. Patients with wound complications underwent physiotherapy, antibiotic therapy, and vacuum drainage. Thus, all patients in the main group were able to avoid significant complications that could have led to amputations. For patients with additional risk factors such as age over 70 years, a history of stroke or myocardial infarction, or

additional areas of stenosis other than the area of occlusion that was subject to surgical treatment, the intensity and frequency of diagnostic procedures in the postoperative period were increased. The least risky surgical options were also chosen for these patients. Also, for this group of patients, every effort was made to make the duration of the operation as short as possible. In addition, for this group of patients, not only was standard antiplatelet therapy performed, but also hemodynamic parameters and coagulation were monitored before surgery. The number of patients in both the control and study samples is insufficient to prove the success of the methodology of thorough risk analysis and active monitoring of patients at risk in the postoperative period, but an important proof of the usefulness of this methodology is the absence of such events as myocardial infarction, stroke, and pulmonary embolism during the entire treatment process in any patient at risk.

The factors that could not be influenced are complex anatomical conditions and the presence of multiple occlusions, as well as a significant extent of the lesion. Attempts were made to identify the features of surgical tactics suitable for patients with complex anatomical features (attempts to refuse alloprosthetics, work with the smallest surgical access, and non-simultaneous performance of all stages of surgery), but no common features and treatment features that could improve clinical outcomes were identified. A noticeable complication is an allograft infection. This complication is mentioned in other literature sources, but the reasons for this phenomenon are still unclear. One possible reason may be the quality of the prosthetic material or the presence of a chronic infection in the patient's body. Neither of these hypotheses was confirmed or denied during the study, as all patients received the same prosthetic material, and chronic infections were treated in all cases, which was confirmed by laboratory results.

Attention should also be paid to the distribution of the types of operations performed by segment. All segments of the infrarenal abdominal aorta were operated on (aortoiliac, iliofemoral, femoral-popliteal, popliteal, and ankle-foot segments). However, the study results clearly show that most operations were performed on the femoral-popliteal segment. The structure of these operations is mainly bypass surgery, but in two cases in the main group and 3 cases in the control group the scope of the operation was limited to endarterectomy from the common femoral artery, which is a much easier operation than bypass surgery, in two cases in the main group and 4 cases in the comparison group, profundoplasty with an autovenous patch was performed and in 1 case in the main group and one case in the control group, profundoplasty with an allograft was performed. In general, the results were the best in the group of patients who underwent surgery on the femoral-popliteal segment. Regarding operations on the aorta-abdominal segment, the structure of patients includes 2 patients from the study group and 2 patients from the comparison group who underwent aortic prosthetics, which is a highly complex operation in conditions of severe calcification, and 5 patients from the study group and 7 patients from the comparison group who underwent aortic-femoral bifurcation allografting, which is also a high level of complexity.

Discussion

Based on the statistical prediction of surgical segment rethrombosis at the diagnostic stage, it was possible to reduce these complications to 30 % in the main group. Among the significant complications, early postoperative thrombosis was reported. In total, this complication was recorded in 11 (11.22 %) patients, 4 of whom had been operated on earlier for the same indication. The incidence of this pathology was higher in the comparison group — 8 (14.54 %) patients versus 3 (6.97 %) patients in the study sample (probability value less than 0.05). The reason for occlusion was the lack of adequate blood outflow pathways. In all patients with early postoperative complications in the main group, blood flow was restored, and the same result was achieved in 5 out of 8 cases in the comparison group. In 3 patients in the comparison group, it was necessary to perform an amputation of the limb at the level of the thigh due to an unsuccessful attempt. These patients underwent amputation of the limb at the level of the thigh due to progressive ischemia. The reason for the amputation was insufficiency of blood outflow pathways, the presence of a significant lesion block and thrombosis of shunts.

Standard complications for this type of pathology, such as hematomas, bleeding, lymphorrhea, lymphostasis and tissue oedema, did not differ statistically (in the control and study samples — in 9 % of patients). Complications were treated with therapeutic methods and vacuum drainage and did not lead to a significant deterioration in the patient's condition, which coincides with the literature. Issues such as the number of complications encountered with different treatment methods and risk assessment in operations to remove thrombi from the infrarenal aorta were analysed in meta-analyses and systematic reviews by I.N. Naazie et al. [15], D.J. Pennywell et al. [16], J.P. Simons et al. [17]. In the early postoperative period, mortality in the comparison group was 7.27 % (4 patients), and in the main group — 4.65 % (2 patients). The causes of death in patients with occlusions of the infrarenal aortic segment and peripheral arteries due to atherosclerosis were mainly heart attacks, left ventricular failure, and critical functional pathologies of internal organs [18–22]. The study notes a decrease in the incidence of postoperative complications from 14.54 to 6.98 %, the number of reoperations from 14.54 to 4.65 %, the number of amputations from 9.09 to 2.32 %, and the ability to reduce and reduce postoperative mortality from 7.27 to 4.65 %.

Currently, the system for predicting rethrombosis does not allow to completely avoid undesirable postoperative consequences or to accurately predict clinical cases when surgery to restore blood flow is not appropriate. However, it should be noted that the existing methods for determining the state of the infrarenal aorta do not provide a complete picture of the state of blood flow in the lower extremities with an assessment of the rheological properties of blood, this problem is discussed in works devoted to reducing the risk of complications in this type of surgery [7]. In addition, the methods mentioned in the article above that have been used to predict the success of arterial plastic surgery (CT or subtraction angiography, ultrasound Doppler hemodynamics with options for determining the resistance index, volumetric blood flow brachialis index, and transcutaneous tissue

oxygen tension ($TcPO_2$)) are performed before surgery, but are not routinely performed in the postoperative period due to the need for additional funds and technical difficulties in performing complex diagnostic procedures in the postoperative period. There is also no data on this issue in the world's scientific literature. Thus, scientists dealing with this issue are faced with the problem of the simplest and most effective means that will allow timely assessment of blood flow and foresee complications and start active therapeutic tactics as early as possible. This issue should be covered in the following works on this clinical situation.

Another important tactical issue is related to staging before deciding on whether to perform surgery and determining the extent of surgery. It is known that patients with the risk factors, such as age over 70 years, diabetes mellitus, history of myocardial infarction or cerebral stroke, decompensated arterial hypertension, infrarenal aortic stenosis caused or complicated by nonspecific aortic arteritis, tuberculosis, syphilis or rheumatism, or other infectious agents — the risks of postoperative complications are higher, as well as the risks of reoperation and amputation and, accordingly, mortality [19, 23, 24]. However, now there is no data (including in the world's scientific sources) that would allow to identify a group of patients for whom surgery to restore the patency of the infrarenal ostium of the aorta and lower extremity arteries would be contraindicated or have the highest risk. Subsequent studies will be aimed at identifying such a group of patients or reducing such risks to statistically insignificant ones [25]. To do this, a thorough analysis of all risk factors and aspects of the clinical situation in patients who failed to preserve a limb or avoided death should be performed. Such an analysis is extremely difficult, as the number of such cases is usually not large enough for statistical processing, but a clinical hypothesis can be put forward and confirmed based on properly processed analysed data.

Another important element that helps to reduce the percentage of postoperative complications is to reduce the risk of infectious complications. The causes of septic complications are the presence of a chronic infection of any genesis in the patient's body and the quality of the implant. It should also be noted that there is information in the world data on intraoperative renal perfusion — otherwise, the risk of generalized spastic and multiorgan pathology increases.

Conclusions

The clinical experience presented, as well as the analysis of international literature data, allowed to draw the following conclusions: the use of risk factor analysis for recurrent thrombosis allows for adequate preoperative preparation and improved planning of a surgical intervention the outflow pathway; active postoperative tactics (observation, including ultrasound monitoring, antiplatelet therapy, early patient uplift, vacuum drainage, and antibiotic therapy) will help prevent most complications and correct existing ones on time; further study of the factors that directly cause occlusions and lack of blood flow in shunted limbs, as well as clinical tactics and clinical course in such cases, is an opportunity to develop measures for the effective prevention of such complications.

Thus, although the issue of revascularization of the aorta, main arteries in its infrarenal department, as well as the arteries of the infrainguinal zone is an important and urgent issue of modern medicine, there are many aspects of this clinical situation that are not fully covered and require further coverage, such as: standardisation of preoperative examination methods (currently there is no approved list in any clinical guidelines); individualized assessment of factors that may affect the success of surgical treatment and determination of the surgical approach depending on them; supplementation of critical risk factors, in particular, surgical and cardiac, which can cause necrosis or death and the formation of a specific protocol to counteract these consequences at all stages of treatment; studying the role of suture materials and prostheses in the formation of anastomotic failure and the development and persistence of postoperative infection and determining the antibiotic therapy protocol with the approval of active substances and dosages that can be prescribed for the treatment of infectious complications in the early stages of complications and in situations of extensive septic inflammation.

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Оптимізація хірургічного лікування атеросклерозу нижніх кінцівок та інфраренальної аорти

Резюме. Актуальність. Атеросклероз інфраренального відділу аорти та нижніх кінцівок — захворювання, обумовлене гіперліпідемією, артеріальною гіпертензією, тютюнопалінням, гіперглікемією, порушенням обміну речовин та гіподинамією. **Метою дослідження** є оптимізація хірургічного лікування та його ефективності в осіб з оклюзіями дистального відділу аорти та нижніх кінцівок. **Матеріали та методи.** У хворих основної групи застосовували діагностичну та прогностичну тактику, спрямовану на 18 основних факторів ризику, які дозволяли передбачити наявність чи відсутність ризику повторного післяопераційного тромбозу, що може призвести до хірургічного втручання з усунення тромбозу, ампутації або смерті. У пацієнтів із значною кальцифікацією артеріальної стінки була використана вдосконалена хірургічна техніка, щоб знизити частоту серйозних ускладнень. **Результати.** Проаналізовано результати лікування 98 хворих з оклюзійно-

стенотичними ураженнями магістральних артерій внаслідок облітеруючого атеросклерозу, оперованих відкритим способом.

Висновки. Результати дослідження засвідчили важливість визначення індивідуального ризику перед операцією, оскільки це дозволило правильно спланувати обсяг втручання та вибрати відповідний доступ. Ці заходи знизили частоту післяопераційних ускладнень. Крім того, з'явилася можливість об'єднати пацієнтів у групу стандартного лікування й тих, хто потребує спеціального моніторингу, що в майбутньому покращило такі ранні післяопераційні результати, як рання післяопераційна смертність та рівень ампутацій. У дослідженні проаналізовано й важливість активної тактики лікування післяопераційних ускладнень, яка знижує ризик виникнення ускладнень, що призводять до повторної операції чи ампутації. **Ключові слова:** облітеруючий атеросклероз; критична ішемія; реваскуляризація; радикальна хірургія; фактори ризику