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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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MODERN METHODS OF SURGICAL TREATMENT OF DIABETIC FOOT SYNDROME

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Abstract.

This article discusses the problems of surgical tactics in diabetic foot syndrome and its complications, both in the early postoperative and remote periods. The above complications require surgeons to search for the most optimal method of surgical treatment.

Aim of the work: To evaluate the results of surgical treatment using different revascularization and non-revascularization methods in patients with diabetic foot syndrome.

Study design: Non-randomized controlled clinical trial.

Materials and Methods: The article presents the experience of treatment at the University Hospital of NCJSC 'SMU' in the period from 2021 to 2024, where 93 patients were operated on. All patients had narrowing or complete occlusion of arteries of the lower limbs on the background of decompensated diabetes mellitus, which required surgical intervention. The patients were divided into 2 groups based on the results of computed tomography or angiography. The first group consisted of 45 patients who underwent revascularization interventions, while in the second group 48 patients underwent nonrevascularization interventions. The most frequently performed revascularization interventions were balloon angioplasty (53.33%), femoral-pelvic bypass (31.1%), bifurcation aorto-femoral bypass (11.1%); profundoplasty of the deep femoral artery and stenting of the superficial artery were performed less frequently (2.2%). Lumbar sympathectomy (89.58%) and revascularisation osteotrepanation (10.42%) were performed in the group of non-revascularisation interventions.

Results: Most complications were observed in revascularisation interventions. 2 complications were in patients who underwent balloon angioplasty, and 3 complications in patients who underwent femoral-popliteal bypass. In other interventions, as well as in non-vascularisation treatment methods, there were no complications. However, wound healing, and the management of lower limb ischaemia were much better in patients who underwent revascularisation intervention.

Conclusions: This study found that revascularisation therapies such as angioplasty and bypass surgery demonstrate higher efficacy rates in the treatment of patients with diabetic foot syndrome compared to non-revascularisation techniques. Revascularisation improves blood flow, reduces the risk of amputations and accelerates wound healing, which is supported by data on low complication rates in the group of patients who received these interventions. However, despite the clear advantages of revascularisation, the choice of treatment method should be based on individual indications, taking into account the degree of vascular damage, the presence of comorbidities and the general clinical characteristics of the patient. In some cases, for example, in less severe circulatory disorders, non-revascularisation methods may be equally effective and less invasive.

Key words. Diabetes mellitus, diabetic foot syndrome, revascularisation, amputation.

Introduction.

Diabetes mellitus (DM) is of great importance in the world in terms of its medical, social, economic significance and leads to loss of working capacity, reduced quality of life, early disability and mortality.

According to the International Diabetes Federation, 537 million people have DM in 2021. Globally, an estimated 45.8% or 174.8 million of all adult diabetes cases remain undiagnosed, ranging from 24.1% to 75.1% according to regional data. An estimated 83.8% of all undiagnosed cases of diabetes mellitus are in low- and middle-income countries.

Modern surgery has many treatment options for diabetic foot syndrome (DFS). Various innovative approaches to treatment have been proposed, the number of highly qualified specialists involved in foot care has increased, modern antibiotics and topical treatments, therapeutic dressings, and X-ray endovascular interventions are available [1]. However, despite all the advances, the number of amputations in diabetes is increasing. Every hour in the world 55 diabetic patients lose a lower limb, and in economically developed countries this figure varies from 13.7 to 32.3 per 100,000 population, which in turn is accompanied by a high mortality rate, treatment and rehabilitation costs [2].

One of the problems of vascular surgery is the treatment of critical lower limb ischaemia in patients with the absence of a perceptual channel, when it is impossible to perform direct reconstructive operations on the main arteries [3]. The number of such patients is increasing, and the results of treatment remain unsatisfactory. The majority of patients undergo high limb amputation [4].

The aim: To evaluate the surgical treatment results using different revascularisation and non-revascularisation therapies in patients with diabetic foot syndrome.

Materials and Methods.

This study was designed as a prospective, controlled clinical trial. A total of 93 patients were operated on at NCJSC SMU University Hospital between 2021 and 2024. Majority of patients were males 62 (66.67%) while females were 31 (33.33%). The mean age was 63.4 years. All patients had narrowing or complete occlusion of the arteries of the lower limbs on the background of decompensated diabetes mellitus, which required surgical intervention.

The inclusion criteria were patients who had signed an information consent to participate in this study, who had stenosis or occlusion of lower limb arteries against the background of decompensated diabetes mellitus and required revascularisation or non-revascularisation surgery.

Exclusion criteria were patients with lower limb arterial lesions not suffering from diabetes mellitus, patients with lower limb arterial lesions on the background of diabetes mellitus not requiring surgical treatment, patients who refused to participate in the study.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and approved by the local ethical committee of the Semey Medical University of Semey (protocol #4 of 20 December, 2021). All patients were given information letters that stated the aim of the study, detailed descriptions of the treatment methods, and how selection into the study groups would be conducted.

Taking into account the elderly age of the patients, presence of diabetes mellitus for many years, we understood the importance of a complete comprehensive examination of these patients before surgical intervention, in this regard, the following methods of research were used: 1. Physical examination of patients; 2. Laboratory diagnostics; 3. USDG of abdominal aorta and arteries of lower limbs; 4. USDG of brachycephalic arteries 5. Video-esophagogastroduodenoscopic examination 6. Electrocardiography; 7. Echocardiogarphy. 8. Review radiography of the chest organs 9. Multispiral computed tomography; 10. Aortoarteriography.

Pre-hospital physical examination of patients was performed to determine the pulsation of lower limb arteries. Pulsation was checked in the projection of the common femoral arteries, hamstring arteries, posterior tibial arteries and the artery of the dorsum of the foot. The fingers and feet were also carefully examined for trophic disorders. After that, patients underwent a full range of laboratory tests on admission: general blood analysis, biochemical blood analysis (blood sugar, urea, creatinine, total cholesterol, HDL-high-density lipoproteins, LDL-low-density lipoproteins, ALT-alaninaminotransferase, AST-aspartateaminotransferase, triglycerides, total protein, alpha-amylase, total bilirubin, direct bilirubin), urinalysis, determination of glycosylated haemoglobin level, coagulogram, blood tests for HIV, hepatitis B and C, Wassermann's reaction, blood group determination.

During instrumental investigations in the preoperative period, the state of other vascular basins - brachycephalic and coronary arteries - was of primary importance. All patients were also examined by specialised specialists as indicated: endocrinologist, nephrologist, cardiologist, neurologist, ophthalmologist, etc. Characteristics of the patients are presented in Table 1.

Table 1. *Characteristics of the patients.*

	Number of patients (n)	**%**
Male gender	62	66,67
Female gender	31	33,33
Average age	63,4 (от 54 до 74)	
Associated pathology: Hypertension Obesity Ischaemic heart disease (history of MI/myocardial revascularisation, angina pectoris) History of acute disorders of cerebral circulation	 93 40 49 24	 100 43,01 52,69 25,81
Late complications of DM Retinopathy Nephropathy Polyneuropathy Ostearthropathy	 57 60 55 4	 61,29 64,52 59,14 4,3
Trophic ulcers of the foot	42	45,16
Ischaemic resting pain	73	78,49

Multispiral computed tomography (MSCT) with contrast and aortoarteriography: are the main methods of arterial basin investigation to determine the exact further tactics of surgical intervention in patients with lower limb arterial lesions. For visualisation of the arteries, the contrast agent Vyhexol was used. Vivexol is a non-ionic dimeric radiopaque contrast agent, which is a water-soluble hexayodinated compound. Its main action is to absorb X-rays due to organically bound iodine, which is delivered to organs and tissues after administration into the bloodstream. A distinctive feature of Vitexol is its low osmolarity even in comparison with other X-ray contrast agents, which contributes to the safety of the procedure. MSCT with contrast is preferable to angiography due to better 3D visualisation of vessels, as well as administration of a lower dose of contrast agent, which can reduce the risks of contrast-induced renal failure. However, when performing possible balloon angioplasty or stenting of lower limb vessels, it is more appropriate to choose X-ray contrast arteriography. It should also be noted that the lesion of the arterial channel in diabetes mellitus is more distal, namely, the popliteal and tibial arteries are affected (Figure 1).

Characterisation of arterial segment lesions according to the results of MSCT and angiography is presented in Table 2.

Allocation into the group of revascularisation or non-revascularisation methods of intervention depended primarily on the results of MSCT or angiography, according to the results of these examinations. If after MSCT we found stenoses or occlusions of lower limb arteries with preservation of arterial patency in the distal channel (tibial arteries), then revascularisation intervention is performed depending on the degree of the affected arteries. However, in case of complete occlusion of the distal segment of the lower limb arteries, revascularisation intervention is not possible. In this case, non-revascularisation interventions such as lumbar sympathectomy or revascularisation osteotrepanation were performed to improve microcirculation.

After complete follow-up examination by MSCT or X-ray contrast angiography, all patients were divided into the following groups:

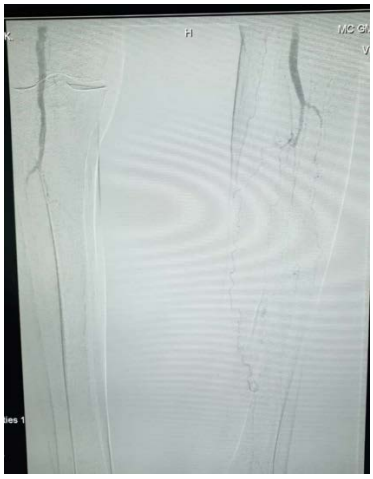

Figure 1. *Arteriography of both lower limbs. The image shows the absence of contrast in the tibial arteries of both lower limbs.*

Table 2. *Characterization of lower limb arterial lesions.*

	Number of patients (n)	**%**
Stenosis/occlusion of the iliac arteries	5	5,38
Stenosis/occlusion of the common femoral artery	5	5,38
Stenosis/occlusion of the superficial femoral artery	15	16,13
Stenosis/occlusion of the deep femoral artery	1	1,08
Stenosis/occlusion of the popliteal artery	42	45,16
Stenosis/occlusion of the arteries of the shin: Anterior tibial artery Posterior tibial artery Fibular artery	 57 73 54	 61,29 78,49 58,06
All three tibial arteries are affected	48	51,61

Table 3. *Revascularisation surgical treatments.*

Type of surgical intervention performed	**Number of patients**	**% (from 45 patients)**	**Complications**
Bifurcation aorto-femoral bypass surgery	5	11,1%	0
Femoral-popliteal bypass	14	31,1%	3
Profundoplasty of the deep femoral artery	1	2,2%	0
Balloon angioplasty of the tibial arteries	24	53,3%	2
Stenting of the superficial femoral artery	1	2,2%	0

1. Revascularisation treatments: 45 patients (of which 5 patients underwent bifurcation aorto-femoral bypass; 14 femoral-pelvic bypass; 1 profundoplasty of the DFA, 24 balloon angioplasty of the tibial arteries, 1 stenting of the superficial femoral artery).

2. Nonvascularisation treatments in 48 patients (of which 43 patients underwent lumbar sympathectomy on the affected side; 5 patients underwent revascularisation osteotrepanation).

Results.

The best treatment results were observed in the revascularisation surgical treatment group. Types of surgical interventions performed in this group are presented in Table 3.

As we can see from Table 3, the largest number of patients (24 patients, 53.3%) underwent balloon angioplasty of the tibial arteries, among which 2 complications were recorded. The complication was the presence of bleeding with the appearance of a false aneurysm of the common femoral artery associated with the patient's failure to observe bed rest after surgery, which led to the loosening of the pressure dressing in the CFA area. Subsequently, this aneurysm was successfully excised with suturing of the CFA defect. Another complication was identified in a 52-year-old man who developed wet gangrene of the foot after balloon arthroplasty, which resulted in a high amputation of the limb. The other 22 patients noted a significant improvement of the condition due to ischaemic pain relief and limb warming. An example of balloon angioplasty is shown in (Figure 2).

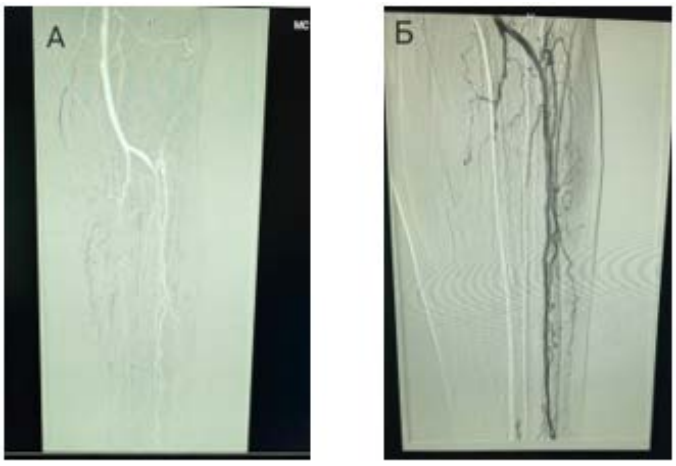

Figure 2. *Results of balloon angioplasty in a 74-year-old woman.*
A - angiography before balloon angioplasty.
B - angiography after balloon angioplasty.

The second in number is the femoral-popliteal bypass (14 patients, 31.1%), in which 3 complications were recorded. Two patients in this group had signs of lymphorrhoea in the postoperative period. One patient had shunt thrombosis on the first day, the patient underwent thrombectomy, and no further complications were observed in the patient. 1 patient aged 65 years had a positive experience of hybrid operation: femoral-popliteal bypass in combination with balloon angioplasty of the posterior tibial artery for trophic disorders (Figure 3).

Other types of interventions such as bifurcation aorto-femoral bypass (5 patients, 11.1%) and stenting of the superficial femoral artery (1 patient, 2.2%) were performed less frequently, and there were no complications. Profundoplasty of the deep femoral artery was also performed in 1 case (2.2%) and there were no complications. It should be noted that patients of each group after surgical treatment received full conservative therapy to maintain the effectiveness of the interventions.

Figure 3. *Patient results after hybrid surgery.*

The results of treatment of the second group, where only non-revascularisation methods of treatment were used, the patients were divided into 2 groups: 1 group of 43 patients who underwent lumbar sympathectomy (LSE) on the affected side. The second group of patients due to the previous history of lumbar sympathectomy, revascularisation osteotrepanation (ROT) was performed. There were no complications in the postoperative period after performing LSE. However, the efficacy compared to revascularisation treatment methods is much lower. The positive result of treatment after LSE was considered to be reduction of pain intensity at rest, pain relief without narcotic analgesics, activation of reparative processes, cleansing and partial epithelialisation of trophic ulcers, and the main thing was reduction of the risk of high amputation of the lower limb. When performing ROT with further application of complex conservative treatment with the use of prostaglandins E1 group drugs, despite subjective assessment of patients' improvement in the first days, in the dynamics there was repeated intensification of ischaemic pain and aggravation of trophic disorders, which led to further amputation of the limb.

In the revascularization treatment group of 45 patients, most showed positive outcomes, especially after balloon angioplasty (24 patients, with 22 showing improvement).

In the non-revascularization treatment group of 48 patients, 43 patients had positive results after lumbar sympathectomy, but the overall effectiveness was lower compared to the first group

Discussion.

Foot lesions in patients with diabetes mellitus are late complications, they occur in 25-80% of patients and in 15% manifest with various ulcerative-necrotic forms, which are often indications for limb amputation [5].

One of the leading factors contributing to the disruption of tissue repair processes is a decrease in arterial blood flow. Against the background of long-term progressive limb ischaemia in patients with diabetic foot syndrome, inflammation is often attached, which tends to a long-term chronic course and recurrence. This leads to depletion of immune defence mechanisms of the organism, increase in the number of microorganisms resistant to the main antibacterial agents. Low immunoreactivity makes it difficult to interpret the results of laboratory indicators of peripheral blood, to assess and predict the course of purulent necrotic changes of the feet [6].

The aim of this study was to evaluate the results of surgical treatment using different revascularisation and non-revascularisation treatment methods in patients with diabetic foot syndrome. The data obtained allow us to compare the efficacy of different approaches and identify the key factors influencing the outcome of treatment. The main direction of correction of arterial limb ischaemia is considered to be the need to restore the main blood flow using reconstructive surgeries. The possibility of performing endovascular correction of chronic occlusive diseases of lower limb arteries is assessed taking into account the localisation, extent and nature of the lesion. Due to the improvement of radiosurgical tools and surgical techniques, the range of minimally invasive interventions is expanding every year [7].

Our results showed that revascularisation techniques such as balloon angioplasty and bypass surgery have higher rates of circulatory improvement and reduced risk of amputation compared with non-revascularisation interventions. However, a significant role in treatment outcomes also belongs to the accurate choice of technique depending on the stage of the disease and associated factors, such as the degree of vascular damage and the presence of infectious processes. According to the results of foreign studies, endovascular revascularisation is characterised by low primary patency compared to bypass surgery, while the number of amputations performed and mortality in the long-term period are comparable and do not depend on the type of intervention [8].

Comparison with previous studies showed that our data are in line with general trends in the surgical treatment of diabetic foot syndrome, where revascularisation often leads to better long-term results. However, much research is currently being conducted in the use of non-revascularisation treatments for diabetic foot syndrome. For example, some scientists claim that the use of tibial ROT, performed repeatedly within 6 to 12 months after the first operation, provides an improvement in the efficacy of complex treatment of patients with purulent-necrotic complications of DFS by reducing the incidence of high amputations of the lower limb [9].

Advantages: The study addresses an important and relevant topic - treatment methods for ischaemic diseases of the lower limbs, which is of great importance for clinical practice. The evaluation of different approaches helps to select the most effective treatment modalities, which may influence clinical practice and improve the outcomes of patients with these diseases. The results of the study open up opportunities for further clinical research, which may aim to improve treatment methods, improve patient rehabilitation, and better understand the mechanisms of complications and their prevention.

Disadvantages: The study does not consider the influence of other factors such as patients' age, comorbidities. The study did not randomise patients into groups due to the use of clear selection criteria depending on the degree of vascular lesions based on MSCT or angiography.

Conclusion.

This study found that revascularisation therapies such as angioplasty and bypass surgery demonstrate higher efficacy rates in the treatment of patients with diabetic foot syndrome compared to non-revascularisation techniques. Revascularisation improves blood flow, reduces the risk of amputations and accelerates wound healing, as evidenced by the low complication rates in the group of patients who received these interventions.

However, despite the clear advantages of revascularisation, the choice of treatment method should be based on individual indications, taking into account the degree of vascular damage, the presence of comorbidities and the general clinical characteristics of the patient. In some cases, for example, in less severe circulatory disorders, non-revascularisation methods may be equally effective and less invasive.

These results emphasise the importance of a comprehensive approach to the treatment of diabetic foot syndrome, where the correct choice of strategy depends on multiple factors, including vascular status, level of infection and other comorbidities. In the future, more research is needed to better understand the indications and contraindications for a particular treatment method depending on the clinical situation.

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Institutional Review Board Statement: The study was conducted in accordance with the guidelines of the Helsinki Declaration and approved by the Ethics Committee of the Semey State Medical University (Protocol 4 of December 20, 2021, Project Identification Code).

Informed Consent Statement: The datasets created and analyzed in the course of this study are available from the relevant author upon reasonable request.

Data Availability Statement: The data is contained in the article.

Conflicts of Interest: The authors declare that there is no conflict of interest.

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