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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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IMPROVEMENT OF LOWER LIMB AMPUTATION PROCEDURE IN PATIENTS WITH CRITICAL LOWER LIMB ISCHAEMIA

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Abstract.

The relevance of the presented topic lies in the rapid growth of complications from diseases that subsequently lead to limb amputation, as well as the problem of untimely detection of ischemic tissues. The aim of the study is to determine and explain the main progressive methods of surgical treatment of obstructive diseases of vessels of different calibers that lead to circulatory disorders and tissue necrosis. The following research methods were used in the work: statistical method, bibliographic, and bibliosemantic. The main indications for lower limb amputation are severe infection, tumor, various types of injuries, gangrene, and limb deformities. In international practice, the most common pathology leading to lower limb amputation is diabetes mellitus and peripheral vascular disease. Critical limb ischemia is the most severe stage of peripheral arterial disease and is characterized by ischemic pain at rest and / or tissue loss. In such patients, the main goal of treatment is to preserve the affected limb. Among some complications that can be successfully treated, only two were noted (which is 9.8% of the total): distal embolization of the peripheral arterial bed and arterial perforation with subsequent bleeding. These conditions significantly worsened the prognosis of the underlying disease. The practical significance of the proposed work can be considered the conclusions that at the first symptoms of lower limb ischemia, one can resort to different types of angioplasty with an improvement in the patient's condition, and in advanced cases it is better to resort to a radical method - amputation, to save the patient's life, in addition, this study brings to science the prospect of creating new methods of limb amputation and new methods of combating ischemia.

Key words. Vascular obliteration, arterial blockage, gangrene, vascular obstruction, diabetic angiopathy, endarteritis.

Abbreviations: WHO: World Health Organisation; ET: Endovascular Treatment; CLI: Critical Limb Ischaemia; PA: Peripheral Arteries; PCDT: Percutaneous Catheter-Directed Thrombolysis; PT: Percutaneous Thromboaspiration; PMT: Percutaneous Mechanical Thrombectomy; DEB: Declarative-Exhibiting Balloon; ABI: Ankle-Brachial Index.

Introduction.

CLI is considered a serious and severe condition in which there is a lack of blood circulation in the limbs. This situation occurs due to blockage of the arteries supplying blood to the lower limbs, usually due to thrombosis or embolism. G. Galyfos describes the main symptoms of ischemia: severe pain, impaired limb function, paralysis or paleness of the limbs [1]. This topic is extremely relevant due to progressive decompensation of ischemic changes in the vessels of the lower limbs. In addition, the relevance increases with a high probability of amputation of the foot or most of the limb in a certain category of people and the associated increased risk of severe complications and an increase in the mortality rate. The presented topic requires further study in connection with the existing complications of classical operations, as well as the emergence of new methods in the diagnosis and treatment of ischemic changes in the lower limb. A. M. Matmurotov notes that while the development of critical ischemia is a manifestation of complete decompensation of blood circulation in the foot and lower leg, amputation in this condition is observed at a rate of 400-1000 per 1 million population annually or in 15-20% of cases among patients with obstructive diseases of the vessels of the lower extremities [2]. According to forecasts of other scientists [3], this frequency will tend to increase by 5-7% in the coming years. More than 200 million people worldwide develop critical ischemia due to the underlying disease of the peripheral arteries of the lower extremities. Thus, people who have diabetes or endarteritis have an increased risk of developing cardiovascular diseases. Peripheral neuropathy and microvascular complications can contribute to the development of foot pathology, which subsequently quickly leads to the need for amputation.

Limb amputation must be recognized as an important surgical measure that involves cutting out or removing a part or the entire limb. This method is used in case of trauma, prolonged compression, surgery or as a result of pathological processes such as infection, gangrene or malignant neoplasms. E. Bonicolini explains [4] that on the one hand, this is a life-saving operation, and on the other hand, it is often accompanied by

various complications. The consequences of damage to the femoral artery and a significant decrease in limb perfusion can be serious. CLI can lead to compartment syndrome, which is a condition when increased pressure in muscle compartments leads to limited blood supply. In severe cases, when such ischemia becomes inevitable, the question of limb amputation may arise. Zh. Kozhakhmetov in his work describes [5] that more than half of the cases of limb amputation are due to peripheral arterial disease and diabetes mellitus, namely: complicated forms. Early postoperative mortality ranges from 4% to 22% after major amputation of any limb for a variety of reasons. Less than two-thirds of patients undergoing below-the-knee amputation achieve successful rehabilitation, while less than half of those undergoing above-the-knee amputation achieve such results. Overall, less than 50% of all patients undergoing amputation are able to regain full mobility.

Treatment of purulent-destructive lesions of the lower extremities (complicated forms of diabetic angiopathy, various forms of gangrene) is a precious, sometimes extremely complex task, requiring significant financial efforts. This process is not always effective and is often accompanied by failure to perform amputation. Statistics provided by A. Nizov and A. Kainazarov indicate [6,7] that such amputations are performed 17-45 times more often than among the general population of patients. These interventions are often modified at the level of the shin and leg, which significantly increases the risk of postoperative mortality to 50% and leads to patient disability. Modern studies by A. Lauria raise doubts about the generally accepted 6-year ischemic threshold for CLI, although there are still differences [8]. Patients suffering from peripheral arterial disease can tolerate prolonged ischemia satisfactorily or well due to the presence of developed collateral circulation.

Thus, the majority of the considered studies on the raised topic of leading scientists cover the issues of mechanisms and causes of occurrence of ischemic changes of lower extremities. But practically not a single study describes complications of amputation and ways of avoiding amputation. In addition, only single sources provide information on the latest improved techniques of operations on vessels in case of ischemia.

The purpose of the article.

To analyze the main aspects of diagnostics and surgical treatment of ischemic changes in small and large caliber vessels. The objective of the work is to substantiate the mechanisms of ischemia of various origins (as a result of atherosclerotic changes, diabetic angiopathy and endarteritis); to describe classical surgical methods of treating vascular ischemia and purulent-necrotic conditions; to characterize the latest methods and techniques of surgical treatment.

Materials and Methods.

To achieve the stated goals, the main methods of literature study were used: bibliographic, bibliosemantic method, statistical, hermeneutics method. The work involved studying and reviewing modern professional international literature on the problem under study. For this purpose, scientometric databases such as Web of Science, Scopus, Google Scholar, PubMed were used for the period of the last 4-6 years (literature from 2019 to 2023 was used). Also, for a broader literature search, other scientometric archives were used, such as Researcher Gate, Elsevier. The research material was the latest scientific literature of a medical nature for the specified period. 245 scientific papers on the given topic were processed. But 47 resources were included in the work, since others did not fit the specified criteria (the presence of other concomitant diseases, the use of other surgical methods of correction, except for amputation, as well as a small number of subjects with ischemia). The object of the study was the ischemia process, the subject of the study were the arteries of the lower extremities. The work is a systematic review of authoritative works on the presented topic. The article analyzes the main scientific information on this topic as a target, including its components, interaction and priority goals. This approach allowed us to understand the problematic topic in its entirety, taking into account not only its individual issues, but also the relationships between them and to give them explanations.

Bibliographic method: The bibliographic method of research is used as a method of collecting and analyzing information, which is based on the studied and analyzed already published sources of information - scientific articles, books, reports, magazines and other documents. This method allowed access to existing data and conclusions made by other researchers.

Bibliosemantic method: The bibliosemantic method is used as a specific method of processing literature to reveal the state of the study of a specific problem or topic, in particular, amputation due to the occurrence of limb ischemia of various origins, as well as to determine possible solutions to the problem based on the analysis of scientific literary and electronic resource sources. This method allowed us to systematize and summarize the information obtained from previous studies and use this data for further understanding of the problem. To write the work, an approach to searching by "title" was used, rather than by "topic" to determine the most suitable research topics. No language restrictions were imposed. To search for scientific information, we used a number of terms, concepts, phrases, and keywords: "ischemia", "occlusion", "obturation", "atherosclerosis", "diabetes mellitus", "microangiopathy", "macroangiopathy", "diabetic angiopathy", "radiography", "angiography", "amputation", "removal", "lower limbs", "surgery", "stump", "foot", "Lisfranc joint", "Chopart joint", "amputation within the foot", "obliterating vascular diseases", "recovery", "prevention", "rehabilitation", "abscess", "abscess", "purulent-necrotic changes", "necrosis", "gangrene", "wet gangrene", "dry gangrene".

Statistical research method: The statistical research method was used in two interrelated directions for the analysis of digital data and for monitoring the numerical data of the study, as well as a general idea of the breadth and variation of the spread of complications of atherosclerosis of the lower extremities, diabetic angiopathy and endarteritis, as well as ischemic changes in the population as a whole. Statistical data among the population of the whole world regarding the prevalence of vascular ischemia were taken into account, special attention is paid to statistical data of Kazakhstan and data presented by WHO. The illuminated statistical information allows us to

analyze the probable causes and mechanisms of a sharp increase in the incidence of ischemic changes, as well as to analyze the main features of amputations of the lower extremities and their complications.

Results.

In the course of the work, 245 modern literary sources with the query ischemia were analyzed. The conditions for inclusion in the review of sources were the following: mention of limb ischemia (left or right), the cause of ischemic changes - atherosclerosis, diabetes mellitus with complications (macro- or microangiopathy) and endarteritis, different age categories, indications for amputation. Of the 245 sources, only 47 were taken into account in the study, the rest were rejected due to the presence of other concomitant diseases, which can give a significant error in the study, another reason for non-inclusion was the use of other surgical correction methods other than amputation. Table 1 shows that the time range for searching for sources with the term "ischemia" was from 2019 to 2023. Each of the sources describes all groups of patients with ischemic changes in the limbs (100%). The side of the lesion (right-sidedness or left-sidedness) was taken into account: 26 sources mention right-sided lesion of the limbs, and 21 cases - left-sided. In 29 sources, it is described that in patients with ischemia, the cause was atherosclerosis of the arteries, in 12 - diabetes mellitus (namely, diabetic angiopathy), and the remaining cases - progressive endarteritis. Of the 47 sources considered, amputation was performed in patients in 40 sources. In others (7 cases), gentle conservative treatment methods were used, which indicates that the form of ischemia was not complicated.

Treatment of CLI is complex and extremely important, and timely diagnosis and treatment are critical, the latter may lead to irreparable tissue damage. Peripheral arterial disease affects more than 230 million people worldwide, with its prevalence among people over 70 years of age being about 15%. Even with such a high incidence, this condition is still underdiagnosed. Atherosclerosis is the most common causative factor affecting the endothelium due to lipid accumulation, cholesterol plaque formation, and slight activation of the inflammatory cascade. This occurs before systemic involvement with symptomatic or asymptomatic coronary or cerebrovascular artery disease in about 70% of patients [9]. The incidence of CLI is gradually decreasing due to improved treatment and prevention techniques. However, mortality during the first year remains at a level of approximately 40% [10], which indicates insufficient awareness of people about their condition and late seeking help at a medical institution. In the literature, authors characterize a number of causes of ischemia and, as a consequence, amputations (Table 2).

The problem of ischemic changes in the lower extremities has been studied by many medical scientists. Thus, in his work M. Muller indicates that patients with minor amputations demonstrate higher levels of physical functioning ($p<0.001$). At the same time, these same patients experience more pronounced pain syndrome ($p<0.001$) [11]. With the help of a report and systematic examination of patients, the cause of acute CLI was discovered.

The degree of CLI is determined in accordance with the Rutherford classification [12], presented in the study of P. Harnarayan (Table 3).

Improved treatment methods for atherosclerotic CLI.

Recently, in addition to complex limb amputation surgery, ET methods have been used. The main goal of ET is to restore blood supply to the affected limb as quickly as possible using medications and/or mechanical devices. This type of therapy includes procedures such as PCDT, PT with or without thrombolytic therapy, and PMT [13]. The use of these methods is aimed at effective treatment and improvement of blood supply, providing a fast and effective therapeutic effect.

The AngioJetTM system is a pharmacomechanical device for thrombectomy using a rheolytic approach. According to Y. Ata [14], the SOLENT platform and the AngioJetTM Ultra device have been approved for the treatment of acute occlusive diseases of the peripheral arteries of the upper and lower extremities in vessels with a diameter of ≥1.5 mm. This confirmed the recognition of this device as effective and safe in the treatment of important vascular pathologies. The AngioJet system consists of three main units: a disposable catheter, pumping equipment, and a reusable drive [15]. The disposable catheter is a sterile wire channel with two lumens.

Several studies have demonstrated the efficacy of the AngioJet system in the treatment of orthopedic surgical interventions accompanied by occlusion [16,17]. It is noted that the catheter used in the system aspirates a significant portion of the thrombus along with orthopedic lymphatic vessel abnormalities and grafts. Data from a multicenter registry [18], including 99 cases with implemented rheolytic thrombectomy, indicate a 70% significance or complete revascularization (residual defect is less than 50%) and less than 5% in-hospital and 30-day limb-related mortality. In addition, the primary patency rates in this study were 74% at 3 months and 69% at 1 year, respectively.

Another new device is the Rotarex S, a highly effective endovascular device specifically designed for rotational and mechanical thromboembolectomy, intended for the treatment of various forms of arterial occlusion, from acute ischemia to CLI. The key feature of the device is its catheter, which has a display range of revolutions - from 40,000 to 60,000 revolutions per minute [19]. This makes it possible to direct and transport thrombotic material to the boundaries of the patient's vascular lumen, which facilitates effective treatment of the affected arteries.

Aspiration thrombectomy is a promising alternative for removing blood clots in people with peripheral arterial occlusive disease. It is particularly useful for those at high risk of bleeding or heart attack when thrombolysis is not an option, such as those with a history of recent surgery, trauma, or neurovascular compromise due to these conditions.

The technique allows for the restoration of normal blood flow in just a few minutes compared to the lengthy process of thrombolysis, which can take several hours [20]. One of the key advantages of this technique is the reduced risk of hemolysis in the case of a disease with rheolytic thrombectomy, making associated thrombectomy significantly safer and more acceptable to use.

Table 1. *Range of the examined modern literature in the time spectrum for the detected lower limb ischaemia in accordance with the causes and treatment.*

Author (study in patient groups)	Year of publication	Detection of disease	Side included in the pathological process	Cause of ischaemia	Performance of amputation
Markatos	2019	+	right side	atherosclerosis	+
Mitish	2019	+	left side	atherosclerosis	+
Bonicolini	2019	+	right side	endarteritis	+
Phair	2019	+	right side	atherosclerosis	+
Nizov	2020	+	right side	diabetes	+
Fluck	2020	+	right side	atherosclerosis	+
Le Hello	2020	+	left side	diabetes	+
Zhang	2020	+	left side	atherosclerosis	-
Lin	2020	+	right side	atherosclerosis	+
Barnes	2020	+	left side	atherosclerosis	+
Ariza Ordoñez	2020	+	left side	endarteritis	-
Mustapha	2020	+	right side	atherosclerosis	+
Levin	2020	+	right side	atherosclerosis	+
Khan	2020	+	right side	diabetes	+
Kalbaugh	2020	+	left side	atherosclerosis	+
Dettori	2020	+	right side	atherosclerosis	-
Traven	2020	+	left side	diabetes	+
Khokhlova	2021	+	left side	diabetes	+
Muller	2021	+	left side	atherosclerosis	+
Harnarayan	2021	+	right side	atherosclerosis	+
Ata	2021	+	right side	atherosclerosis	-
Mendes-Pinto	2021	+	right side	endarteritis	+
Hammad	2021	+	left side	atherosclerosis	+
Armstrong	2021	+	left side	diabetes	+
Armstrong	2021	+	right side	diabetes	+
Weissler	2021	+	left side	atherosclerosis	+
Potseluyev	2021	+	left side	endarteritis	+
Nayar	2022	+	left side	atherosclerosis	+
Anderson	2022	+	left side	atherosclerosis	+
Kozhakhmetov	2022	+	right side	atherosclerosis	+
Matmurotov	2022	+	right side	diabetes	+
Mantilla Ibañez	2022	+	right side	atherosclerosis	-
Karimi	2022	+	left side	atherosclerosis	+
Lozano Navarro	2022	+	left side	endarteritis	-
Popplewell	2022	+	right side	endarteritis	+
Czerniecki	2022	+	right side	atherosclerosis	+
Provance	2022	+	right side	atherosclerosis	+
Shamir	2022	+	right side	diabetes	+
Lauria	2023	+	right side	diabetes	+
Galyfos	2023	+	left side	atherosclerosis	+
Isernia	2023	+	right side	atherosclerosis	+
Shishehbor	2023	+	left side	atherosclerosis	+
Wang	2023	+	right side	atherosclerosis	+
Monaro	2023	+	right side	diabetes	+
Wahood	2023	+	right side	diabetes	+
Habr	2023	+	left side	atherosclerosis	+
Makowski	2023	+	left side	atherosclerosis	-

Currently, three different devices are available that use an identical mechanism to perform aspiration thrombectomy. Two of them use the Aspirex thrombectomy system from Straub Medical AG and the ThromCat XT aspiration system from Spectranetics International [21]. Both of these devices differ in that they use a rotary mechanism to dislodge the thrombus in the ischemic vessel.

According to L. Zhang [22], the Indigo or Penumbra system was originally developed for the treatment of acute ischemic stroke, which resulted in the emergence of unique properties,

Table 2. *Main provisions on the causes of ischaemia, which have been studied by researchers.*

Author	Reason for the amputation	Characteristics
Markatos	Atherosclerosis	Atherosclerosis is a chronic disease of the elastic and musculoskeletal arteries, which occurs due to a violation of lipid metabolism and is accompanied by the deposition of cholesterol and certain lipoprotein fractions in the intima of blood vessels.
Nizov	Diabetic angiopathy	Diabetic angiopathy is a complication of diabetes mellitus, manifested in damage to all blood vessels in the human body, but mainly small arteries are affected.
Popplewell	Endarteritis	Endarteritis is a disease that affects the arteries, leads to clogging of their lumen and disruption of the circulatory process. Pathology is often accompanied by the development of gangrene. The vessels of the legs are most often affected by endarteritis.

Table 3. *Rutherford's classification.*

Stage	Forecast	Conclusion		Doppler signal	
		Reduced sensitivity	Motor deficit	Arterial	Venous
1	The limb is viable, there is no immediate threat	None	None	Detected	Detected
2a	The viability of the limb is at risk, it can be saved if treatment is started quickly	Minimum (fingers)	None	It is often not detected	Detected
2b	The viability of the limb is at risk, it can be saved if revascularisation is started immediately	Not just the fingers, the pain is at rest	Light or moderate	Not detected	Detected
3	Irreversible limb damage, significant tissue necrosis or irreversible unavoidable nerve damage	Deep anaesthesia	Paralysis (immobile limb)	Not detected	Not detected

making it particularly favorable for this area of medicine. One of these features is the possible smooth atraumatic tip, which helps to minimize tissue damage during surgical manipulation. The combination of this factor, along with noticeable traceability and effective pressure suction makes the Indigo/Penumbra system very effective for working with thrombus work in the vascular system.

In the study group of 20 patients (19.6%), blood flow of varying quality was successfully restored after angioplasty. In these cases, occlusion of the popliteal artery branches without formed collateral blood flow was detected, in addition to occlusion of the distal femoral artery and popliteal artery. During the next 12 months of observation, no negative events such as death, myocardial infarction, stroke or limb amputation were recorded in all 48 cases. That is, this can be regarded as a satisfactory state of lower limb perfusion, not accompanied by signs of critical ischemia. Only 1 patient (2.1%) noted pain at rest, and 7 (14.6%) had temporary claudication. In 13 families (27.1%, excluding those who died or had limbs amputated), where duplex sonography showed residual ischemia, there were signs of occlusion or severe stenosis of target arteries. The authors' conclusions showed [23-25], that the short- and medium-term effect of treating the disease with critical arterial ischemia of the lower extremities in the femoropopliteal segment is a safe and effective method of restoring blood flow.

Features of amputation in diabetic angiopathy.

Amputation of the lower limbs in people with diabetes is a rather serious consequence of complications of this disease. According to the study by C. Lin [26], complicated forms of diabetes cause damage to the nerves (neuropathy) and blood vessels (angiopathy), especially in the lower limbs. Such complications sharply reduce sensitivity and blood supply, which can lead to the penetration of viruses, infections, and tissue necrosis. Amputation in diabetic angiopathy has its own characteristics due to the specific complications that occur in connection with this disease. The main important points of amputation in diabetes include: the need to remove purulent-necrotic tissue (in case of spread of infection or tissue necrosis, repeated removal of part of the leg may occur, and not just a single amputation); the difficulty of healing a necrotic wound before surgery and after amputation (patients with diabetes mellitus have a reduced ability of tissue to heal due to a significant reduction in blood supply and immunological problems). This can lead to a number of complications in the healing process after amputation. In addition, there is a high risk of recurrent infection. After amputation, especially if proper wound treatment and care are not observed, infection and necrosis can be provoked again. Amputation in diabetes mellitus can be performed at different levels of the legs. There are several levels of lower limb amputation in diabetic angiopathy: at the level of the digital phalanx. If a small tissue defect is noted that is not amenable to treatment and threatens infection, the surgeon performs amputation of the digital phalanges. Another type of surgical care is A at the level of the foot: if the lesion extends, it is necessary to perform A of part or the entire foot. This may include removal of the forefoot or along the midfoot. A separate type of A is the level of the lower third of the leg: in case of more serious damage, A is performed at the level of the lower third of the leg, in extremely complex situations the operation is performed above the knee bend (transtibial amputation).

Amputation for diabetic foot and amputation performed due to atherosclerotic complications differ in several aspects: in diabetes mellitus, amputation is often performed due to complications of the disease, such as infections, viruses or tissue necrosis, which leads to damage to blood vessels and nerves (diabetic neuropathy). J. Barnes [27] notes in his work that in the case of atherosclerosis, the cause of the problem is impaired blood circulation due to atherosclerotic seals in the arteries. Amputation is performed when the circulatory disorder becomes so severe that it is necessary to remove the affected tissue.

As for diabetic angiopathy, most amputations are performed on the lower extremities, for example, fingers or parts of the foot, and then the process moves up to higher parts of the leg depending on the severity of the disease. Amputation caused by progressive atherosclerosis is often performed at a level where the blood supply is seriously damaged by atherosclerotic seals. This is often higher than in the case of diabetic amputation.

Features of amputation in case of endarteritis.

Obliterating endarteritis is a specific disease affecting the walls of arteries and capillaries, mainly in the legs. The symptoms of this disease, similar to those of atherosclerosis, cause in both cases compression or narrowing of the lumen of the vessels, which can cause ischemia (insufficient blood supply) in the extremities. However, according to N. Ariza Ordoñez [28], obliterating endarteritis and atherosclerosis have different mechanisms of development and differences in their inflammatory processes. In the case of obliterating endarteritis, the inflammatory process occurs due to damage to the vessel walls as a result of an autoimmune reaction. This can cause damage to the vessel walls, an increase in their thickness and remodelling of the normal wall tissue, which leads to narrowing or blockage of the normal blood supply. In contrast, atherosclerosis is caused by the formation of cholesterol plaques on the walls of blood vessels, which narrows the lumen and can lead to the formation of blood clots or ulcers. Therefore, amputation becomes necessary in the case of complex forms of endarteritis, when the circulatory disorder is so severe that it leads to progressive tissue necrosis. The complexity of amputation in endarteritis occurs in the following cases: if endarteritis develops in the lower extremities, especially in the feet, tissue ischemia may occur, which can make the amputation procedure extremely difficult due to a decrease in overall health. If endarteritis has led to extensive damage to bones or a complex of bones and tissues, amputation may be more radical and complex. In addition, people with endarteritis may have a reduced ability to heal wounds due to impaired blood supply. This fact can complicate the amputation process and the postoperative period. Given the sharp decrease in blood circulation and the general condition of the patient, preparation for amputation may take longer to ensure optimal conditions for surgery and subsequent recovery. These factors make the amputation procedure more complex in the case of endarteritis, requiring a more careful and individual approach to treatment in order to minimize risks and promote successful recovery of the patient after surgery. Amputation in endarteritis often concerns those parts of the body that are affected by the inflammatory process.

The prognosis after amputation both in endarteritis and in diabetic angiopathy and atherosclerosis may depend on the degree of development of the inflammatory process and remote lesions. After surgery, it is important to provide the patient with comprehensive rehabilitation to restore functions and quality of life.

Lower limb amputation is performed primarily to relieve acute and chronic limb ischemia caused by vascular disease, poorly controlled diabetes, or sometimes infection. Atherosclerosis is the main cause of chronic arterial ischemia and the most common reason for amputation. There are various amputation typing methods, such as circular, single- and double-flap, and situational. The use of circular amputations is relatively rare, due to the fact that this method does not ensure the formation of a normal stump, significantly complicating the subsequent stage of postoperative treatment and recovery. In general, amputations with the formation of stumps in a circle cause significantly more problems with subsequent prosthetics. Therefore, this method is used only in cases of gas gangrene, some other infectious lesions, and as an emergency measure. The flap method is used during planned operations, allowing you to close the cut with a flap or several flaps of the patient's skin and thereby suture the stump. This method of suturing significantly simplifies the subsequent process of recovery and prosthetics, as it eliminates the formation of an open wound at the amputation site, which usually requires long-term and careful care. Situational amputation is used in traumatic injuries, when the surgeon has to improvise in a sense, working with what is left after an injury received, for example, in a traffic accident or other emergency circumstances. In particular, in hand amputations, the fascioplastic method is preferable. In this case, the flap includes fascia - connective tissue covering the muscles, as well as subcutaneous tissue and skin. This method allows the surgeon to more accurately form the stump, which is of great importance for subsequent prosthetics. The myoplastic method involves suturing muscles and forming stumps from them. However, the muscles in this area gradually turn into connective tissue. This is why this method is not optimal for hand prosthetics. At the same time, in the case of lower limb amputations, this method may be more suitable for subsequent prosthetics.

Discussion.

The global prevalence of peripheral arterial disease increased by more than 23.5% from 2000 to 2010 (from 164 to 202 million people), indicating a global pandemic of peripheral arterial disease. And this situation is becoming increasingly complex each year. Moreover, these percentages often underestimate the true burden of disease because they are derived from studies in populations where peripheral arterial disease is defined based on a decreased ABI [29]. CLI is a serious condition that affects the outcome of atherosclerosis, a disease that affects the arteries and restricts blood flow to the extremities. This situation can occur even with minimal exertion and rest, causing pain, and can further lead to tissue loss due to malnutrition. CLI is associated with an increased risk of limb amputation due to severe tissue damage and decreased quality of life. Moreover, it significantly increases the risk of developing cardiovascular complications, which can lead to death.

According to S. Levin [30], consideration of primary amputation below or above the knee is observed in the context of care for those at high risk of perioperative mortality. This may include a situation where diseases are concomitant, seriously limiting the quality of life or when an incurable disease is present. Peripheral arterial disease is a common problem that is observed due to the restriction of the arteries that feed the lower extremities and other areas of the body. Often this condition is caused by the formation of atherosclerotic plaques (deposit of lipocytes in the lumen of the vessel) or thrombi that reduce

or block blood flow through the arteries, leading to significant ischemia (insufficient blood supply) to the tissue. This condition can lead to pain during walking, loss of sensitivity, heaviness in the legs and complications that can lead to severe tissue damage and, in case of exacerbation, even to the threat of amputation. In the work of S. Levin and the presented study, the conclusions about the tactics of diagnosis and treatment of ischemic changes in the extremities are common. That is, it is noted that treatment should be started immediately after the diagnosis of ischemia. In addition, the combined use of vascular visualization using duplex ultrasonography to determine the location and degree of arterial stenosis. A distinctive feature of the author's work and this study is that S. Levin focuses more on drug treatment and the use of alternative therapy. Data are provided that if revascularization is impossible or has not brought results, but the limb is still viable, then alternative treatments can be used instead of amputation. Hyperbaric oxygen therapy is proposed, during which patients inhale oxygen into a compression chamber to increase oxygen supply to ischemic tissue in order to promote wound healing. Treatment may include drug therapy, vascular lumen restoration procedures, or in some cases, surgical interventions [31]. Today, endovascular surgery, open surgery, and combined operations are the three main vascular surgical methods used to treat peripheral arterial disease.

In adult patients, placement and fixation of the prosthesis in the vessel is difficult, which increases with proximity to the amputation site. Graded amputation is characterized by higher success rates, lower perioperative mortality, and lower 30-day mortality. Peripheral arterial disease is a major health problem that affects more than 202 million people worldwide, accounting for 70% of cases in developing countries. The overall prevalence of this disease ranges from 3% to 18% and increases with age, with a 20% higher prevalence in adults over 70 years of age [32]. Occlusive ischemia is due to insufficient perfusion caused by progressive stenosis of the arterial lumen, interrupting the anterograde flow of the major systemic arteries. In almost 90% of cases, the etiology of such ischemia is atherosclerosis, and in some cases, it can lead to chronic occlusion, which is a serious complication.

Lower limb amputation due to ischemia is a serious surgical intervention that is actually performed when the blood supply to the limbs becomes insufficient due to prolonged ischemia. Ischemia is a condition in which the volume of tissue blood supply is significantly reduced or stopped, which can lead to tissue necrosis and a threat to life. Amputation due to limb ischemia is aimed at eliminating the source of necrosis and infection, as well as improving the patient's quality of life after surgery. According to M. Popplewell [33], the procedure requires removing the affected areas of the legs to prevent the spread of infection and preserve other parts of the body. Before amputation, doctors carefully assess the patient's condition, taking into account his health, the possibility of rehabilitation after surgery and other factors. After removing damaged tissue, it is necessary to ensure effective rehabilitation, which includes physiotherapy and teaching patients to use prostheses to restore limb mobility. If lower limb ischemia is acute, the condition becomes a serious threat to life. Damaged collateral arteries cannot develop quickly to compensate for the drop in perfusion. The incidence of acute lower limb ischemia is approximately 1.5 cases per 10,000 people per year. Even with early revascularization of this pathology, 30-day mortality still remains at the level of 10-15%. Embolic causes associated with acute limb perfusion impairment include cardiac embolism, aortic embolism, graft thrombosis, ergotism, hypercoagulability, paradoxical embolism, as well as iatrogenic complications associated with endovascular procedures, as well as the usual in the presence of atherosclerotic plaques. A distinctive feature of the work of J. Czerniecki [34] is that the author determined the annual risk of contralateral amputation in patients with ischemic changes associated with the level of occurrence of the amputation incident. While in this study the annual risk was not determined at all, and contralateral amputation was not taken into account. What both studies have in common is the examination of the lower extremities when ischemic changes in the arteries occur. In addition, both studies confirm the risk categories of people - with the presence of diabetic angiopathy, endarteritis or atherosclerosis.

Other studies have also focused on amputations due to ischemic changes. In turn, the distinctive feature of the study by S. Kalbaugh [35] is that it includes a whole range of indications for amputation and is not limited to ischemia. Surgical indications for major amputation were classified as chronic ischemia, acute limb ischemia, infection, oncology, trauma, other indications, or any combination of these indications. What is common in the presented studies is that it is noted that diabetes mellitus is often a provocateur of the creation of conditions for ischemia of small and minor vessels of the lower extremities.

The latest development of specialized devices has opened up new horizons for the treatment of patients with acute limb ischemia, creating more effective minimally invasive therapies. This allows overcoming the limitations of open surgery and intravascular thrombolysis, which have long been considered the only viable alternative for the treatment of such conditions [36,37]. Although the choice among a wide range of different devices may seem clearly daunting, each of these devices has its own unique features, manifestations, as well as a list of advantages and disadvantages. In the work of P. Dettori [38], what is distinctive is that the scientist conducted a study of the role of the index of the number of blood cells of systemic inflammation in the occurrence of the risk of ischemia and, as a consequence, the result of amputations. The author clinically proved that there is a correlation between the described processes. That is, the more groups of such inflammatory cells are observed, the greater the likelihood of ischemia of various origins in the arteries of the lower extremities. What the studies have in common is that both studies offer only surgical (interventional) treatment of the ischemic condition and life preservation, while drug treatment does not deserve exclusive attention.

Revascularization procedures may be effective in preserving the affected lower limb, but they do not always improve long-term tissue perfusion. There is also a significant risk of amputation after revascularization. In addition, the majority of the population may not be able to undergo surgery due to age-related incompetence and the presence of comorbidities.

Previous studies by J. Provance [39] have found significant variations in the incidence of disease and complications in families used by the Medicare program and in which peripheral artery surgeries are performed. These variations have a significant impact on sites and topographic localization, indicating that increased intensity of vascular treatment is associated with a decrease in the incidence of lower limb amputations. Based on the data [39] presented in the work, it was found that the amputation reserve rates are 3%, which is slightly modified by comparing previous values - from 2% to 6%. This figure is below the proposed objective effectiveness threshold for assessing peripheral procedures, which is 3%, but it should be noted that more than four dozen sites studied in the study under consideration had rates above this threshold, making them particularly prominent.

In turn, the aim of the study by J. Phair [40] was to evaluate the effectiveness of paclitaxel-coated stents and paclitaxel-coated balloons in terms of amputation-free survival in patients with CLI. The use of a paclitaxel-coated stent for CLI is also associated with a significant improvement in wound healing compared to a drug-coated balloon without coating. The final results of the scientist indicated the effectiveness of using such coated balloons.

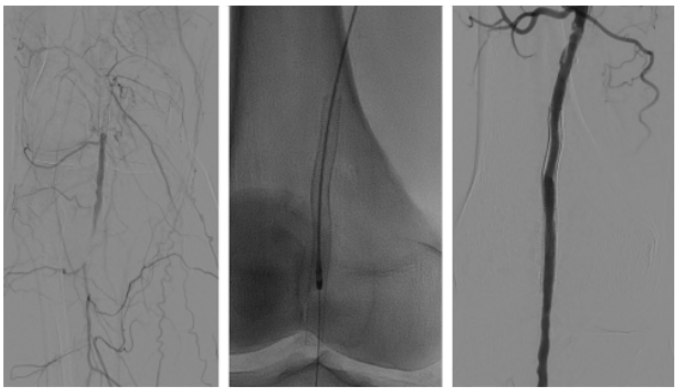

Figure 1. *Effective treatment of affected arteries: a) visualization of subtraction angiography performed on a patient with acute occlusion of the popliteal artery; b) Rotarex 6 Fr intrastent passage; c) condition after the manipulation.*

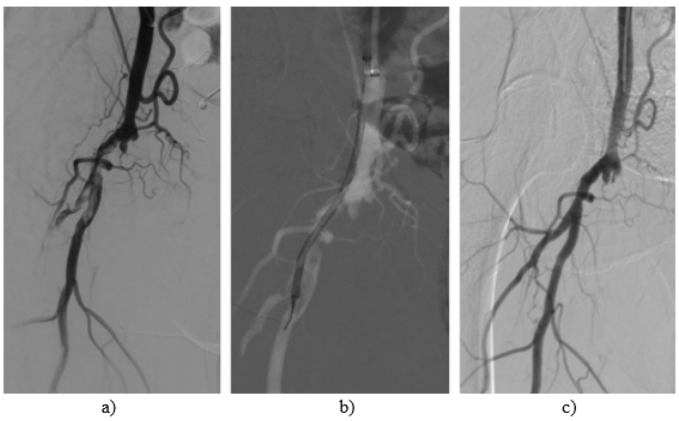

Figure 2. *Removal of blood clots in people with obliterating PA diseases: a) visualization of subtraction angiography performed by a patient with chronic occlusion of the femoral-popliteal canal in the space of a deep artery; b) use of Indigo 8 Fr; c) the final result of the procedure.*

K. Markatos points out [41] that from the time of Hippocrates to the present day, the surgical approach to amputation has remained almost unchanged. However, significant changes in the indications for amputation should be noted, especially in the case of diabetes mellitus and serious diseases of the peripheral arteries. Changes in medical practice have led to a more precise definition of the amputation process and have helped to improve this operation.

The development and implementation of new industry methods for the prevention, diagnosis and treatment of CLI is becoming a strict requirement and the main purpose in vascular surgery. CLI remains a key indication for the reconstruction of the arterial bed. This is due to the fact that the restoration of the main blood flow can not only stop the process of amputation, but also significantly improve the patient's quality of life.

In view of the importance of the problem, the global CLI society is actively considering the following recommendations aimed at reducing the incidence of primary amputation in the average population of patients with CLI [42]. This will contribute to improving clinical outcomes for deprivation and reducing social burden. Primary amputation is considered as a last resort when other therapeutic options have been exhausted or when there are important reasons for ongoing intervention. A generally accepted approach aimed at restoring blood circulation and treating pathological complications can reduce the need for such a radical intervention as A [43]. Peripheral arterial disease is a serious risk for CLI, which can lead to the need for amputation. This is a rather difficult decision, and after taking such a step, amputation procedures are often performed through other emergency surgeries. N. Habr [44] describes a patient with cold extremities, damage and tension, such signs can be manifestations of limited blood circulation, and spots and cyanotic coloration can indicate deterioration of tissue oxygen supply.

Despite the development of modern technologies, the question of the relevance of limb amputation still arises. There are many variations of lower limb amputation surgeries: foot amputation (amputation of the phalanx or disarticulation of the metatarsophalangeal joint), transmetatarsal amputation of the middle and back of the foot (transmetatarsal (according to Lisfranc, mid-tarsal according to Chopart), disarticulation of the ankle joint according to Syme); transtibial amputation below the knee joint, transfemoral amputation above the knee joint [45,46]. Each of the listed types of surgeries has a number of advantages and disadvantages. Thus, according to D. Potseluev, the described amputation process includes measuring and marking the lines passing through the tibia and fibula [47]. In this case, the surgeon cuts the skin and demonstrates the cutting of nerves and blood vessels and also produces flaps. All this is done with the provision of adequate amputation of the limb part. In addition, for to minimize the risk of neuropathic pain, nerves are cut under tension so that their ends are retracted into the tissue beyond the cut end to heal. This can help reduce the risk of developing pain in the areas where the surgery was performed. The tibia amputation procedure involves using an oscillating saw to cut away the bone. This procedure leaves approximately

12-17 cm of bone. The tibia is usually bevelled at approximately 45° to remove the sharp front edge, the fibula, which will be 1-2 cm shorter than the tibia in the perpendicular axis.

Below-the-knee amputation may be required in patients with advanced critical limb ischemia or diabetic sepsis of the foot who have no other treatment options. There is no consensus on which surgical technique provides the greatest rehabilitation potential.

Conclusion.

Therefore, lower limb ischemia is a serious condition that occurs due to insufficient blood supply to the entire leg or foot. Lower limb ischemia is an emergency condition, and it is important to respond promptly to prevent further tissue damage and avoid complications. Lower limb amputation is an extreme measure that is intended to remove parts of tissue or limbs due to serious damage such as ischemia. The decision to amputate lower limb ischemia should occur when other treatment methods are ineffective, there is a risk of infection spreading, or there is a threat to the patient's life due to uncontrolled ischemic process. It is important to consider amputation as a last resort after all possible conservative and surgical treatment attempts.

Improvement of amputations in lower limb ischemia includes development of new methods and technologies aimed at improving surgical results, reducing complications and improving quality of life. Development of minimally invasive amputation methods, such as endoscopic amputation or surgical systems, can help reduce surgical trauma, reduce the number of complications and accelerate the process of regeneration and rehabilitation. The approach to amputation and subsequent rehabilitation is determined regardless of the cause in combination with careful selection of a prosthesis, and this can contribute to improving patient mobility. In severe forms of critical lower limb ischemia, there is a need for highly effective treatment methods. Survival after limb amputation contains many factors, including the cause of amputation, the general health of the patient, the quality of medical care and postoperative rehabilitation.

Therefore, each case of ischemia is unique, and the treatment approach must be individualized. Integration of various methods, such as drug therapy, surgical interventions and rehabilitation, can be very effective. If amputation becomes necessary, it is important to focus maximum efforts on preserving the patient's functionality and quality of life after surgery. The development and program of rehabilitation significantly improves the expected results. Proactive measures to prevent ischemia, such as control of risk factors (e.g. diabetes, arterial hypertension), can help to prevent the need for amputation.

Thus, ischemia and amputation of limbs are serious mutually complementary processes that require complex and individualized treatment with the best results for the patient. In addition, despite a wide range of surgical technologies, some problems, such as timely detection of lower limb ischemia and complications of operations, have only been partially solved. For better study and prevention of unpredictable complications, the presented problem requires further detailed research.

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