GEORGIAN MEDICAL NEWS

ISSN 1512-0112

NO 12 (357) Декабрь 2024

ТБИЛИСИ - NEW YORK

ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

Monthly Georgia-US joint scientific journal published both in electronic and paper formats of the Agency of Medical Information of the Georgian Association of Business Press. Published since 1994. Distributed in NIS, EU and USA.

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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Содержание:

GEORGIAN MEDICAL NEWS
No 12 (357) 2024

FEATURES OF THE POSTOPERATIVE COURSE IN PATIENTS WITH DIABETIC FOOT SYNDROME AND SYSTOLIC MYOCARDIAL DYSFUNCTION AFTER LOWER LIMB AMPUTATION

Levytska O.V, Dubivska S. S*.

Kharkiv National Medical University, Kharkiv, Ukraine, Kyiv City Clinical Hospital #1, Kyiv, Ukraine.

Abstract.

Background: Diabetic foot syndrome is a serious complication of diabetes mellitus, often requiring amputations and associated with high mortality. In patients with diabetic foot syndrome and systolic myocardial dysfunction on the background of obesity, surgical treatment is complicated by systemic inflammation, circulatory disorders and tissue perfusion.

Objective: To evaluate the effect of optimizing systolic cardiac function on the postoperative period in patients with diabetic foot syndrome and systolic left ventricular dysfunction in lower limb amputations above and below the knee.

Materials and methods: The study included 38 patients with type 2 diabetes mellitus, obesity (BMI >30 kg/m2) and systolic myocardial dysfunction (EF <50%). All patients underwent lower limb amputation (25 at the hip level, 13 at below the knee level). Patients were divided into 2 groups: control (n=20), which received standard therapy, and main (n=18), where hyperosmolar solutions and inotropic therapy were additionally used.

Results: 72 hours after surgery, patients in the main group showed a significant improvement in hemodynamic and metabolic parameters. The mean blood pressure in the main group was 75±12 mm Hg vs. 62±7.1 mm Hg in the control group. The number of patients who required vasopressor infusion after 72 hours was lower in the main group (11% vs. 40% of patients). The dynamics of blood lactate levels ranged from 3.7±0.4 to 2.9±0.5 mmol/l in patients in the control group and from 3.5±0.08 mmol/l to 1.5±0.2 mmol/l in the main group. Acute kidney injury and wound complications in patients of the main group were observed three times less often (22% vs. 60% and 22% vs. 65%, respectively) ($p<0.05$).

Conclusions: Optimization of myocardial systolic function through the use of hyperosmolar solutions and inotropic therapy effectively reduces the risk of complications and mortality in patients with diabetic foot ulcers and systolic myocardial dysfunction.

Key words. Diabetic foot syndrome, obesity, systolic dysfunction, hyperosmolar solutions, lower limb amputations.

Introduction.

Obesity and diabetes are risk factors for high morbidity and mortality from heart failure, and the clinical course of heart failure itself is significantly more severe in patients with diabetes than in those without diabetes. Among the pathogenetic mechanisms of the development of diabetic cardiomyopathy, systemic insulin resistance, hyperglycemia, impaired cardiac insulin metabolic signaling and systemic inflammation are distinguished. Systemic inflammation is a key pathophysiological mechanism for the development of complications in type 2 diabetes mellitus, including cardiovascular diseases. Inflammatory mediators cause structural and metabolic changes, including damage to the vascular endothelium, cardiomyocyte apoptosis, myocardial hypertrophy and fibrosis with subsequent dilation of the heart chambers, which leads to clinical manifestations of diabetic cardiomyopathy [1-12]. The presence of left ventricular systolic dysfunction in a patient against the background of obesity and diabetes mellitus creates special conditions for blood supply, organ function and wound healing. Systolic myocardial dysfunction is the essence and reflection of the severity of the course of systemic inflammation and a manifestation of the depth of damage to the regulatory functions of the body. Therefore, the algorithm of intensive therapy in the perioperative period in patients with diabetic foot syndrome (DFS) needs to be improved, considering the manifestations of systemic inflammation.

Objective. To assess the impact of optimizing systolic cardiac function on the course of the postoperative period in patients with DFS and left ventricular systolic dysfunction after lower limb amputations above and below the knee.

Materials and Methods.

We evaluated the results of treatment of 38 patients with type 2 diabetes mellitus and obesity who had systolic myocardial dysfunction (EF<50%) according to the results of echocardiography (EchoCG). All patients were treated at the Kyiv City Clinical Hospital No. 1 during 2022-2024. All patients underwent amputation of the lower limb - 25 at the level of the thigh and 13 at the level of the upper third of the tibia. The indication for amputation was the purulent-necrotic form of DFS. All patients underwent a standard set of laboratory tests - a complete blood count, biochemical blood test, indicators of hemostasis and acid-base status, and instrumental methods of examining the cardiovascular system (ECG, EchoCG) were performed. EchoCG was performed on all patients in the conditions of the intensive care unit or upon admission to the hospital. Inclusion criteria for the study: patients with an ejection fraction (EF) of less than 50%, a history of type II diabetes mellitus, the presence of a purulent-necrotic form of DFS that required surgical treatment in the form of amputation of the lower limb above or below the knee, a body mass index of more than 30 kg/m2, and an assessment of the severity of the condition on the APACHE II scale of more than 12 points. The surgical intervention was performed under combined general anesthesia (induction ketamine 50 mg + diazepam 5 mg + fentanyl 100 μg + atracurium 0.5 mg/kg, maintenance of anesthesia sevoflurane 1.0-1.5 vol%, fentanyl 2-4 μg/kg, if necessary, atracurium 0.1-0.2 mg/kg was added). Extubation of the trachea was performed on the operating table under the condition of satisfactory muscle tone, consciousness and adequate breathing or the patient was transferred to the intensive care unit for prolonged mechanical ventilation. According to the applied treatment, the patients

were divided into 2 groups - control and main. Patient data are presented in Table 1.

Table 1. *Patient data.*

Indicator	Control group (n=20)	Main group (n=18)
Sex	men – 11 (55%), women – 9 (45%)	men 9 (50%), women - 9 (50%)
Age, years	65,4 [52; 73]	65,16 [53; 75]
Body mass index, kg/m2	36,3 [31,8; 39,6]	36,05 [32,3; 41,1]
APACHE II score, points	15,7 [12; 18]	15,1 [13; 18]
Ejection fraction, %	41 [33; 47]	42 [35; 46]
Systolic blood pressure, mm Hg	90 [85; 96]	89 [83; 97]
Mean blood pressure, mm Hg	59 [54; 64]	56 [52; 61]
Central venous pressure, mm Hg	95 [70; 160]	100 [60; 150]
Heart rate, beats/min	99 [56; 149]	102 [60; 163]
Leukocytes, x10^9/l	18,3 [12,7; 22,3]	21,1 [14,9; 27,2]
Procalcitonin, ng/ml	5,2 [1,44; 9,1]	4,9 [1,1; 10,4]
Glucose, mmol/l	16,2 [3,8; 22,2]	17,1 [5,9; 23,1]
Creatinine, μmol/l	149 [126,3; 204,8]	142 [119,3; 198,8]
Diuresis rate, ml/kg·h	0,42 [0,35; 0,6]	0,43 [0,3; 0,63]
Lactate, mmol/l	3,7 [2,1; 5,3]	3,5 [2,3; 5,5]
C-reactive protein, mmol/l	76,9 [52,6; 96,7]	81,1 [49,9; 112,1]
Sodium concentration, mmol/l	137 [133; 145]	138,4 [134; 142}
Blood osmolarity, mosmol/l	285 [280; 292]	282 [280; 286]

The values in table 1 signify the mean and range of each indicator.

Patients in both groups did not differ significantly in terms of baseline parameters.

In the control group, 20 patients received infusion therapy with crystalloids 30-40 ml/kg/day and vasopressors (noradrenaline). In the main group, 18 patients received treatment aimed at supporting inotropic heart function (dobutamine at a dose of 4-6 μg/kg/min and/or digoxin 0.125-0.5 mg/kg/day), isoosmolar crystalloid solutions at a dose of 8-12 ml/kg/day, balanced crystalloid solutions with increased osmolarity (based on 5-atom alcohol xylitol with balanced electrolytes and osmolarity 610 mosmol/l) at a dose of 4-7 ml/kg/day and furosemide at a dose of 0.8-1.8 mg/kg/day for correction of intravascular volume of circulating blood and treatment of edematous syndrome. Infusion of noradrenaline was prescribed to patients in the main group in case of impossibility of achieving mean BP more than 65 mm Hg due to dobutamine. In the postoperative period, antibacterial therapy (cephalosporins of the 3rd or 4th generation in combination with metronidazole), thromboprophylaxis (enoxaparin in prophylactic doses) and analgesia (morphine) were identical in both groups.

The primary endpoint of this study was patient admission to hospital, next points for clinical and laboratory assessments were in an hour after surgery, in 24 and 72 hours after surgery.

Taking into account the results of the patient assessment according to the Apache II scale and the risk of surgical intervention, the expected mortality was on average 20%.

Results and Discussion.

In 24 and 72 hours after surgery, the number of patients who required vasopressor infusion and the average dose of vasopressors were assessed; in 72 hours after surgery, clinical and laboratory parameters (systolic and mean blood pressure, heart rate, CVP, diuresis rate, leukocyte levels, glucose, creatinine, procalcitonin, lactate, sodium concentration and blood osmolarity) were assessed.

The results of patient treatment are shown in Table 2.

Table 2. *Treatment results.*

Indicator	Control group (n=20)	Main group (n=18)
Number of patients requiring norepinephrine infusion after 24 hours	14 (70%)	8 (44,4%)
Average dose of norepinephrine after 24 hours, μg/kg·min	0,31 [0,26; 0;39]	0,26 [0,2, 0,3]
Number of patients requiring norepinephrine infusion after 72 hours	8 (40%)	2 (11%)
Average dose of norepinephrine after 72 hours, μg/kg·min	0, 22 [0,18, 0,25]*	0,09 [0,07; 0,12]*
Systolic blood pressure, mm Hg	105 [97; 115]*	121 [114; 130]*
Mean blood pressure, mm Hg	62 [60; 65]*	75 [69; 80]*
Central venous pressure, mm Hg	97 [70; 140]	82 [65; 125]
Heart rate, beats/min	92 [75; 130]	84 [70; 95]
Leukocytes, x109/l	13 [8,9; 18, 1]	10 [7,9; 14,3]
Procalcitonin, ng/ml	4,8 [1,1; 9,2]*	2,1 [0,4; 2,6]*
Glucose, mmol/l	9,2 [6,3; 14,6]	8,1 [6,4; 11,9]
Creatinine, μmol/l	157 [110; 248]*	115 [79; 137]*
Diuresis rate, ml/kg·h	0,46 [0,38; 0,63]*	0,72 [0,58; 1,05]*
Lactate, mmol/l	2,9 [2,5; 4,0]*	1,5 [1,2; 2,2]*
C-reactive protein, mmol/l	42,7 [35; 63]	35,9 [27,4; 50,1]
Sodium concentration, mmol/l	137 [134; 140]	143 [137; 148]
Blood osmolarity, mosmol/l	282 [280; 286]	290 [285; 293]

** $p<0,05$ relative to the control*

During surgery and during the first hours of the postoperative period, all patients in the control group and 11 (61%) patients of main group required norepinephrine infusion. 24 hours after surgery, 30% of patients of the control group were able to withdraw norepinephrine, while 70% still required it.

After 24 hours, we did not find a significant difference between the blood pressure values in patients of both groups, but the number of patients requiring vasopressor infusion was lower in the main group (44.4% versus 70% in the control group). After 72 hours, the systolic and mean blood pressure values in the main group were significantly higher than in the control group, and the procalcitonin level was lower. Indicators of kidney function (creatinine, diuresis rate) and tissue perfusion (lactate) responded better to treatment in the main group. The number of patients requiring vasopressor infusion after 72 hours was lower in the main group (11% versus 40% of patients).

Systolic myocardial dysfunction may be a manifestation of decompensation or exacerbation of systemic inflammation or be a consequence of previous cardiovascular events (acute

myocardial infarction, prolonged arrhythmias, valvular heart disease). Echocardiography is important when a patient is admitted to the ICU for the differential diagnosis of septic shock and decompensation of chronic heart failure, as well as for assessing the degree of volemia, since CVP indicators have a low correlation with the patient's actual circulating blood volume and are unable to predict the hemodynamic response to infusion load.

Critically ill patients with a source of infection and poor hemodynamic high lactate level, and multiple organ involvement may be considered to have sepsis. Therefore, control patients were treated according to the Surviving Sepsis Campaign recommendations without waiting for the results of a blood culture [3]. However, it should be noted that there are some discrepancies in the recommendations for the treatment of patients with sepsis and decompensated heart failure. The standards for the volume of infusion therapy according to which sepsis or septic shock should be treated can be fatal for patients with left ventricular systolic dysfunction. In septic shock, a crystalloid bolus of 30 ml/kg over 3 hours is indicated, whereas in decompensated heart failure, infusion is limited or contraindicated altogether, and, conversely, loop diuretics are indicated [3,9]. Despite strong recommendations for large infusion volumes in septic shock, a systematic review found very low quality and quantity of evidence for fluid volume strategies [10], and negative fluid balance during the de-escalation phase of infusion therapy was associated with lower mortality [3]. Of the cardiotonic agents indicated for sepsis, vasopressors are indicated, which have a greater effect on vascular tone, while in heart failure, in the case of unstable hemodynamics, treatment begins with inotropic agents that increase the force of cardiac contractions [3,9]. The results of our study demonstrate that patients who received a combination of norepinephrine with inotropic agents were stopped cardiotonic support earlier, they had better indicators indicating the adequacy of tissue and organ perfusion (lactate level, creatinine level and diuresis rate).

The quality of drugs for infusion therapy in septic shock is still widely debated in the literature. Currently, balanced crystalloids are recommended, but there are no recommendations regarding the osmolarity of these solutions - should they be iso- or hyperosmolar? Taking into account the decrease in blood oncotic pressure due to the movement of albumin through capillary pores into the interstitium during the outflow phase in distributive shocks [8], in our opinion, it is advisable to transfuse crystalloids with increased osmolarity to prevent hypovolemia and the increase in systemic interstitial edema against the background of concomitant hypoalbuminemia. D. Kelm et al. showed that in patients with severe sepsis or septic shock who received aggressive fluid therapy in the intensive care unit, 67% had evidence of fluid overload, as determined by both clinical and radiological findings, or by the need for diuretics or thoracentesis [7]. Gang Heng et al. in a retrospective analysis showed that patients with normal osmolarity had lower mortality than patients with hypo- or hyperosmolarity [5].

E. Besnier et al. found that the use of hypertonic sodium lactate solution in sepsis prevents cardiac dysfunction, impaired mesenteric microcirculation and capillary permeability, and also reduces the severity of the inflammatory process by reducing the level of interleukin 1β, interleukin 10 and tumor necrosis factor α [1]. Several studies have shown that excessive infusion therapy in sepsis is the cause of delayed recovery of internal organ function, increased duration of stay of patients in the ICU and hospital, and higher mortality [11,13]. It should be noted that our use of solutions with increased osmolarity is by no means a complete replacement for isoosmolar solutions, but their addition allows us to avoid excess infusion volume, which is extremely undesirable in systolic dysfunction of the left ventricular myocardium.

Complications of the postoperative period are listed in Table 3.

Table 3. *Postoperative complications.*

Complications	**Control group (n=20)**	**Main group (n=18)**
Congestive pneumonia	7 (35%)	2 (11%)
Pericarditis	8 (40%)	2 (11%)
Local wound complications	13 (65%)*	4 (22%)*
Acute myocardial infarction	1 (5%)	0
Pulmonary artery branch thromboembolism	1 (5%)	0
Acute kidney injury	12 (60%)*	4 (22%)*
Sepsis	4 (20%)	4 (22%)
Duration of mechanical ventilation, hours	23 [3; 46]	4,5 [2,2; 12]
Duration of treatment in the intensive care unit, days	5,9 [1; 12]	4,2 [1; 7]
Hospital mortality	5 (25%)	2 (11%)

p <0,05 between groups.

According to the results in Table 3, patients in the main group had significantly fewer complications associated with hyperhydration and heart failure (pneumonia, pericarditis). The failure of the stump due to impaired blood flow or infectious complications was higher in the control group. Patients in the control group required more time on mechanical ventilation due to respiratory failure due to pneumonia or unstable hemodynamics. Acute kidney injury in patients in the main group was observed three times less often due to optimization of cardiac activity, timely administration of diuretics and vasodilator effect of dobutamine on renal vessels. Our proposed approach to intensive care of patients with obesity and systolic dysfunction allowed to halve the mortality after high amputations.

The effectiveness of hyperosmolar solutions in pneumonia and sepsis was confirmed by the international multicenter randomized trials RheoSTAT-CP0698 and RheoSTAT-CP0620, respectively. Low-volume infusion therapy with sorbitol-based hyperosmolar solutions contributed to the rapid normalization of circulating blood volume, stabilization of hemodynamic parameters, acid-base, electrolyte and gas composition of the blood. Due to the hypertonic concentration, the infusion of sorbitol-based solutions caused a significant anti-edema effect, in particular, it contributed to the reverse development of pulmonary edema and a significant osmotic diuretic effect. A statistically significant improvement in markers of endogenous intoxication (concentration of urea, creatinine and total bilirubin,

leukocyte count and calculated intoxication indices) was found on the 3rd day of treatment. Administration of the drug at a dose of 200-400 ml per day did not lead to fluid overload, pulmonary edema and pleural effusion, and did not cause a clinically significant increase in endogenous blood lactate [4,14].

Conclusion.

The study determined that EchoCG is a reasonable proven diagnostic criterion in patients in critical condition on the background of DFS with a history of cardiovascular events and with a decrease in systolic blood pressure of less than 100 mm Hg. Diagnosis of systolic dysfunction (ejection fraction less than 50%) in this category of patients requires the appointment of inotropic drugs. The study also found that infusion of hyperosmolar solutions at a dose of 4-7 ml/kg/day is safe for patients with systolic myocardial dysfunction. It was determined that the use of inotropic therapy and hyperosmolar solutions significantly increases the survival of patients with DFS and systolic myocardial dysfunction in the event of successful surgical rehabilitation.

Conflict of interest.

The authors declare that there is no conflict of interest or financial interest in carrying out this study.

Funding information.

No external funding sources were involved in the study.

Connection with scientific programs, plans and topics.

The article is a fragment of research work of the Department of Emergency Medicine, Anesthesiology and Intensive Care of Kharkov National Medical University of the Ministry of Health of Ukraine "Optimization of anesthetic management for operations with diabetic foot syndrome in obese patients" (№ state registration 0120U10217).

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Резюме

Актуальність. Синдром діабетичної стопи є серйозним ускладненням цукрового діабету, що часто вимагає ампутацій і пов'язаний з високою смертністю. У пацієнтів із синдромом діабетичної стопи і систолічною дисфункцією міокарда на фоні ожиріння хірургічне лікування ускладнюється системним запаленням, порушенням кровообігу та тканинної перфузії.

Мета: оцінити вплив оптимізації систолічної функції серця на перебіг післяопераційного періоду у хворих з СДС та систолічною дисфункцією лівого шлуночка при ампутаціях нижньої кінцівки вище і нижче коліна.

Матеріали і методи. Дослідження включало 38 пацієнтів із цукровим діабетом 2-го типу, ожирінням (ІМТ >30 кг/м^2) та систолічною дисфункцією міокарда (ФВ<50%). Усім пацієнтам виконано ампутацію нижньої кінцівки (25 – на рівні стегна, 13 – на рівні гомілки). Пацієнти були розподілені на 2 групи: контрольну (n=20), яка отримувала стандартну терапію, та основну (n=18), де додатково застосовували гіперосмолярні розчини та інотропну терапію.

Результати. Через 72 години після операції у пацієнтів основної групи спостерігалось значне покращення гемодинамічних та метаболічних показників. Середній

артеріальний тиск в основній групі становив 75±12 мм рт. ст. проти 62±7,1 мм рт. ст. у контрольній. Кількість пацієнтів, які потребували інфузії вазопресорів через 72 год, була нижче в основній групі (40% проти 11% пацієнтів). Динаміка рівня лактату в крові склала від 3,7±0,4 до 2,9±0,5 ммоль/л у пацієнтів контрольної групи та від 3,5±0,08 ммоль/л до 1,5±0,2 ммоль/л в основній групі. Гостре пошкодження нирок та ранові ускладнення у пацієнтів основної групи спостерігались втричі рідше (22% проти 60% та 22% проти 65% відповідно) ($p<0,05$).

Висновки. Оптимізація систолічної функції міокарда щляхом застосування гіперосмолярних розчинів та інотропної терапії ефективно знижує ризик ускладнень і смертність у пацієнтів з сиромом діабетичної стопи та систолічною дисфункцією міокарда.

Ключові слова: синдром діабетичної стопи, ожиріння, систолічна дисфункція, гіперосмолярні розчини, ампутації нижньої кінцівки.