

# GEORGIAN MEDICAL NEWS

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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 ВИНТИ 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 ВИНТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებშიდან.

### WEBSITE

[www.geomednews.com](http://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](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. Корректур авторам не высылаются, 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 computer-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.nlm.nih.gov/bsd/uniform_requirements.html)  
[http://www.icmje.org/urm\\_full.pdf](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 საქურაღებოლ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დაიცვათ 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. რენტგენოგრაფიების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალებების შედეგების 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 ფხიხლებში 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.

Tolegen A. Toleutayev, Altay A. Dyussupov, Merey N. Imanbaev, Dina M. Toleutaeyva, Nazarbek B. Omarov, Zhasulan O. Kozhakhmetov, Yernur M. Kazymov, Aldiyar E. Masalov. MODERN METHODS OF SURGICAL TREATMENT OF DIABETIC FOOT SYNDROME.....	6-10
Lipatov K.V, Asatryan A.G, Vinokurov I.A, Kazantsev A.D, Melkonyan G.G, Solov'eva E.I, Gorbacheva I.V, Sotnikov D.N, Vorotyntsev A.S, Emelyanov A.Y, Komarova E.A, Avdienko E.V, Sarkisyan I.P. SURGICAL TREATMENT STRATEGIES OF DEEP STERNAL WOUND INFECTION FOLLOWING CARDIAC SURGERY.....	11-17
Yerasyl A. Mukash, Nazarbek B. Omarov, Meyrbek Zh. Aimagambetov, Altai A. Dyussupov, Tolkyng A. Bulegenov, Samatbek T. Abdrakhmanov, Medet A. Auyenov, Muratkan T. Kuderbayev, Aldiyar E. Masalov. WAYS TO IMPROVE THE RESULTS OF SURGICAL TREATMENT OF DIFFUSE TOXIC GOITER.....	18-26
Hasmik G. Galstyan, Armine V. Sargsyan, Artyom A. Sahakyan, Razmik A. Dunamalyan, Siranush A. Mkrtchyan, Ganna H. Sakanyan, Rhapsime Sh. Matevosyan, Lusine M. Danielyan, Marine A. Mardiyan. QUALITY OF LIFE IN INDIVIDUALS WITH VARYING LEVELS OF TRAIT AND STATE ANXIETY.....	27-33
Abdulmajeed Alghamdi, Hashim Abdullah Saleh Alghamdi, Adel Khaled Alghamdi, Adham Mohammed H. Alghamdi, Anmar Ali Saad Alghamdi, Abdulaziz Musaad Safir Alkathami, Abdullah Ali Abdullah Al-Mimoni, Muhannad Essa Salem Alghamdi. PREVALENCE AND RISK FACTORS OF UROLITHIASIS AMONG THE POPULATION OF AL-BAHA REGION, SAUDI ARABIA.....	34-41
Tetiana Fartushok, Dmytro Bishchak, Iryna Bronova, Olena Barabanchyk, Yuriy Prudnikov. ANALYSIS OF CHALLENGES AND POSSIBILITIES OF USING ARTIFICIAL INTELLIGENCE IN MEDICAL DIAGNOSTICS.....	42-53
Noor N. Agha, Aisha A. Qasim, Ali R. Al-Khatib. EFFECTS OF SESAMUM INDICUM (SESAME) OIL IN REMINERALIZING OF WHITE SPOT LESIONS INDUCED AFTER BRACKET DEBONDING: AN IN VITRO STUDY.....	54-60
Kordeva S, Broshtilova V, Tchernev G. GRAHAM-LITTLE-PICCARDI-LASSEUR SYNDROME (GLPLS) IN A BULGARIAN PATIENT: CASE REPORT AND SHORT PATHOGENETIC UPDATE IN RELATION TO THE CONNECTION TO ANTIGEN/ MOLECULAR MIMICRY.....	61-67
Emad A ALwashmi, Betool R Alqefari, Sadeem S Alsenidi, Eithar O Alwasidi, Yazeed M Alhujaylan, Abdullah H Alsabhawi, Monirh M Almshighah. ASSESSMENT OF THE RELATIONSHIP BETWEEN OVERACTIVE BLADDER AND FUNCTIONAL CONSTIPATION, IN QASSIM REGION, SAUDIARABIA.....	68-74
Yeralieva B.A, Paizova M.K, Yerkinbekova G.B, Shlymova R.O, Nurgazieva G.E, Rakhmanova G.M, Nuralim M.N. COMPARATIVE ANALYSIS OF ANTIBIOTIC CONSUMPTION IN MULTIDISCIPLINARY HOSPITALS IN ALMATY PERSPECTIVES ON AWARE AND ABC ECONOMIC ANALYSIS.....	75-77
Mohammed AH Jabarah AL-Zobaidy, Sheelan Ameer Sabri, Abdulhameed Salim Barrak, Nabaa Abdulhameed Salim, Suha Ameer Sabri. A NEW COMBINATION OF KNOWN AGENTS FOR TREATMENT OF ALOPECIA AREATA: A CASE-SERIES STUDY.....	78-82
Levytska O.V, Dubivska S. S. FEATURES OF THE POSTOPERATIVE COURSE IN PATIENTS WITH DIABETIC FOOT SYNDROME AND SYSTOLIC MYOCARDIAL DYSFUNCTION AFTER LOWER LIMB AMPUTATION.....	83-87
Knarik V. Kazaryan, Naira G. Hunanyan, Margarita H. Danielyan, Rosa G. Chibukchyan, Yulia Y. Trofimova, Arusyak V. Mkrtchyan, Kristine V. Karapetyan, Tatevik A. Piliposyan. CORRELATION BETWEEN RHYTHMOGENESIS OF THE RAT URETERS UNDER HISTAMINE EXPOSURE.....	88-94
A.Y. Abbasova, V.A. Mirzazade, I.I. Mustafayev, N.R. Ismayilova. FEATURES OF THYROID DYSFUNCTION IN PATIENTS WITH ATRIAL FIBRILLATION.....	95-98
Adil Khalaf Altwaairgi. CHRONIC INFECTION WITH SCHISTOSOMA HAEMATOBIIUM LEADS TO THE DEVELOPMENT OF SQUAMOUS CELL CARCINOMA OF THE BLADDER.....	99-103
Shkvarkovskiy I.V, Moskaliuk O.P, Kozlovska I.M, Kolotylo O.B, Rusak O.B. PREVENTION AND TREATMENT OF PANCREATITIS AFTER ENDOSCOPIC SURGERY ON THE BILE DUCT.....	104-107
Meruert T. Orazgalieva, Meyrbek Zh. Aimagambetov, Samatbek T. Abdrakhmanov, Nazarbek B. Omarov, Medet A. Auyenov, Merkhata N. Akkaliyev, Ainash S. Orazalina, Aldiyar E. Masalov, Daniyar S. Bokin, Julia V. Omarova Aida M. Ulbauova. METHOD FOR PREVENTION OF COAGULOPATHIC BLEEDING DURING SURGERY FOR MECHANICAL JAUNDICE.....	108-114
Munther Natheer, Mohammed Tariq, Tameem Thamir, Rami Ramadhan. NURSES' KNOWLEDGE WITH REGARD PAIN AS A PART OF A VITAL SIGNS.....	115-118

Olga Kim, Zilola Mavlyanova, Bakhridin Doniyorov, Mukhayakhon Khamdamova, Fariza Khalimova. INDIVIDUAL CHARACTERISTICS OF HIGHER NERVOUS ACTIVITY AS A FACTOR IN ADAPTATION AND RECOVERY OF THE CARDIOVASCULAR SYSTEM IN ATHLETES.....	119-124
Jingjing Liu, Anli Hu, Yulei Xie. A STUDY ON THE RELATIONSHIP BETWEEN TYPE A PERSONALITY, EMPLOYMENT STRESS, AND MENTAL HEALTH OF RESIDENT PHYSICIANS IN TERTIARY HOSPITALS IN NANCHONG, CHINA.....	125-131
Rym ben Othman, Inchirah Karmous, Ramla Mizouri, Olfa Berriche, Amina Bornaz, Ines Mannai, Faten Mahjoub, Fethi Ben Slama, Henda Jamoussi. INTERMITTENT FASTING (5:2) VS. NON-FASTING: A COMPARATIVE ANALYSIS OF ANTHROPOMETRIC PARAMETERS, DEPRESSION, AND STRESS IN HEALTHY ADULTS - A CROSS-SECTIONAL STUDY.....	132-137
Noor Mohammed Mousa, Abdull Jabar Attia, Karima Fadhil Ali. DESIGN, MOLECULAR DOCKING, MOLECULAR DYNAMICS, AND EVALUATION OF NOVEL LIGANDS TARGETING BETA-2 ADRENERGIC RECEPTOR FOR ASTHMA THERAPEUTICS.....	138-147
Kolev I, Andreev A, Zazirnyi I. ARTHROSCOPIC TREATMENT OF POSTERIOR ANKLE IMPINGEMENT SYNDROME – SYSTEMATIC SURGICAL APPROACH AND CASE REPORT.....	148-153
Rusudan Devadze, Arsen Gvenetadze, Shota Kepuladze, Giorgi Burkadze. FEATURES OF DISTRIBUTION OF INTRATUMORAL LYMPHOCYTES IN OVARIAN EPITHELIAL TUMOURS OF DIFFERENT HISTOLOGICAL TYPES AND DEGREE OF MALIGNANCY.....	154-158
Merey N. Imanbayev, Altai A. Dyussupov, Yersyn T. Sabitov, Nazarbek B. Omarov, Yernur M. Kazymov, Zhassulan O. Kozhakhmetov, Dina M. Toleutayeva, Samatbek T. Abdrakhmanov, Merkhata N. Akkaliyev, Aldiyar E. Masalov. PREVENTION OF COMPLICATIONS OF SURGICAL TREATMENT OF PATIENTS WITH OCCLUSION OF THE AORTOILIAC SEGMENT.....	159-167
Salah Eldin Omar Hussein, Awadh S Alsubhi, Ammar Abdelmola, Saadalnour Abusail Mustafa, Praveen Kumar Kandakurti, Abdulrahman Algarni, Elryah I Ali, Abdelrahman Mohamed Ahmed Abukanna, Hussam Ali Osman, Ayman Hussien Alfeel. ASSOCIATION BETWEEN GLYCATED HEMOGLOBIN AND ELEVATED THYROID HORMONES LEVELS IN PATIENTS WITH TYPE 2 DIABETES MELLITUS.....	168-172
Sami A. Zbaar, Islam K. Kamal, Atyaf Alchalabi. ASSOCIATION BETWEEN SERUM LEVELS OF ADIPOKINES IN PATIENTS WITH PROSTATE CANCER.....	173-177
Ramazanov M.A, Bogaevskaya D.V, Sobolev D.A, Riabov A.A, Vysokikh I.S, Makhmudova A.A, Eremenko A.A, Motskobili G.G, Sadkovskaia A.I, Alibekov Gulyakhmed-haji A. IMPROVEMENT OF COGNITIVE FUNCTION IN WISTAR RATS UNDER CHRONIC STRESS CONDITIONS WITH MELATONIN.....	178-180
Olena Babkina, Svitlana Danylchenko, Ihor Korobko, Vadym Zozuliak, Valerii Kucher. DIAGNOSTIC OF PANCREATIC INJURY USING INFRARED THERMOMETRY.....	181-186
Takuma Hayashi, Krishna Prasad Acharya, Sarita Phuyal, Ikuo Konishi. THE IMPORTANCE OF ONE HEALTH IN PREVENTING THE SPREAD OF HIGHLY PATHOGENIC AVIAN INFLUENZA/H5N1..... .....	187-189

## WAYS TO IMPROVE THE RESULTS OF SURGICAL TREATMENT OF DIFFUSE TOXIC GOITER

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### Abstract.

**Introduction:** This article discusses the prevention of intraoperative complications in the surgical treatment of diffuse toxic goiter. The above complications push surgeons to find a more optimal method of surgical treatment.

**Aim:** Development of new methods to reduce the risk of intraoperative complications in the surgical treatment of patients with diffuse toxic goiter.

**Materials and methods of research:** From 2017 to September 2020, 85 patients with diffuse toxic goiter were operated in the surgical department of the University Hospital NCJSC «Semey Medical University». The age of the patients ranged from 21 to 68 years. The average age of the patients was 36±2.

All patients were divided into 2 groups: I — the main group, which included 39 patients operated using the "method for the prevention of postoperative laryngeal paresis after thyroidectomy" and "instrument for the removal of the recurrent laryngeal nerve", as well as using the technique of thyroid embolization and II— control, in which 46 patients underwent traditional surgical intervention without the use of these techniques.

**Results:** According to the safety drainage, hemorrhagic discharge was noted in all patients after surgery on the same day. In the main group - in the amount of 16.4 ± 7.4 ml, in the control group - 36.1 ± 8.4 ml (p> 0.05). On the 1st day in the main group of patients, the amount of discharge was scarce or zero, drainage was removed. In the control group, this manipulation was most often performed only for 2 days. All patients were examined by an ENT (ears, nose and throat) doctor on the 3rd day to assess the condition of the vocal cords. 2 patients (4.3%) with unilateral transient paresis of the vocal cords were identified in the control group, while no such problems were found in the main group. A complication in 2 patients in the control group was transient unilateral laryngeal paresis. It was completely medically stopped during the next 4-6 months. Hypoparathyroidism in the main group was registered in 1 (2.5%) cases, while in the control group 4 (8.6%) cases of hypoparathyroidism were observed. Postoperative bleeding was noted in 2 (4.3%) cases in the control group, while in the main group this complication was not noted. The duration of inpatient treatment after thyroid surgery using new techniques ranged from 3 to 8 days, averaging 4.2 ± 0.6 days. In the control group, the same indicator ranged from 5 to 10 days (On average - 6.1 ± 0.8 days).

There were no fatal outcomes among the patients of both the main and control groups.

**Conclusions:** The complex use of a method for the prevention of postoperative laryngeal paresis after thyroidectomy, and the use of a tool for the removal of the recurrent laryngeal nerve during surgery, and preoperative X-ray endovascular embolization of the thyroid arteries in patients with DTG (diffuse toxic goiter) can reduce the risk of intraoperative complications and improve immediate and long-term results of surgical treatment.

The use of a new method for the prevention of postoperative laryngeal paresis after thyroidectomy and "a tool for the removal of the recurrent laryngeal nerve" as well as endovascular embolization of the thyroid arteries in the surgical treatment of patients with DTG can reduce the duration of surgery by 26%, the volume of intraoperative blood loss - by 52.5%, and also avoid complications such as recurrent nerve injury and bleeding in early postoperative period.

**Key words.** Diffuse toxic goiter, thyroidectomy, thyroid resection, embolization of the thyroid artery.

### Introduction.

Diffuse toxic goiter (DTG) – this is a systemic autoimmune disease characterized by a diffuse increase in the thyroid gland with hyperthyroidism and develops due to the production of antibodies to thyroid-stimulating hormone (TSH) receptors. The disease is multifactorial and ranks second after diabetes mellitus in the structure of endocrine pathology [1-4].

Treatment of patients with diffuse toxic goiter remains an unsolved task of modern medicine [2-9]. This is due to the fact that there is no single generally accepted approach to the treatment of this category of patients [10-15]. It is known that through conservative therapy it is not always possible to achieve a stable clinical effect, and the recurrence of the disease, according to various data, can reach 80% [16-21].

The ideal treatment for DTG should provide a sufficiently rapid elimination of the clinical symptoms of thyrotoxicosis, a return to the thyroid state, accompanied by a minimal risk of complications for the patient. In the USA, the most common method of treating patients with DTG is thyroid ablation with radioactive iodine (69% of respondents from the American Thyroid Association). In Russia, as in Japan and China, surgical intervention remains one of the main methods of treatment of DTG, and drug therapy serves only as a preparatory stage for surgical treatment [2,8,16,22-30].



In the treatment of thyroid surgery in particular, X-ray endovascular embolization of the thyroid arteries has been widely used. This technique was applied for the first time in Kazakhstan in the city of Almaty at the A.N. Syzganov Research Institute and in the city of Astana. With this technique the frequency of intraoperative complications decreases due to the elimination of arterial blood flow to the thyroid gland, followed by a decrease in its volume, which leads to a decrease in the traumatic nature of the operation and intraoperative blood loss. This technique is especially relevant for large volumes of the gland, as well as for the posterior location of the goiter, in which there is a high probability of traumatization of the lower thyroid artery. When using the above method, a decrease in the number of toxic crises has been proven. This approach is also used as an independent method of treatment, because it allows you to reduce the production of thyroid hormones without surgery.

Despite the accumulated experience of thyroid surgery, prevention of intraoperative complications is still not a fully solved problem. Intraoperative complications in the surgical treatment of DTG range from 3 to 35% [11,16,29]. In this regard, there is a clear need for the development and implementation of unified, most optimal preventive measures aimed at reducing intraoperative complications in the surgical treatment of DTG. In modern literature, insufficient attention is paid to these issues, which was the reason for this study.

In the work, new techniques were used to reduce or completely eliminate the occurrence of a number of intraoperative complications (intra and postoperative bleeding, damage to recurrent nerves), namely: X-ray endovascular occlusion of the thyroid arteries, and a method of preventing postoperative laryngeal paresis after thyroidectomy, as well as using a tool to divert the recurrent laryngeal nerve during surgery.

**Aim:** Development of new methods to reduce the risk of intraoperative complications in the surgical treatment of patients with diffuse toxic goiter.

**Research design:** A single center randomized clinical trial.

## Materials and Methods.

From 2017 to September 2020, 85 patients with diffuse toxic goiter were operated on in the surgical department of the University Hospital NCJSC «Semey Medical University». The age of the patients ranged from 21 to 68 years. The average age of the patients was  $36 \pm 2$ .

All patients were divided into 2 groups: I — the main group, which included 39 patients operated using the "method for the prevention of postoperative laryngeal paresis after thyroidectomy" and "instrument for the removal of the recurrent laryngeal nerve", as well as using the technique of thyroid embolization and II— control, in which 46 patients underwent traditional surgical intervention without the use of these techniques.

### Inclusion criteria:

- Age over 18 years.
- Primary surgical treatment, including X-ray endovascular embolization of the thyroid arteries.
- Availability of informed consent of the patient for surgical intervention in the form provided for by the study protocol and

the randomization structure and anonymous use of the data obtained in scientific work.

### Exclusion criteria:

- Implementation of surgical intervention in other health facilities.
- Refusal to participate in the study at any stage until the analysis is completed.

In our clinic, 2 types of operations were used for DTG: thyroidectomy and, according to the classical technique, subtotal subfascial resection of the thyroid gland according to O.N. Nikolaev. In the main group 14 patients (35.8%) had thyroidectomies and 25 patients (64.2%) had subtotal subfascial thyroid resection. In the control group — 16 patients (34.7%) and 30 patients (65.3%). Patients were admitted after a comprehensive examination and treatment by an endocrinologist.

During performing operations on the thyroid gland in the main group, all 39 patients used a "method for the prevention of postoperative laryngeal paresis after thyroidectomy" to minimize the risk of postoperative laryngeal paresis. After thyroidectomy while maintaining the anatomical integrity of the recurrent laryngeal nerves, as well as a significant reduction in the frequency of postoperative hypocalcemia using interferon in combination with tachocomb (to implement hemostasis in the wound). The use of interferon can improve the results of treatment of patients with thyroid diseases (Figures 1 and 2).

In order to prevent damage to the recurrent laryngeal nerve, an intraoperatively used "Instrument for the removal of the recurrent laryngeal nerve". It was also tested in all patients with DTG in the main group. The tool allows you to create conditions for better and safer work of the surgeon during thyroid surgery, by removing, fixing the recurrent laryngeal nerve and creating a good overview of the surgical field and during various surgical interventions to prevent their injury (Figures 3-5).

The technique of endovascular embolization of the thyroid arteries was used by us as a preoperative preparation 3-4 days before the operation. These terms are based on practical material: a significant decrease in the volume of the thyroid gland (by a maximum of 15-20% from the initial one) and a decrease in vascularization (according to ultrasound of the thyroid gland with Doppler mapping in dynamics after embolization) were noted precisely at these terms. In the future there was no significant change in these indicators. The purpose of the technique: to achieve reduction of blood flow in the thyroid tissue, reduction of intraoperative blood loss, potentiation of preoperative thyrostatic therapy.

The technique of endovascular embolization of the thyroid arteries was used by us in 12 patients of the main group (Figure 6). In these patients, the volume of the thyroid gland exceeded 100 ml<sup>3</sup>, averaging  $125.6 \pm 8.3$  ml<sup>3</sup>. In addition, 7 patients had a partially retrosternal thyroid gland.

Among 39 patients of the main group there were 11 (28.2%) men and 28 (71.8%) women aged 26 to 65 years. The average age of patients was  $32.1 \pm 8$  years, of which 90% were of working age (up to 60 years). This fact emphasizes the special social significance of the problem under consideration.



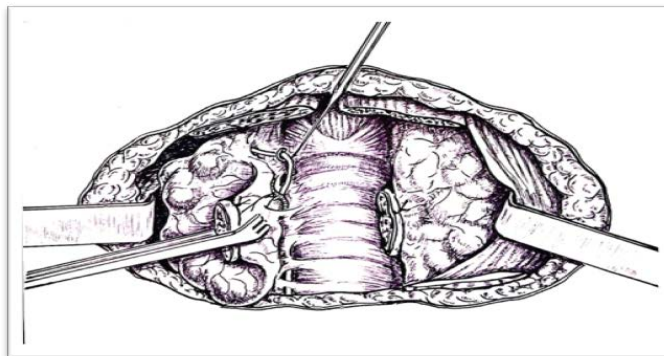
**Figure 1.** 2 plates of 2.0 x 2.0 cm tachocomb of the right and left thyroid lobes were installed under the parietal leaf of the 4th fascia of the neck in the area of branching of the recurrent laryngeal nerve.



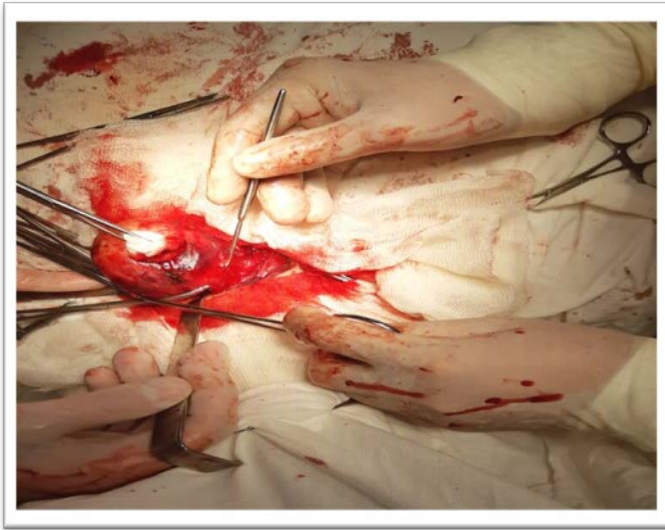
**Figure 2.** After installing the tachocomb, we then pour interferon 4 ml with a syringe. In this case, the Tachocomb absorbs the drug itself and performs the function of a hemostatic and protective framework, and interferon has pronounced antiviral, antiproliferative and immunomodulatory properties.



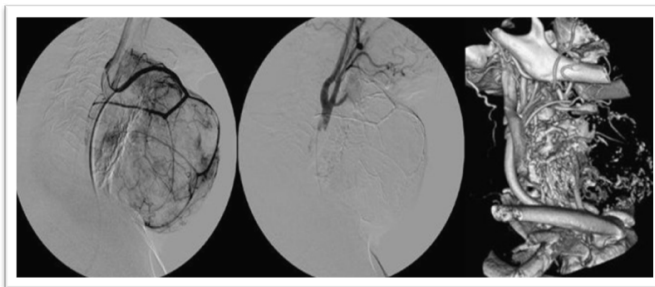
**Figure 3.** General view of the tool.



**Figure 4.** Sketch of the nerve removal with the help of the proposed tool.



**Figure 5.** Intraoperatively, during the revision, the recurrent laryngeal nerve was found and isolated, after which the working part of the proposed instrument was seized and pulled aside.



**Figure 6.** Condition before (left) and after (middle) embolization of the right upper thyroid artery (side view) and angio-CT 16W with 3D reconstruction 24 hours after SETA (right).

The clinical manifestation of DTG in the main group for 1-3 years was in 14 (35.9%) patients, from 3 to 5 years - in 18 patients (46.2%), over 5 years - in 7 (17.9%). 22 (56.4%) patients underwent previous repeated inpatient or outpatient conservative treatment.

The clinical picture of the disease in patients of the main group was characterized by vivid symptoms of the disease, which has certain features inherent in the pathology of DTG.

Patients complained of increased mental excitability, irritability, restlessness, fussiness, inability to concentrate in 35 patients (89.7%), a feeling of pressure in the neck area in 23 (58.9%); difficulty swallowing in 15 (38.4%); a feeling of constant heartbeat, interruptions in the heart area in 17 (43.5%); constant diffuse sweating 25 (64.1%). During the examination, diffuse uniform increase of the thyroid gland of various degrees was noted. Ocular symptoms were detected in 30 patients (76.9%).

The distribution of patients in the control group by gender was as follows: out of 46 patients, there were 12 (26%) men and 34 (74%) women aged 26 to 70 years. The ratio of men and women is comparable with the main group ( $p=0.05$ ). As for the average age of patients, it was  $33.4 \pm 2.4$  years in the control group, while 86% of patients were of working age (up to 60 years).

The manifestation of clinical manifestations of the disease occurred for a period of 3-5 years in most patients of the control group and amounted to 47.8% of all patients (22 people), for a period of 1 to 3 years, symptoms of DTG were observed in 20 patients (43.4%), and for a period of more than 5 years - in 4 patients (8.8%). 26 patients of the control group (56.5%) repeatedly underwent courses of conservative therapy on an outpatient basis or in a hospital setting.

The complaints of patients in the control group were similar to those in the main group.

The program of examination of patients included: general blood analysis and general urine analysis; biochemical blood analysis; immunological examination of blood: the content of B- and T-lymphocytes, subpopulations of T-lymphocytes, immunoglobulins, thyroid-stimulating immunoglobulins, circulating immune complexes; examination of the functional state of the thyroid gland: determination of the content of T4, TK, thyroxine-binding thyroglobulin in the blood (if it is impossible to determine the level of thyroid hormones in the blood — capture by the thyroid gland); ultrasound of the thyroid gland; ECG; consultations of specialists: cardiologist, endocrinologist, oculist (fundus examination), neurologist; chest X-ray. In some cases, CT scans of the chest organs were performed, which allowed us to assess not only the degree of the supraorbital location of the thyroid gland tissue, but also its relationship with the surrounding tissues, the degree of their compression.

In both groups of patients, the following characteristic changes were observed during laboratory and instrumental examination:

1. General blood test: moderate normochromic anemia, slight reticulocytosis, tendency to leukopenia, relative lymphocytosis.
2. General urinalysis: without pathology.
3. Biochemical blood analysis: reduction of cholesterol, lipoproteins, total protein, albumin, with significant liver damage - an increase in the content of bilirubin and alanine aminotransferase; an increase in the level of gamma globulins, glucose.
4. Immunological examination of blood: decrease in the number and functional activity of common T-lymphocytes and suppressor T-lymphocytes, increase in the content of immunoglobulins, detection of thyroid-stimulating immunoglobulins, antibodies to thyroglobulin, microsomal antigen.
5. Ultrasound of the thyroid gland: diffuse enlargement, uneven change in echogenicity.
6. Determination of the degree of absorption of the thyroid: the absorption rate was sharply increased after 2-4 and 24 hours.
7. Radioisotope scanning of the thyroid gland made it possible to identify functionally active tissue in the thyroid gland, determine the shape and size of the gland, the presence of nodes in it. Radioisotope scanning of the thyroid gland was performed with  $^{99m}\text{Tc}$ spertechnetat. The DTG was characterized by an enlarged image of the thyroid with increased isotope capture.
8. Determination of the content of T3 and T4 in the blood (by radioimmune method): an increase in the level of T3 and T4 was noted, the most significant was the determination of free fractions of hormones.
9. Determination of the content of protein-bound iodine in the blood (indirectly reflects the function of the thyroid gland): indicators are increased.

In the main group of patients there were 71.7% of patients with moderate thyrotoxicosis and 28.3% with severe thyrotoxicosis, and in the control group - 73.9% and 26.1%, respectively [31,32] (Table 2).

The average thyroid volume in the main group was 95.1±3.3 ml, in the control group - 86.1±3.9 ml.

The average level in the main group was T3 - 149±6.5 nmol/L, T4 - 3.5±0.2 nmol/L, TSH - 0.59±0.06 mmol/L, respectively, and in the control group T3 - 148.1±1.2 nmol/L, T4 - 3.41±0.3 nmol/L and TSH - 0.64±0.04 mmol/l, respectively (Table 3).

The posterior location of the thyroid gland in the main group was noted in 10 patients, and in the control group — in 6 patients.

Statistical processing of the obtained data was performed using biometric analysis methods (Kharisova I.M., Sharafutdinova N.H., 1999; Rebrova O.Yu., 2002).

The average value of M, the mean square deviation, and the average error of the average value of t were calculated. The reliability of the difference was assessed using the method of a two-sample t-test with different variances. The differences were considered significant at p<0.05. Nonparametric Mann-Whitney (U) and Wilcoxon criteria were used to compare the groups.

Correlation coefficient - r was used to determine the relationship between the two features. Correlation dependence was evaluated using paired and multiple correlation and regression.

## Results.

Evaluation of the results of surgical treatment of patients in the intraoperative period was carried out according to the following criteria:

- Average duration of surgical intervention.
- Resistance of hemostasis during the operation (volume of blood loss).
- Convenience of technical execution of the operation.
- The amount of consumables.
- Intraoperative complications.

**Table 1.** Distribution of patients by age and sex.

Age, years	Main group (n=39)				Control group (n=46)			
	male		female		male		female	
	n	%	n	%	n	%	n	%
21-30	2	18,3	3	9,8	2	16,6	5	14,28
31-40	4	36,3	13	36,3	4	33,3	15	44,1
41-50	3	27,2	8	27,0	3	25	7	20,5
51-30	2	18,2	3	13	2	16,6	5	14,7
61-70	0	0	1	9,8	1	8,5	2	5,8
Total	11	100	28	100	12	100	34	100

**Table 2.** Distribution of patients by severity of thyrotoxicosis.

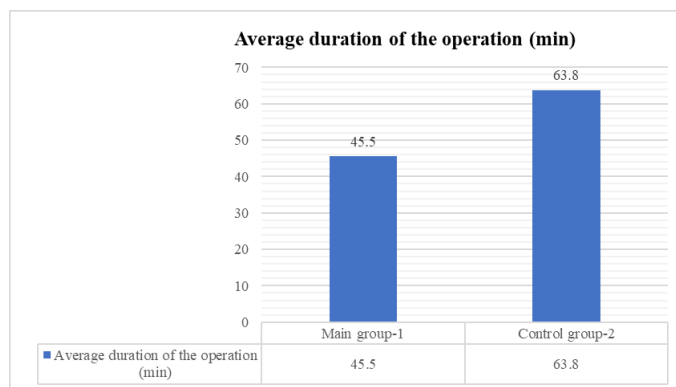
The severity of thyrotoxicosis	Main group (n=39)	Control group (n=46)
Average	28 (71.7%)	34 (73,9%)
Heavy	11 (28.3%)	12 (26,1%)

**Table 3.** The average level of hormones in the blood.

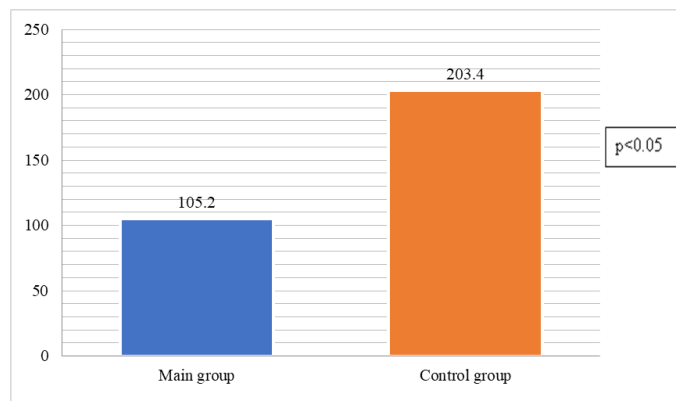
Hormones	Main group (n=39)	Control group (n=46)
T3 (nmol/l)	149±6,5	148,1±1,2
T4(nmol/l)	3,5±0,2	3,41±0,3
TSH(mmol/l)	0,59±0,06	0,64±0,04

**Table 4.** Results of treatment of patients with DTG in study groups.

Indicator	Main group (n=39)	Control group (n=46)	P
Average duration of the operation (min.)	45,4-35,8	63,7-6,1	<0,05
Average volume of intraoperative blood loss (ml)	105,2-315,3	203,4-314,7	<0,05
Average search time for the recurrent nerve (min.)	3,130,7	9,2-30,8	<0,05
Complications			
--injury of the recurrent nerve	—	2	>0,05
--postoperative bleeding	—	1	>0,05
- hypoparathyroidism	1	3	>0,05
--relapse of the disease	—	2	>0,05
Average amount of discharge by drainage (ml)	17,5-17,5	35,9-38,3	<0,05
Average severity of pain syndrome on the 1st day after surgery (points)	3,1-30,8	3,5-30,5	>0,05
Average duration of postoperative hyperthermia (day)	1,07-30,8	2,17-30,8	>0,05
Average duration of Inpatient treatment (day)	4,2-30,6	6,1-0,8	>0,05



**Figure 7.** Average duration of the operation (min).



**Figure 8.** Average volume of intraoperative blood loss (ml).

Intraoperative use of the "instrument for the removal of the recurrent laryngeal nerve" reduced the time of its search (Figure 7). Thus, in the control group, the search time averaged  $9.2 \pm 0.8$  minutes, while in the main group -  $3.1 \pm 0.7$  minutes ( $p < 0.05$ ).

The total duration of the operation in patients of the control group ranged from 49 to 75 minutes and averaged  $63.7 \pm 6.1$  minutes. Whereas in the main group, due to the use of a "tool for diverting the recurrent laryngeal nerve" and preliminary embolization of the thyroid arteries, the average duration of surgery was less and amounted to  $45.4 \pm 5.8$  minutes (from 37 to 53 minutes,  $p < 0.05$ ).

As for hemostasis during the operation, absolute reliability in the main group was achieved in all 39 patients. In the patients of the main group during the operation, we did not observe massive bleeding ( $>200$  ml). As a result, the volume of blood loss during surgical intervention with DTG in the main group was significantly less than in the control group, namely:  $105.2 \pm 15.3$  ml, versus  $203.4 \pm 14.7$  ml, respectively ( $p < 0.05$ ) (Figure 8).

It should be noted the significant technical convenience of performing surgical intervention in the main group when using these techniques, in contrast to the control group. One operation in the main group took only a few ligatures for ligation of the main trunks of the thyroid arteries, whereas in the control group the amount of consumable material was significantly greater ( $p < 0.05$ ).

In the control group, 2 cases of intraoperative bleeding in the area of surgery were recorded, while in the main group there were no such complications.

In the early postoperative period, we evaluated:

- Severity of pain syndrome.
- Duration, quantity and nature of the discharge through the safety drainage.
- Temperature reaction of the body.
- The condition of the vocal cords.

The severity of the pain syndrome on the 1st day after surgery in the main group, on average, was  $3.1 \pm 0.8$  points; with a gradual decrease in the future, and in the control group -  $3.5 \pm 0.5$  points ( $p > 0.05$ ).

According to the safety drainage, hemorrhagic discharge was noted in all patients after surgery on the same day. In the main group - in the amount of  $16.4 \pm 7.4$  ml, in the control group -  $36.1 \pm 8.4$  ml ( $p > 0.05$ ). On the 1st day in the main group of patients, the amount of discharge was scarce or zero, drainage was removed, whereas in the control group, this manipulation was most often performed only for 2 days.

All patients were necessarily examined by an ENT doctor on the 3rd day to assess the condition of the vocal cords. At the same time, 2 patients (4.3%) with unilateral transient paresis of the vocal cords were identified in the control group, while no such problems were found in the main group. The complication in 2 patients of the control group - transient unilateral laryngeal paresis - was completely stopped from a medical point of view during the next 4-6 months.

Hypoparathyroidism in the main group was registered in 1 (2.5%) cases, while in the control group 4 (8.6%) cases of hypoparathyroidism were observed.

Postoperative bleeding was noted in 2 (4.3%) cases in the control group, while in the main group this complication was not noted.

The duration of inpatient treatment after thyroid surgery using new techniques ranged from 3 to 8 days, averaging  $4.2 \pm 0.6$  days. In the control group, the same indicator ranged from 5 to 10 days. (on average -  $6.1 \pm 0.8$  days).

There were no fatal outcomes among the patients of both the main and control groups.

With dynamic observation of patients at the outpatient stage for 1-3 years, there was no recurrence of the disease in the main group of patients, whereas in the control group there were 2 cases of recurrence of the disease. The cosmetology of the postoperative scar was identical in the compared groups of patients.

Thus, the comprehensive use of the prevention of postoperative laryngeal paresis after thyroidectomy, the use of a tool for the removal of the recurrent laryngeal nerve during surgery and preoperative X-ray endovascular embolization of the thyroid arteries in patients with DTG, reduces the risk of intraoperative complications and improves immediate and long-term results of surgical treatment.

## Discussion.

Diffuse toxic goiter (DTG) is a disease accompanied by hyperproduction of thyroid hormones and changes in the functional state of various organs and systems in this regard [33,34]. In terms of prevalence among thyroid diseases, it ranks second after endemic goiter [35]. To date, there is no consensus on a single tactic for treating thyroid diseases. There are supporters of both radical and organ-preserving surgeries. In this regard, the problem of choosing the scope of surgical intervention for diffuse toxic goiter arises [36].

The increase in morbidity is accompanied by an increase in surgical activity and, as a consequence, an increase in the number of unsatisfactory treatment results and the emergence of postoperative complications [36,37].

Due to significant progress in endovascular technologies, relatively recently this technology has also found its application in the treatment of DTG by embolization of the thyroid arteries (TG) [38].

It is known that postoperative laryngeal paresis and hypocalcemia remain the most pressing problems of modern surgical thyroidology. Many authors consider the minimum number of relapses and postoperative complications to be the criteria for the effectiveness of surgical treatment. Despite certain successes in the development of endocrine surgery, many aspects of the problem of postoperative complications have not been finally resolved.

A method is known that includes partial or complete removal of the thyroid gland with isolation and intraoperative visual control of the recurrent nerve, wherein after removal of the thyroid gland, the isolated recurrent nerve is covered with a grooved plate made of porous titanium nickelide. The plate is fixed on top with local tissues. The use of this invention allows for the prevention of damage to the recurrent nerve that occurs as a result of compression by postoperative scar tissue after thyroid surgery [39].

This method has the following disadvantages: 1. The plate is not elastic, so after some time, damage to the gland tissue is possible. 2. Titanium is a metal, so rejection may begin. 3. The plate may not correspond to the anatomical features of each person's neck and the gland bed after thyroidectomy. 4. If a different size (large or small) is required during surgery, it is difficult to create a size that would immediately correspond to the titanium bed.

There is a method of administering drugs subcutaneously and intramuscularly as a general treatment. The standard treatment regimen in the postoperative period includes the administration of corticosteroids (prednisolone 0.01 mg per 1 kg of body weight intravenously, 2-3 times a day), anticholinesterase drugs (proserin, 0.05% - 1 ml subcutaneously, 2 times a day), vitamins B and E 1 ml intramuscularly once a day, expectorants, electrical stimulation, reflexology.

There is a method of using the drug locally, for this purpose at the end of the surgical intervention under the parietal leaf of the 4th fascia of the neck in the area of the branching of the recurrent laryngeal nerve a catheter is installed. Then through this catheter the following drugs are sequentially administered: 1 ml of a 0.05% solution of proserin, 1 ml (4 mg) of a solution of dexamethasone and 2 ml of a 1% solution of dibazol. The administration is continued in the postoperative period once a day for 3-5 days. At the end of the course of administration the catheter is removed. The method allows to increase the effectiveness of the treatment of temporary paresis of the recurrent laryngeal nerve by creating in the required area the maximum concentration of drugs that affect various links in the pathogenesis of this pathology [40].

These methods have the following disadvantages: 1. During the installation of the catheter in the area of the branching of the recurrent laryngeal nerve, due to rigidity and non-plasticity, it is possible to damage it. 2. After performing a thyroidectomy, a catheter is installed in the resulting bed, which can subsequently change its position, it is possible for it to fall out, which will lead to a violation of the delivery of the drug to the desired area and also cause an inflammatory process. 3. In the postoperative period, the administration is continued 1 time per day for 3-5 days, introducing through the catheter, constantly moving it, which is painful for the patient, and removing the catheter on the 3rd-5th day increases the risk of bleeding. 4. With subcutaneous, intramuscular and intravenous administration of drugs, a general effect on the body is noted, with possible side effects.

There are various medications known that are used rectally for the treatment of postoperative laryngeal paresis.

Clinical studies by the authors of the proposed method have established that the introduction of Viferon in a therapeutic dose (1,000,000 IU in the form of rectal suppositories at 12-hour intervals) one day before thyroidectomy, as well as for 4 days after the operation, made it possible to avoid postoperative laryngeal paresis in these patients. In addition, the authors also established that the introduction of Viferon made it possible to reliably reduce the incidence of postoperative hypocalcemia from 38% to 32%.

The authors' clinical observations suggest that when using the drug "Viferon" and maintaining the anatomical integrity of the

recurrent laryngeal nerves, the risk of developing postoperative laryngeal paresis is minimized [41].

But this method has a number of significant disadvantages: 1. Rectal administration of the drug prolongs the delivery time to the required area. 2. Possibility of rectal irritation (in some cases). 3. The apparent unaesthetic nature of the application disgusts some patients. 4. Difficulties in selecting bases (melting point requirements, absence of irritating effect, release of medicinal substance). 5. Storage is only permissible at certain temperatures. In hot climates, storage at room temperature is impossible.

In our study, we used the "method of preventing postoperative laryngeal paresis after thyroidectomy" in thyroid surgery in the main group in all 39 patients to minimize the risk of postoperative laryngeal paresis after thyroidectomy while maintaining the anatomical integrity of the recurrent laryngeal nerves, as well as a reliable decrease in the incidence of postoperative hypocalcemia using interferon in combination with tachocomb (to achieve hemostasis in the wound). The use of "interferon" improves the treatment results for patients with thyroid diseases.

The instrument for thyroid gland operations allows to reduce traumatization of soft tissues of the neck and recurrent laryngeal nerve due to the presence of a hook with a spherical tip, carefully separating and not damaging it. The base provides convenience in using the device, especially with diffuse-nodular goiter of large sizes. The ruler on the handle is used to measure the size of the thyroid gland, residual tissue, which also provides convenience.

Currently, practical surgeons use improvised instruments capable of isolating the recurrent laryngeal nerve, so the complication in the form of damage to the recurrent laryngeal nerve is high, for example, a tool used in traumatology is known tendon strippers ("B. Braun Aesculap", catalog numbers - FO930R, FO935R, FO937R, FO939R): Used to isolate the sural nerve. As a prototype, taking into account the specifics of pediatric surgery, the tendon stripper FO935R was chosen due to the fact that this product is the smallest in size. The tendon stripper FO935R has a head with a longitudinal through hole of a cylindrical shape (for placing the sural nerve), located between the area of the connection of the head with the rod and the opposite surface; a rod 300 mm long and a handle. The head is bullet-shaped with a narrowing in the area of the front edge of the tool and a perpendicular relationship between the side and back edges. The connection of the rod and handle is carried out by welding at the end.

The disadvantages of this product are: 1. It cannot be used in a small area due to the wide rod and wide head. 2. High risk of the product jamming and the impossibility of removing it. 3. Risk of breaking the tool under alternating load between the rod and the handle due to welding in the area where the rod and the end of the handle meet.

A device for isolating and cutting a nerve is known, comprising a head with a knife, connected by means of a rod to a handle, wherein the head is made in the form of a sleeve with a cutting edge at the end, and the axis of the rod is located parallel to the axis of the sleeve.

But this method has a number of significant disadvantages: 1. This device does not allow to isolate a nerve located in a tortuous area, on a small area, because it has a straight rod attached to the handle, while the rib has a curved shape - not maneuverable. 2. This device does not allow to dissect soft tissues, which is necessary for extracting the nerve.

In our study, we used a tool we developed that has a simpler design, is easy to use, and creates comfortable conditions for the surgeon to work.

The technical result is the creation of a good overview and access to the organs, arteries and veins and fascia of the thyroid gland, the abduction of the recurrent laryngeal nerve with fixation and an increase in the quality of operations to prevent damage to the recurrent laryngeal nerve during operations on the thyroid gland, which is a decrease in the frequency of damage to the laryngeal nerves and the subsequent development of dysphagia and dysphonia.

Thus, the comprehensive use of the proposed methods reflected in our study allows us to reduce the risk of intraoperative complications and improve the immediate and long-term results of surgical treatment.

#### **Conclusion.**

A method for the prevention of postoperative laryngeal paresis after thyroidectomy minimizing the risk of postoperative laryngeal paresis after thyroidectomy while maintaining the anatomical integrity of the recurrent laryngeal nerves, as well as a significant reduction in the frequency of postoperative hypocalcemia with the use of interferon in combination with tachocomb. The use of Interferon can improve the results of treatment of patients with thyroid diseases.

The "instrument for the withdrawal of the recurrent laryngeal nerve" was also tested in all patients with DTG in the main group. Tool- allows you to create conditions for better and safer work of the surgeon during thyroid surgery, by removing, fixing the recurrent laryngeal nerve and creating a good overview of the surgical field and during various surgical interventions to prevent injury.

The technique of endovascular embolization of the thyroid arteries in patients with DTG in the preoperative period helps to reduce the volume of the thyroid gland by 15-20% compared to the initial one, allows to significantly reduce intraoperative blood loss, which facilitates the technical side of the operation.

The use of a new method for the prevention of postoperative laryngeal paresis after thyroidectomy and "a tool for the removal of the recurrent laryngeal nerve" as well as endovascular embolization of the thyroid arteries in the surgical treatment of patients with DTG can reduce the duration of surgery by 26%, the volume of intraoperative blood loss - by 52.5%, and also avoid complications such as recurrent nerve injury and bleeding in early postoperative period.

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