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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

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. 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.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. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შედეგის 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.

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DIAGNOSTIC OF PANCREATIC INJURY USING INFRARED THERMOMETRY

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Abstract.

Aim: The study of the dynamics of changes in the temperature indicators of the injured pancreatic tissues in various types of mechanical trauma, depending on the time elapsed since the injury and the time of death.

Material and methods: The material of the study was the pancreatic tissue of 256 individuals, both male and female, aged 20 to 60, who died with a known time of injury and time of death, with or without the presence of alcohol in the blood.

Results: The article analyzes the issue of diagnostics, determining the time of injury and time of death. In the course of the conducted studies, statistically reliable dynamics of temperature decrease was revealed in both injured and intact pancreatic tissues in individuals who died from injuries, which can be used as one of the criteria for determining the time of injury. The study revealed that higher quantitative temperature indicators are observed directly in the area of pancreatic damage in comparison with uninjured pancreatic tissues with an average difference of 1.5-3°C (± 0.17). It was established that the sex of a person (male or female) does not significantly influence the temperature indicators of the pancreas.

Conclusions: Based on the results of the study, a regression model was proposed for using to determine the time of death. This model takes into account the temperature indicators of the parenchymal organs of the abdominal cavity and retroperitoneal space in combination (liver, pancreas, spleen, kidneys) in dynamics at both positive and negative temperatures, using a modern method of infrared thermometry.

Key words. Injury, pancreas, diagnostics, thermometry.

Introduction.

The modern development of scientific and technical progress, industry, an increase in a number of vehicles, natural and man-made disasters are characterized by a significant increase in injuries, leading to an increase in mortality from injuries, which ranks third after cardiovascular and oncological diseases, and is the leading cause of death among the population under 40 years old. Furthermore, the issue of investigating criminal cases involving injury and death, especially in the context of international armed conflicts, which leads to a constant increase in the number of injured, dead, and missing persons, is a very relevant problem today [1-4]. Accordingly, there is a need for the constant development and application of new methods and techniques to increase the informativeness, justification, and objectivity of injury diagnostics [5-7].

The article analyzes the issue of diagnostics, determining the time of injury and time of death. According to the research results, recommendations were provided for the practical application of statistically significant dynamics of decreasing

temperature indicators in injured and intact tissues of the organs of the abdominal cavity and retroperitoneal space, in particular, the pancreas in individuals who died from injuries as one of the criteria for determining the time of injury and death.

In the overall structure of mechanical injury to the parenchymal organs of the abdominal cavity, the number of pancreatic injuries according to various data is up to 9% and is characterized by high mortality according to various data from 12% to 42% due to the absence of clinical symptoms, therefore there are difficulties in diagnostics [7-9]. The objective of the study was to study the dynamics of changes in the temperature indicators of the injured pancreatic tissues in various types of mechanical injuries, depending on the time elapsed since the injury and the time of death.

Materials and Methods.

Study design and participants:

The research material to date is pancreatic tissues of 256 individuals, both male and female, aged 20 to 60, who died with a known time of injury and time of death, with or without the presence of alcohol in the blood. These people were subjected to autopsy in the anatomical department of the Bureau of Forensic Medical Examination (Kyiv, Ukraine).

The work was carried out in accordance with the requirements of the «Instructions on the Forensic Medical Examination» (Order of the Ministry of Health of Ukraine No. 6 dated 01/17/1995), in accordance with the requirements and norms, standard provision on ethics of the Ministry of Health of Ukraine No. 690 dated 09/23/2009, «Procedure for the Removal of Biological Objects from the Dead, whose Bodies are Subject to Forensic Examination and Pathoanatomical Examination for Scientific Purposes» (2018). Ethics Committee of the O.O. Bohomolets National Medical University, Kyiv, Ukraine (project no 1, date: 24.01.2023)

Method of data collection:

We used the modern method of infrared thermometry to resolve the issue of limitation of pancreas damage. The methods of infrared thermometry were used to determine the temperature of the injured and intact tissues of the liver, spleen, pancreas and kidneys to establish the limitation of death and the time of damage. We conducted the study using the thermal ITMO tracer models Th 9100 pmvi-wl, which is a contactless high-sensitive infrared cameras (Japan). Infrared radiation from the object registered and converted the camera into an electrical signal, after which the analog temperature signal was converted into a digital signal, which was displayed in the form of a colored thermogram. In the case of studies, we studied the pancreas temperature after 1, 2, , 10, 12, 14, 16, 18, 20 and 24 hours after opening the temperature of the internal organs of

healthy persons is quite constant, depends on the amount of heat they produce, the activity of metabolic processes and chemical reactions. The temperature of the internal environment of the abdominal cavity is quite constant and is an average of $37.0 \pm 1^\circ$ system of the environment in the morgue during research was 18°C .

Statistical Analysis:

Statistical data processing was carried out using Microsoft Excel XP and Statsoft Statistica 10.0 software packages.

Group indicators of descriptive statistics were calculated - arithmetic mean (m), 95 % trust interval average (95 % CI), medium (M) error, median (ME), lower 25 % quarter (LQ), upper 75 % quarter UQ. To choose the criterion for evaluating the significance of even differences, the correspondence of the form of distribution was checked, the criterion of Kolmogorov - Smirnova was used, and the equality of general variances using Fisher F -criterion was controlled. The hypothesis of the equality of general average in all cases was performed using the U- the Mann-Howitney Test criterion for independent variables, which were the most significant non-parametric alternative to the Student's T-criterion. The level of significance did not exceed 5 %, ie $p < 0.05$. For determining the required sample volume, the value of the arithmetic and average quadratic deviations determined. During biometric analysis, the calculations were performed using the PSAT system using the relevant licensing applications. The registration of research materials, depending on their features, was entered in the corresponding protocols. Microphotography of the objects of the study was carried out both on the photographic facilities "Mikrat-300" with the help of the camera "Zenith E", and with the help of modern digital technologies (camera "Canon", computer). Standard photographs were used for microphotoms.

Results.

As a result of a study of the temperature indicators in injured and intact pancreatic tissues using the infrared thermometry method, it was established that the temperature indicators in the area of injured pancreatic tissues and intact parts gradually decrease as the time since the injury increases, while the temperature indicators of the skin covers were also taken into account, as shown in (Figures 1-4).

When conducting an analysis of the obtained temperature indicators of the pancreas from the area of injury and adjacent uninjured tissues, with mandatory consideration of the temperature indicators of the skin covers, it was established that there is a statistically significant dynamic decrease in the temperature indicators of the pancreas in both men and women, depending on ambient temperature at the time of death, the thickness of subcutaneous tissue, and the time of examination of the injured and intact organs after autopsy.

The dynamics of changes in temperature indicators of the pancreas depending on sex and ambient temperature at the time of death are shown in (Table 1 and Figure 5).

A statistically significant dynamic decrease in temperature indicators in both injured and intact pancreatic tissues in individuals who died from injuries was established. It was used as one of the criteria for determining the time of the injury onset. The identified statistically significant difference in the temperature indicators of the pancreas depending on the time of injury and the time of death allowed to develop mathematical models for the most accurate determination of the time of death, taking into account external and internal factors, such as ambient temperature, thickness of the subcutaneous tissue and the time of the study after autopsy. Such a factor as sex does not significantly affect the temperature indicators of the pancreas.

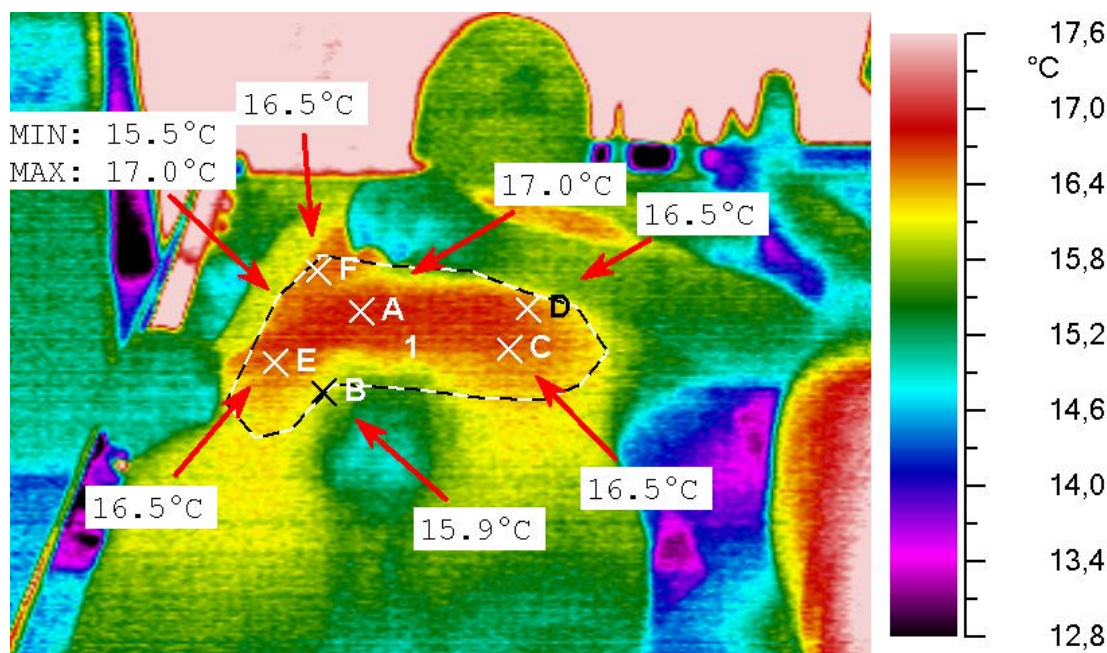


Figure 1. Temperature indicators of the skin cover of a 48-year-old male who died from a mechanical injury.
Notes: A – anterior surface of the abdominal wall in the liver area; B – inguinal area on the right; C, E – anterior abdominal wall; D – anterior abdominal wall in the pancreatic area; F – anterior surface of the chest on the right.

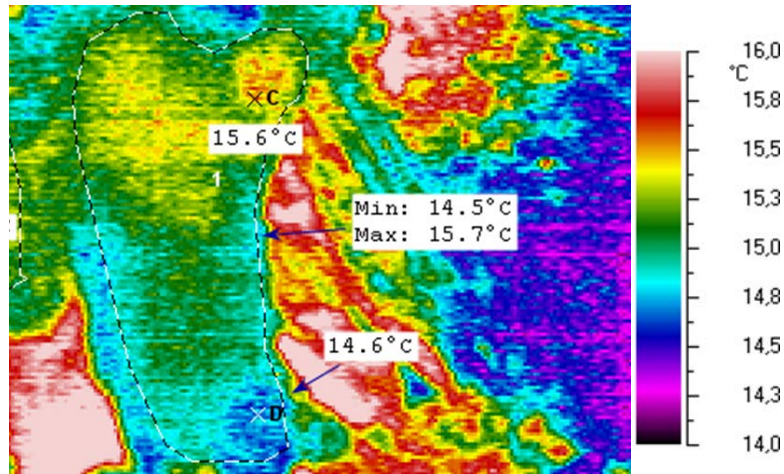


Figure 2. Temperature indicators of pancreatic tissues 1 hour after autopsy.
Notes: C – area of injury; D – area of uninjured tissues.

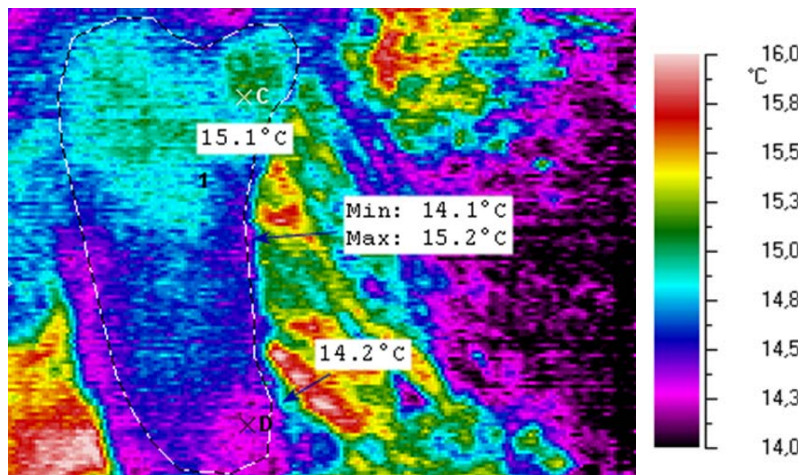


Figure 3. Temperature indicators of pancreatic tissues 6 hours after autopsy.
Notes: C – area of injury; D – area of uninjured tissues.

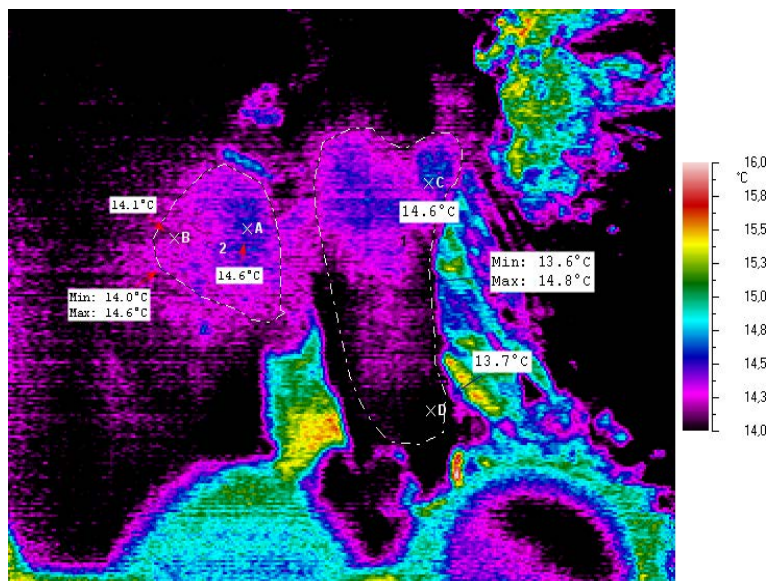


Figure 4. Temperature indicators of pancreatic tissues 24 hours after autopsy.
Notes: C – area of injury; D – area of uninjured tissues.

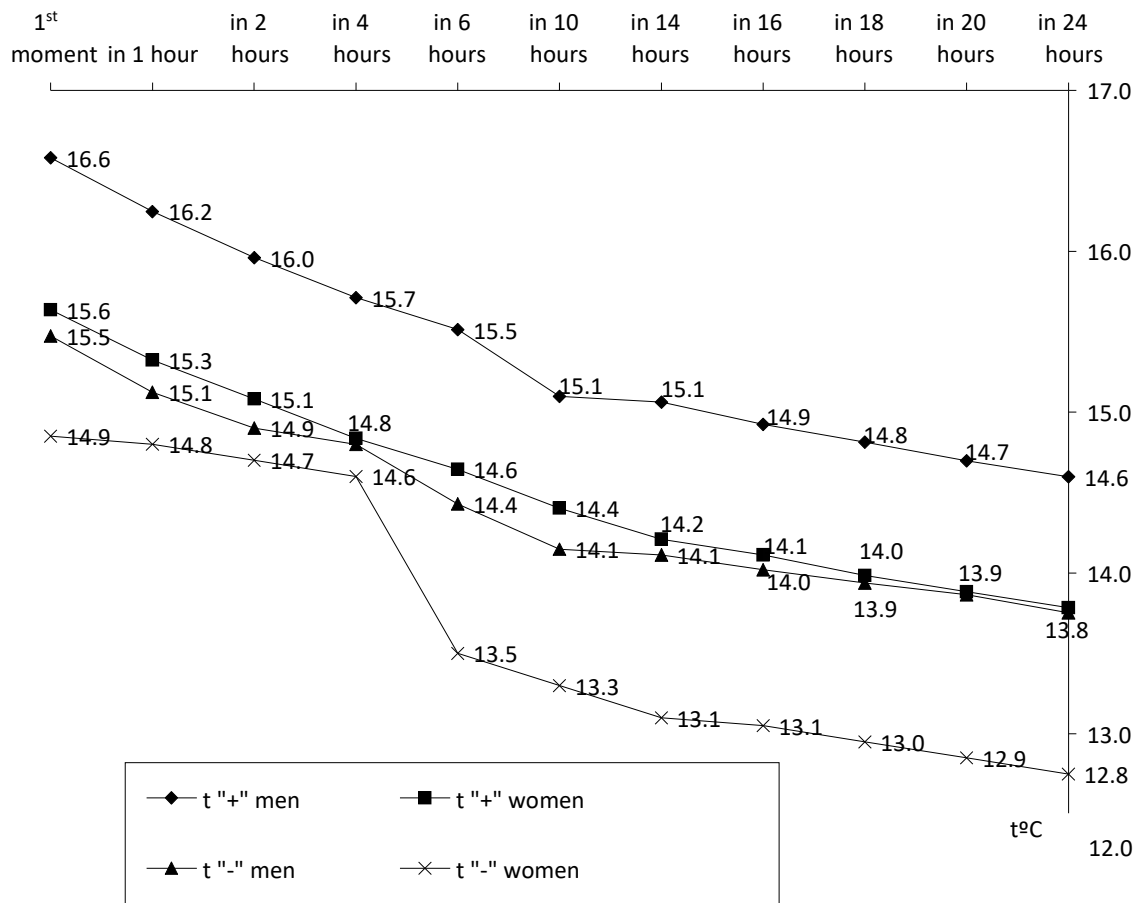


Figure 5. Dynamics of changes in the temperature of the pancreas depending on sex and ambient temperature at the time of death.

Notes: t'+ men – temperature indicators of pancreatic tissues in men at positive ambient temperature; t'' men – temperature indicators of pancreatic tissues in men at negative ambient temperature; t'+ women – temperature indicators of pancreatic tissues in women at positive ambient temperature; t'' women – temperature indicators of pancreatic tissues in women at negative ambient temperature.

Table 1. Dynamics of changes in the average values of the temperature of the pancreas depending on sex and ambient temperature, M±m (95% CI).

Terms of research after autopsy	Negative temperature		Difference level	Positive temperature		Difference level
	Male, n=76	Female, n=32		Male, n=80	Female, n=68	
5 minutes	15.64±0.16 (15.32 – 15.95)	15.37±0.19 (14.98 – 15.75)	0.187	16.58±0.20 (16.17 – 16.99)	15.47±0.04 (15.39 – 15.56)	0.003
1 hour	15.32±0.16 (15.01 – 15.63)	15.03±0.19 (14.65 – 15.42)	0.041	16.25±0.20 (15.85 – 16.65)	15.12±0.05 (15.03 – 15.21)	0.002
2 hours	15.08±0.15 (14.78 – 15.39)	14.73±0.20 (14.33 – 15.13)	0.024	15.96±0.20 (15.56 – 16.36)	14.82±0.04 (14.75 – 14.90)	0.001
4 hours	14.84±0.15 (14.54 – 15.14)	15.04±0.15 (14.73 – 15.35)	0.008	15.71±0.19 (15.32 – 16.10)	14.65±0.05 (14.55 – 14.75)	0.003
6 hours	14.64±0.15 (14.34 – 14.95)	14.25±0.20 (13.84 – 14.66)	0.044	15.51±0.19 (15.12 – 15.90)	14.43±0.04 (14.35 – 14.51)	0.002
10 hours	14.40±0.15 (14.10 – 14.71)	13.96±0.22 (13.52 – 14.40)	0.036	15.10±0.22 (14.66 – 15.53)	14.15±0.05 (14.06 – 14.24)	0.007
14 hours	14.21±0.15 (13.91 – 14.51)	13.84±0.20 (13.43 – 14.25)	0.046	15.06±0.20 (14.67 – 15.45)	14.11±0.05 (14.01 – 14.21)	0.023
16 hours	14.11±0.16 (13.80 – 14.42)	13.75±0.19 (13.36 – 14.15)	0.049	14.92±0.20 (14.53 – 15.32)	14.02±0.05 (13.91 – 14.13)	0.09
18 hours	13.98±0.15 (13.68 – 14.29)	13.64±0.19 (13.25 – 14.04)	0.038	14.81±0.20 (14.42 – 15.21)	13.94±0.05 (13.83 – 14.05)	0.12
20 hours	13.88±0.15 (13.58 – 14.19)	13.55±0.20 (13.15 – 13.94)	0.063	14.70±0.20 (14.30 – 15.09)	13.86±0.06 (13.75 – 13.98)	0.18
24 hours	13.78±0.15 (13.48 – 14.09)	13.45±0.20 (13.05 – 13.84)	0.063	14.60±0.20 (14.20 – 14.99)	13.75±0.06 (13.64 – 13.87)	0.15

As a result of further statistical processing of the temperature indicators of the pancreas, it was found that for a more accurate determination of the time of death, the temperature indicators of the pancreas alone are not enough. It is necessary to take into account the temperature indicators of other parenchymal organs of the abdominal cavity and retroperitoneal space (liver, spleen, kidneys), as a result of which a regression model was obtained for determining the time of death of individuals who died as a result of mechanical injury at different temperatures. In the case of negative temperatures:

$$Y=7291.5+X_1x18.3-X_2x6.9-X_3x631.3+X_4x281.2-X_5x173.3-X_6x40.9+X_7x268.8$$

where Y – time of death, X_1 – thickness of subcutaneous tissue; X_2 – temperature of external covers; X_3 – liver temperature; X_4 – spleen temperature; X_5 – pancreas temperature; X_6 – temperature of the right kidney; X_7 – temperature of the left kidney.

The regression model for determining the time of death according to the temperature indicators of parenchymal organs of the abdominal cavity and retroperitoneal space (liver, pancreas, spleen, kidneys) of individuals who died as a result of mechanical injury in the case of positive temperatures is as follows:

$$Y=6324.7+X_1x24.5-X_2x844.3+X_3x760.7+X_4x277.9-X_5x14.7+X_6x633.2-X_7x917.6$$

where Y – time of death, X_1 – thickness of subcutaneous tissue; X_2 – temperature of external covers; X_3 – liver temperature; X_4 – spleen temperature; X_5 – pancreas temperature; X_6 – temperature of the right kidney; X_7 – temperature of the left kidney.

Discussion.

According to a number of authors, isolated pancreatic injuries are observed in 18% of patients, in 82% pancreatic injury is combined with injuries of the liver, gall bladder and bile ducts, spleen, and intestines [10-13] The conducted studies established statistically significant dynamics of temperature reduction in both injured and intact pancreatic tissues in individuals who died from injuries, which can be used as one of the criteria for determining the time of injury [1,5,14,15]. The study resulted in new findings and the development of mathematical models for determining the time of death, taking into account the temperature indicators of the organs of the abdominal cavity and retroperitoneal space using the modern method of infrared thermometry [13].

Conclusion.

The study revealed that higher quantitative temperature indicators are observed directly in the area of pancreatic injury compared to uninjured pancreatic tissues, with an average difference of 1.5-3°C (± 0.17). It was established that such a factor as sex does not significantly affect the temperature indicators of the pancreas. To establish the time of death, it is advisable to use a regression model that takes into account the effect on the temperature indicators of the parenchymal organs of the abdominal cavity and retroperitoneal space in combination

(liver, pancreas, spleen, kidneys) in the dynamics of positive and negative temperature. The proposed comprehensive approach, based on determining thermometric indicators of the parenchymal organs of the abdominal cavity and retroperitoneal space, optimizes the accuracy and probability of addressing issues regarding the time of death and the time of injury. To obtain objective information, it is necessary to repeatedly measure the temperature in dynamics at the recommended time intervals.

Ethics.

Ethics Committee Approval: This study was approved by «Instructions on the Forensic Medical Examination» (Order of the Ministry of Health of Ukraine No. 6 dated 01/17/1995), in accordance with the requirements and norms, standard provision on ethics of the Ministry of Health of Ukraine No. 690 dated 09/23/2009, «Procedure for the Removal of Biological Objects from the Dead, whose Bodies are Subject to Forensic Examination and Pathoanatomical Examination for Scientific Purposes» (2018). Ethics Committee of the O.O. Bohomolets National Medical University, Kyiv, Ukraine (project no 1, date: 24.01.2023).

The authors declare no conflict of interest regarding this article.

The authors declare that all the procedures and experiments of this study respect the ethical standards in the Helsinki Declaration of 1975, as revised in 2008(5), as well as the national law.

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Author Contributions:

Conceptualization, **Babkina Olena** and **Korobko Ihor**; methodology, **Babkina Olena**, **Korobko Ihor**; software, **Danylchenko S.**; validation, **Zozuliak Vadym** and **Korobko Ihor**; formal analysis, **Valerii Kucher**; investigation, **Babkina Olena**, **Korobko Ihor**; resources, **Zozuliak Vadym**, **Valerii Kucher**; data curation, **Valerii Kucher**, and **Zozuliak Vadym**; writing-original draft preparation, **Babkina Olena**, **Korobko Ihor**; writing-review and editing, **Babkina Olena**, **Korobko Ihor**; visualization, **Babkina Olena** and **Danylchenko S.**; supervision, **Korobko Ihor**; project administration, **Babkina Olena**, **Korobko Ihor**. All authors contributed equally to the present work. All authors contributed to the critical revision of the article for valuable intellectual content. All the authors have read and agreed with the final version of the article.

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