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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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

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

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

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

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

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

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

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

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

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

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

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

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

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

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

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

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

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

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

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

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

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

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

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

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

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

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

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

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

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

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

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

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

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

Содержание:

APPLICATION OF ARTIFICIAL INTELLIGENCE IN CIVIL AND MILITARY MEDICINE

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Abstract.

Artificial intelligence (AI) encompasses the advancement of computers and robots, enabling them to surpass human capabilities in various aspects. By utilizing AI, programs have the ability to autonomously analyze and interpret data, offering information and executing actions without any human involvement. The ongoing war in Ukraine showed various aspects of severe gunshot injuries because of previously unknown course of wounds after application of ballistic missiles, drones, etc., which is frequently applied by russians. In such conditions, decision-making process by military medical doctors must be quick and rational, however in case of massive casualties, combined trauma (e.g. thoracoabdominal gunshot injury) MDs might have permanent challenges to apply appropriate care options and individualized approach. The aim of this study is to start the discussion about role and possible application of AI in management of gunshot injuries in combat patients or other individuals who received wounds relating to high-energy weapon. Conclusions. Gunshot wound is a clinical challenge in many cases among patients who were injured by high-energy weapons, requiring complex and quick decisions. AI might be applied as an additional tool for the decision-making process in case of severe trauma in deployed field hospitals, or in hospitals of higher Roles (3-4). This study is to start the research discussion about the utility of AI application for the management of the injured in the war associated with high-energy weapons.

Key words. Artificial intelligence, severe trauma, injuries, high-energy weapons.

Introduction.

Artificial intelligence (AI) encompasses the advancement of computers and robots, enabling them to surpass human capabilities in various aspects [1]. By utilizing AI, programs have the ability to autonomously analyze and interpret data, offering information and executing actions without any human involvement. Presently, there are techniques like natural language processing and computer vision that facilitate task automation, expedite decision-making, and enable customer interaction through chatbots, presenting opportunities for enhanced communication. There are two approaches to automatic data sorting: AI and machine learning (ML). The consideration for application of AI for medical purposes is ongoing according to published reports. The AI is considered as an effective and promising tool in various fields of medicine including high medical education and routine clinical setting to help students and then medical doctors in data analyses and support decision for management of the patients [2,3]. Other possible applications for AI might be considered for the management of severe trauma, including injuries by high-energy weapon [2,4]. The ongoing war in Ukraine showed various aspects of severe gunshot injuries because of previously unknown course of wounds after application of ballistic missiles, drones, etc., which is frequently applied by russians [5-14]. In such conditions, decision-making process by military medical doctors must be quick and rational, however in case of massive casualties, combined trauma (e.g. thoracoabdominal gunshot injury) MDs might have permanent challenges to apply appropriate care options and individualized approach. Another issue to be considered is pathologic changes in the human tissues within the area of gunshot wound and its canal as well as consequences to the patients outcomes.

The overall presentation of Artificial intelligence.

There are two approaches to automatic data sorting: artificial intelligence AI and ML. Both of these methods can be very effective in identifying relationships between available information for data classification. Although artificial intelligence and machine learning are often used interchangeably, machine learning is actually a subset of the broader category of artificial intelligence [1].

Machine learning, for its part, is a means of achieving artificial intelligence. Within the realm of artificial intelligence, machine learning employs algorithms to autonomously learn and detect patterns within a dataset, subsequently utilizing this acquired knowledge to make progressively precise decisions [1]. Deep learning, an advanced form of machine learning, takes this concept a step further. Deep learning models employ expansive neural networks that mimic the workings of the human brain to analyze intricate patterns and generate predictions autonomously, without relying solely on the input data [15]. The field of machine learning can be categorized into two primary divisions: supervised learning and unsupervised learning. In supervised learning, human experts assign labels to the data, designating them as either significant or insignificant, which is then used as input for an algorithm that constructs a model to categorize the data into distinct classes. Conversely, unsupervised learning eliminates the need for manual labeling or training data. Instead, the algorithm autonomously groups similar data together and classifies them based on the consistency within each class and the distinctiveness between classes [16]. In order to achieve the primary goal, namely, the classification of large and complex data with great accuracy and the creation of a database for further use, it is appropriate to apply machine learning. If one considers the algorithms that can be used in the development of machine learning the following aspects might be seen: the k-nearest neighbor (k-NN) technique involves analyzing the Euclidean distance between data samples to determine classes for new data items. This allows easy classification of a new element based on its proximity to previously classified data elements [16]. The k-NN technique is an attractive choice for data classification because it can quickly learn and discover relationships between new and previously known information [16]. Currently, experts are investigating the application of k-NN for real-time data sorting [17]. This method has been used successfully to detect sorting data and is most effective when the data can be represented by a model that allows us to measure its distance to other data, such as a distribution or a Gaussian vector.

But in order to achieve truly precise and highly accurate data analysis, deep machine learning, also known as Deep Learning, is the ideal approach. Deep Learning is a specialized field within machine learning that mimics the learning process of humans by leveraging vast quantities of data. Within a "deep learning algorithm" or "deep neural network", numerous intermediate layers exist between the input and output data, enhancing the complexity and sophistication of the analysis.

Artificial Neural Networks (ANNs) is a deep learning computing technology inspired by the functioning of neurons in the human brain that transmit and interpret information [18]. In ANNs, a neuron is represented as a mathematical formula that receives input data and produces a target output value that is then passed to the next neuron based on its value. The ANN algorithm continues to iterate until the output value is close enough to the target value that the neurons can learn and calibrate their weights by evaluating the discrepancy between the expected and previous output value. After completing this process, the algorithm provides a mathematical formula that generates a value that can be used to classify and sort the data [16]. A key advantage of artificial neural networks is their ability to adapt their mathematical models based on new data, unlike other mathematical models that may become outdated as new studies appear [16].

It is also necessary to understand that the construction of a database for artificial intelligence, especially for processing medical data on injuries, requires significant efforts due to their specificity, both visual and research. In such cases, using off-the-shelf AIs such as GPT chat may not be appropriate as they may not have sufficient expertise or skills to work with such data [19]. Therefore, it is important to consider the use of specialized models, developed taking into account the needs and characteristics of the medical field, having the appropriate experience and training to work with such data. Artificial intelligence obtained through the above methods will be specialized for medical use, focusing on treatment. It will be characterized by high accuracy, as it is based on machine learning and in particular deep learning technologies [19]. The final result of the examination of this artificial intelligence will be independent of human influence, which will ensure objectivity and reliability in the decision-making process.

The aim of this study is to start the discussion about the role and possible application of AI in management of gunshot injuries in combat patients or other individuals who received wounds relating to high-energy weapon.

Materials and methods.

We used the PubMed and Google Scholar search engine electronic database of publications, searching for abstracts using the following key words: artificial intelligence and wounds, artificial intelligence and gunshot wounds management, artificial intelligence, and healthcare. Based on the results of this search, 4,753 articles were identified and analyzed, followed by selection of the most important and appropriate to the scope of this research publications that meet modern scientific and practical standards as well as the current need for the AI application for medical purposes. The exact criteria for the selecting literature were relation to the gunshot injury or gunshot-related injury as well as trauma related to the combat casualties.

Current applications of AI for gunshot wounds.

Nederpelt et al. demonstrated application of artificial intelligence triage (information aware Dirichlet deep neural network) for prediction of shock and showed its utility for overall bleeding control procedures as well as in cases of massive blood transfusion in case of gunshot wounds. In this study, AI used various data about the anatomy locations and clinical data to predict shock course. By using AI, Nederpelt et al. developed a probability model to be used for prediction of shock [20]. Cheng et al performed research aimed to evaluate various specific features of entrance and exit gunshot wounds, which is frequently problematic for forensic doctors. This study used AI, evaluating clinical data from the forensic cohort, and resulted in identification specific protocol for the defining of entrance and exit holes. According to presented data, AI demonstrated utility for the correct classification of the abovementioned gunshot hole features (imprints, peripheral tears, stippling, bone beveling, border irregularity) and reported it as an image. The study is another evidence of excellent application of AI for medical purposes [21]. Other good example of AI application for the healthcare task is shown by Barakat-Johnson et al. This study evaluated patients with gunshot wounds in terms of the improvement of emergency care by using virtual medical aid. The AI was applied as a tool for remote patient monitoring, aiming to reduce patient transportation time to other levels of medical care in case of the worsening patient's condition [22]. In line with others, Alser et al. developed a model with using of AI for prediction of patients with chest gunshot wounds as well as outcomes of their treatment. The study demonstrated the high utility of AI to solve mentioned tasks with a high accuracy, showing good results for the fast mobilization of appropriate resources as well as the improving of timing for doctors' decisions. Overall, the results from this study showed significantly better outcomes for those patients who were managed with using such additional tool as AI [2]. It is also worth mentioning the study by Lee et al., who suggested to apply AI to create the model for prediction mortality in the Department of Emergency in order to identify high risk cases and reduce the mortality rate. The authors performed research on large nationwide data sets, resulting in a model and minimizing overfitting. We anticipate that our AI-based risk calculator tool will substantially aid health care providers, particularly regarding triage and early diagnosis for trauma patients [23]. The role of AI was also shown by Rippon et al. in their study of wound care. The study reported application of AI for assessment of acute and hard-to-heal wounds and possible role of AI for decisions in management of the patients with such clinical problems. It was shown that AI might be applied for the optimization of the protocols for wound care specifically in hard-to-heal wounds, which is in line with our hypothesis of possible AI application for the patients with gunshot wounds received due to high-energy weapon injury [24]. The further development of AI is also related to mobile application, considering their quick response in case of rapid clinical need. For example, Han et al. reported study of mobile application of AI for the critical patients in the intensive care unit with fractures in order to create a prediction for the early mortality among these individuals. The results from this study supported the conclusion of the utility of AI model (with the eXGBM algorithm), showing high performance in critical patients, allowing to predict 30 days mortality [25]. Still, the analyses of the published data lacking the information about the application of AI for the better understanding of wound healing process as well as understanding of wound healing process, and the possible features of the molecular stress and temporary and permanent cavity impacts on the healing process in the patients who received gunshot injury due to high-energy weapon, including combat patients wounded in the Russo-Ukrainian war.

The overall challenges in wound management.

Despite all the modern developments and research in the field of studying wounds caused by high-energy weapons, there is currently no comprehensive view of the entire set of consequences of wounds, not only from shrapnel wounds, but even from bullet wounds. According to published reports, the consequences of gunshot wounds were well described, in view of the changes in cell membranes in the area of the wound channel and the temporary pulsating cavity, as well as features of the microbial flora [14,26,27]. The basic research studies also showed ballistic features of gunshot wounds, including mathematical modeling of wounds in relation to the different types of bullets (explosive, ordinary) on animal models and ballistic plasticine or gel [11,14,28-30]. There are also multiple original publications, case reports, and patient series regarding the course of the wound process in various cases. However, the data often disagree with each other, sometimes having a paradoxical character, which ultimately led to the absence of a single effective protocol for the management of patients with severe gunshot wound based on the proven effectiveness of its use. The criterion of such a protocol should be reduction of patient's' disability time, shortening of treatment duration, and return to service. Also, in addition to the specified criteria, we did not find reliable morphological criteria for tissue damage when exposed to high-energy weapons, which can be relied on for analysis and prognosis. The role of microcirculation disturbance in the zones of the wound channel is not defined: the zone of primary necrosis, the zone of molecular shock, necrobiosis fields (areas of primary and secondary necrosis) [4,26,31,32]. According to the treatment criteria (classical non-inflammation wounds), both acute and chronic (diabetic foot syndrome) wounds are associated with the microcirculation disorders, playing a significant prognostic role in the healing process. It is possible to consider and compare wounds in the case of a diabetic foot, demonstrating changes of microcirculation that might be detected by determining the level of transcutaneous oxygen $TcPO_2$, which also might be considered for penetrating gunshot wounds. Therefore, the existing zone of detection of non-viable tissues during tissue primary debridement and subsequent conservative treatment is excluded based on the experience and worldview of the doctor, which cannot give the predicted permanent effect. Due to the narrow specialization of medical doctors, there is often no exchange of modern methods of diagnosis and treatment, which are used in different fields of medicine. Therefore, the most productive method is the synthesis and summation of the experience of specialists from various fields who are experts in narrow fields that may not be directly related to wound treatment (geneticists, biochemists, biologists, etc.). The problem exists for tissue microcirculation detection and evaluation, and various methods have been suggested. One of these is related to the application of indocyanine green (ICG), which is a contrast fluorophore agent to detect areas of microcirculation disturbance in damaged tissue, and the correlation of these data to the histological study of these tissues over time of follow up. Determination of the ICG signal in the near-infrared area is known as fluorescence-guided surgery, especially for the endocrine surgeons during operations on the thyroid gland to identify and preserve the parathyroid glands as well as to detect their recurrent laryngeal nerve and other peripheral nerves using the ICG fluorophore angiography [33-37]. Oncologists and endocrinologists dealing with thyroid cancer use fluorescence-guided surgery method to determine the localization of metastatic lymph nodes and perform minimally traumatic surgery for breast cancer, a similar method is used in laparoscopic operations to determine the extent of metastatic damage to the peritoneum and pelvic organs in malignant gynecologic neoplasms and bowel formations. However, the use of such a technique is limited on the one hand by the technical parameters of spectrometers that are presented on the market of Ukraine, and on the other hand by unmotivated high prices from distributors, which often exceed similar prices, as well as bad planning in the healthcare sector [38]. The fluorescence-guided surgery with and without ICG application might be used for the prediction of the perfusion of the tissues and to be used as a possible tool for the evaluation of wound healing process, which is different for the gunshot wounds. The inclusion of fluorescence-guided surgery to the AI algorithms for the valuation of the gunshot combat injury might be considered in future studies.

Therefore, at the final stage is the development and implementation of a new multispectral device that would be effective in evaluating the ICG-induced signal in various tissues, and at various depths of biological tissues, including those after exposure to the high-energy weapon. Evaluation of the existing spectral analogues for detecting ICG signal showed that such devices are associated with narrow "specialization" and applicable only on certain biological tissues. The preliminary results of the application of the ICG angiography for tissue evaluation to inspire optimism and help to expand and supplement previously studied data on the course of the wound process that were obtained earlier. But given the vast massive of the unrelated signals, there is no cause-and-effect relationship, and there are areas of gaps at both the basic and clinical research levels for the ICG application for evaluation of the gunshot wounds. It is also worth mentioning, that translational studies (a combination of basic research and clinical experiments in one study) also lack a systematic relationship with long-term outcomes of treatment of gunshot wounds. Therefore, a multidisciplinary research group turned to the experience of applying AI in this field. According to peer-reviewed literary sources, the absolute majority are based on an AI system such as ChatGPT and are descriptive in nature, without taking into account the interaction of numerous unrelated factors.

Conclusion.

Gunshot wounds are clinical challenge in many cases among patients who were injured by high-energy weapons, requiring complex and quick decisions. AI might be applied as an additional tool for the decision-making process in case of severe trauma in deployed field hospitals, or in hospitals of higher Roles. This study is to start the research discussion about the utility of AI application for the management of the injured in the war associated with high-energy weapon as well as for the application in the basic, translational, and clinical studies of the gunshot injury.

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