

DOI: <https://doi.org/10.34921/amj.2025.3.28>**SEPTİK PERİTONİT FONUNDA AĞ SIÇOVULLARIN BÖYÜK PİYLIYİNİN
TƏDQIQI ÜSULU**

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Məqalədə ağ siçovullarda septik peritonit modeli yaratmaq üsulunun hazırlanması və iltihab ocağında böyük piyliyin reaktiv dəyişikliklərini tədqiq etmək məqsədilə aparılmış tədqiqat işi haqqında məlumat verilmişdir. Tədqiqat işi kütləsi $276 \pm 6,56$ q olan 15 baş cinsi yetişkənliyə çatmış ağ siçovul üzərində aparılmışdır. Septik peritonit modeli bu üsulla yaradılmışdır: steril şəraitdə efir narkozu altında heyvanların qarın boşluğu orta-orta kəsik üzrə 2-3 sm ölçüdə açılmış, kor bağırsağın zirvə hissəsi yara üzərinə gətirilərək onun ön divarı G16 ölçülü inyeksiya iynəsi vasitəsilə perforasiya edilmişdir. Alınmış bağırsaq möhtəviyyatı salfet vasitəsilə silinmişdir. Bundan sonra kor bağırsaq yenidən qarın boşluğuna daxil edilmiş, laparotomik yaraya kapron sapla (N20) tikiş qoyulmuşdur. Tədqiqat göstərmişdir ki, ağ siçovullarda septik peritonit fonunda böyük piyliyi tədqiq etmək üçün təklif edilmiş üsuldən istifadə edildikdə peritonun septik iltihabının yaranmasına şərait yaradılmalıdır. Təklif edilən eksperimental üsul sadə, standartlaşdırılmış, tez müddətdə və asan başa gələn olub, müvafiq tədqiqatlar zamanı istifadə edilməyə yararlıdır.

Açar sözlər: böyük piylik, kor bağırsaq, selikli qışa, septik peritonit, eksperimental modelləşdirilmə

Ключевые слова: большой сальник, слепая кишка, слизистая оболочка, септический перитонит, экспериментальное моделирование

Keywords: greater omentum, cecum, mucous membrane, septic peritonitis, experimental modeling

**METHOD OF STUDYING THE GREATER OMENTUM OF WHITE RATS
IN SEPTIC PERITONITIS**

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The article presents the methodology for creating a septic peritonitis model in white rats and investigates the reactive changes in the greater omentum at the site of inflammation. The study was conducted on 15 sexually mature male white rats with a body weight 276 ± 6.56 g. Septic peritonitis was modeled as follows: under sterile conditions and ether anesthesia, experimental animals underwent a midline laparotomy (2-3 cm in length), the apex of the cecum was localized and exteriorized through the incision; using a G16 injection needle, a perforation was made in the anterior wall of the cecum, and the intestinal contents were removed with a gauze pad, after which the cecum was repositioned into the abdominal cavity and the abdominal wall was then sutured using 2/0 capron sutures.

The study demonstrated that proposed method for studying the greater omentum of white rats in septic peritonitis involves the initiation of intraperitoneal septic inflammation of the peritoneu. The suggested experimental approach is technically simple, standardized, quick, and cost-effective, making it suitable for use in relevant research studies.

Introduction. To date, the treatment of patients with acute peritonitis remains one of

the most serious and life-threatening challenges in general surgery. The course of

this pathology is often accompanied by the development of systemic inflammatory response syndrome and abdominal sepsis, which frequently results in death. Despite a substantial number of studies and the development of experimental models aimed at disrupting the endogenous intestinal barrier, methods for the management and treatment of peritonitis have not significantly reduced the persistently high mortality rate [1-3].

The peculiarities of the development and progression of acute peritonitis can be studied under acute experimental conditions. Numerous methods for modeling acute septic peritonitis have been described, based on the introduction of pathogenic substances into the peritoneal cavity of experimental animals, including fecal autolysates, suspensions containing clinical strains of various microorganisms, chyme, bile, superficial injury to abdominal organs, as well as various surgical techniques [4-6].

The relevance of studying the greater omentum of white rats in septic peritonitis is driven by the need for a deeper understanding of the mechanisms underlying inflammatory processes in the abdominal cavity, which are of critical importance to medicine. Septic peritonitis is one of the most severe surgical pathologies, associated with high mortality due to the development of sepsis and multiple organ failure [7-10]. The greater omentum, as an important anatomical structure of the abdominal cavity, plays key immunological and protective roles; however, its involvement in the pathogenesis of septic peritonitis remains insufficiently explored [11].

Studies, conducted on white rats, enables the modeling of pathological processes occurring during peritonitis, thereby allowing the investigation of the effects of various therapeutic approaches and the development of new treatment methods. The findings of such studies can be applied to improve the diagnosis and management of peritonitis in clinical practice, ultimately enhancing the likelihood of favorable outcomes for patients suffering from this severe condition [12-16].

Purpose. To develop a method for the experimental modeling of septic peritonitis and to investigate the response of the greater omentum of white rats to the inflammatory

focus.

Methods and Material. The study was conducted on 15 sexually mature male white rats weighing 276.75 ± 6.56 grams. All animals were maintained under standard conditions in the experimental biological clinic (vivarium) of Poltava State Medical University, in accordance with the regulations for the care and use of experimental animals established by the Directive of the European Parliament and Council (2010/63/EU), the Order of the Ministry of Education and Science, Youth and Sports of Ukraine dated March 1, 2012, No. 249 "On the Approval of the Procedure for Scientific Institutions to Conduct Experiments on Animals," and the "General Ethical Principles for Animal Experiments" adopted by the Fifth National Congress on Bioethics (Kyiv, 2013). The study was approved by the Biomedical Ethics Committee of Poltava State Medical University (Minutes No. 198, dated October 21, 2021).

Considering that, according to the publications, the highest concentration of microbiota is found in the cecum, it was selected as the object of our study [17-20].

Under ether anesthesia and in compliance with sterile conditions and ethical requirements for experimental animal research, the animals underwent sequential laparotomy via an incision along the linea alba. Infection of the peritoneal cavity was induced by perforating the anterior wall of the apex of the cecum at four points using a G16 injection needle. Following the perforations, the edges of the abdominal wall were sutured with Capron thread, which is non-antigenic.

Animal vivisection was performed by administering an overdose of ether anesthesia. It should be noted that throughout the 3-day duration of the experiment, no animals died. Following a systematic and methodologically sound vivisection, the animals' abdominal cavities were sequentially opened and immediately irrigated with 10% neutral formalin solution that ensured preservation of all organs in a living state throughout the morphological study, which was conducted using conventional anatomical and histological methods. The obtained serial paraffin sections of 4 μm thick were stained with hematoxylin and eosin.

The examination and documentation of the specimens were performed using a "Konus" light microscope equipped with a Sigeta DCM-900 9.0MP digital microphotography attachment, operated with the Biorex 3 software (serial number 5604) adapted for these studies. Morphometric characteristics of the tissue structures in the respective specimens were obtained using a visual

analysis system for histological preparations, as well as an object micrometer Sigeta X 1 mm/100 divisions $\times$ 0.01 mm, which calibrated scale (1 mm total length, with each small division corresponding to 10 μ m) was superimposed onto the corresponding microphotographs taken at equivalent magnification.

Results. In order to improve the outcomes of surgical treatment for acute peritonitis, it is advisable to develop and refine existing methods for modeling acute peritonitis. In developing a method for studying the greater omentum of white rats in septic peritonitis, we aimed to design a procedure that would initiate an intraperitoneal inflammatory process and accurately replicate the damage to the integrity of a hollow organ as the source of septic peritonitis; additionally, the method had to be both standardized and experimental in nature. The model should be technically simple, rapid and demonstrate a high degree of reproducibility.

The utility model is based on the objective of developing a method to study the response of the local immune system of the greater omentum in white rats, as a derivative of the peritoneum, in the context of septic peritonitis modeled by perforations of the apex of the cecum.

The stated objective is achieved by developing a method for studying the greater omentum of white rats in septic peritonitis, which involves creating conditions for the

emergence of a septic infectious focus. This method differs from existing approaches in that the investigated material includes the perforated wall of the cecum along with a segment of the tamponed greater omentum.

The proposed method is carried out as follows: Septic peritonitis was modeled as follows: under sterile conditions and ether anesthesia, experimental animals underwent a midline laparotomy (2–3 cm in length), the apex of the cecum was localized and exteriorized through the incision; using a G16 injection needle, a perforation was made in the anterior wall of the cecum, and the intestinal contents were removed with a gauze pad, after which the cecum was repositioned into the abdominal cavity and the abdominal wall was then sutured using 2/0 Capron sutures (Fig. 1).

The achievement of all stated objectives was confirmed by the findings of macroscopic and microscopic examinations. None of the laboratory animals died from complications of peritonitis or septic shock. Following euthanasia by overdose of ether anesthesia, macroscopic examination of the opened abdominal cavity revealed localized hyperemia at the site of cecal perforation and in some specimens, focal hemorrhages in the cecal wall, fibrinous deposits and tamponade of the perforation sites were observed. These findings indicate the involvement of the local immune system in

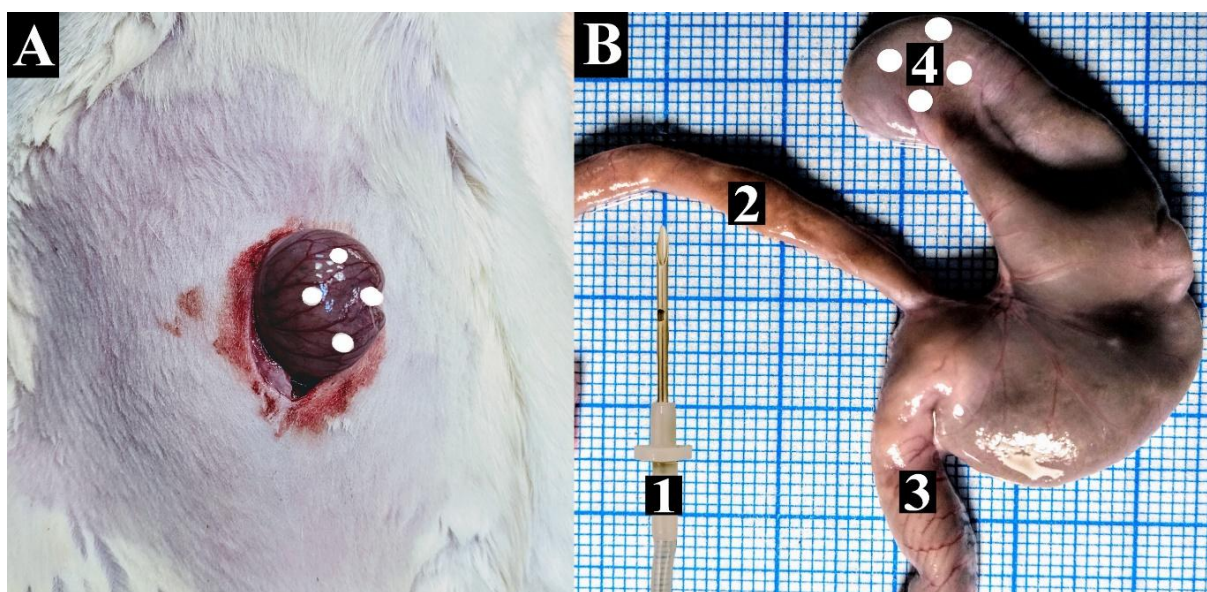


Fig. 1. Cecum of a white rat with sites of perforation. Macrophoto, Magnification: A – 3 $\times$, B – 4 $\times$

A: Apex of the cecum exteriorized through the incision with marked sites of perforation.

B: 1 – needle used for creating full-thickness perforations of the cecal wall; 2 – ileum; 3 – colon; 4 – apex of the cecum.

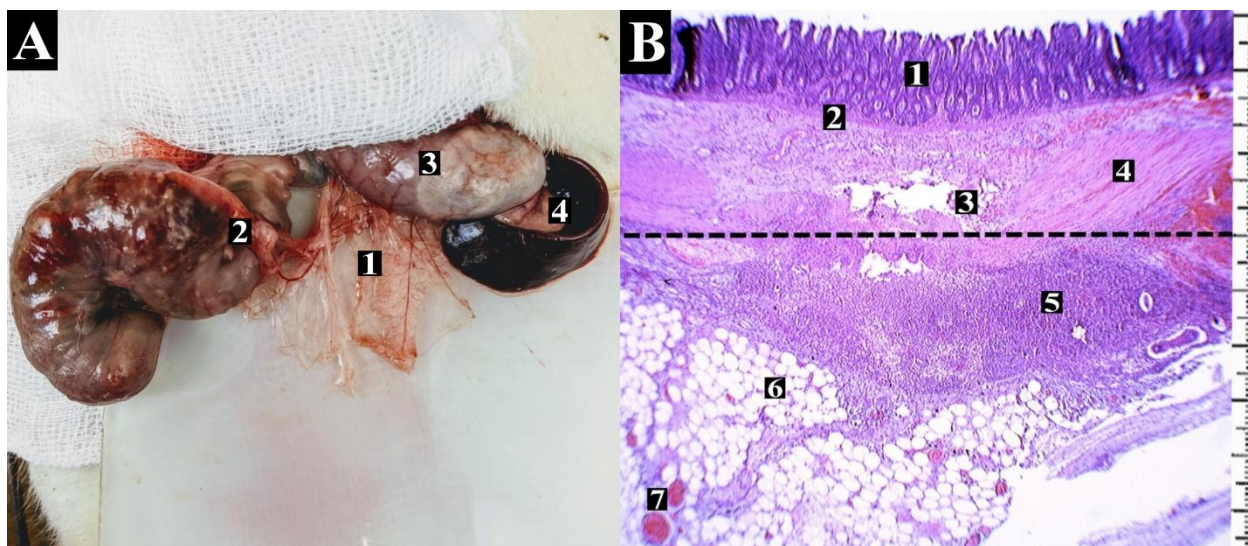


Fig. 2. Zone of consolidation between the greater omentum and the perforated wall of the cecum in a male rat. **A** – Macrophoto, Magnification: 4×. **B** – Paraffin section; stained with hematoxylin and eosin. Objective lens: 4×. The smallest division of the scale bar corresponds to 10 μ m.

A: 1 – greater omentum; 2 – site of consolidation between the greater omentum and the perforated cecum; 3 – stomach; 4 – spleen.

B: 1 – epithelial layer of the cecal mucosa; 2 – lamina propria of the cecum; 3 – traces of perforation damage; 4 – muscular layer of the cecum; 5 – lymphoid infiltrate; 6 – adipose tissue of the greater omentum; 7 – blood vessels.

The dashed line indicates the boundary of consolidation between the omentum and the cecal wall.

resolving the peritoneal focus, characterized by intertissue consolidation of the greater omentum with the cecum (Fig. 2).

As a result of this process, blood vessels from the omentum invade into the site of infection, facilitating the transport of immune-competent cells. This leads to the formation of substantial lymphoid infiltrates in the affected area, as well as the proliferation of adipose tissue, which forms a thick layer isolating the inflammatory focus from the peritoneal cavity. The observed macroscopic and microscopic changes indicate the active involvement of the local immune system of the greater omentum in white rats in resolving the septic inflammatory focus within the peritoneum.

This method of studying the greater omentum in white rats with septic peritonitis closely approximates the clinical scenario of distal intestinal perforation, where the severity gradually progresses depending on the systemic and local immune responses. The presented model effectively simulates the onset and development of acute septic peritonitis and is sufficiently adequate for investigating both the pathology itself and for testing new methods of peritonitis management.

Discussion. Currently, there are numerous experimental models of peritonitis, each with its

own advantages and limitations. Conventionally, these models can be categorized into three groups: the first involves the introduction of foreign bodies or chemical substances into the peritoneal cavity; the second involves bacterial contamination of the peritoneal cavity using pathogenic microorganism cultures or by opening the lumen of the large intestine; and the third is a combination of the first and second methods [13, 15, 21]

The most clinically relevant and one of the most widely used methods for modeling acute peritonitis remains the model developed by Wichter K. et al., which involves ligation and puncture of the cecum. The cecal ligation is performed just below the ileocecal valve, creating a source of necrotic tissue. The next step is the perforation of the cecum, allowing intestinal contents to spread into the peritoneal cavity. Subsequently, sepsis typically develops, leading to the death of the animal. The extent of induced peritonitis in this technique depends on several factors, including the percentage of the cecum ligated and the volume of necrosis induced, the microbial load introduced into the peritoneal cavity, the number and size of punctures, the pressure within the cecum, and the magnitude of the immune response. This model is particularly preferred for studying the

immunological and pathophysiological mechanisms underlying sepsis development [22].

The method most similar in design and technical execution to the proposed approach is that developed by M.S. Hnatyuk, which involves creating a rhomboid or square perforation measuring 2×2 mm or 4×4 mm in the cecum, combined with intragastric administration of a 0.5% aqueous sodium nitrite solution at a dose of 1 ml/kg body weight. Sodium nitrite induces impaired tissue respiration in the experimental animal, leading to tissue hypoxia and a sharp decrease in peritoneal resistance, consequently weakening the immune defense [23].

Conclusions. Consequently, the proposed method for studying the greater omentum of white rats in septic peritonitis involves the initiation of intraperitoneal septic inflammation

of the peritoneum and is both standardized and reproducible under experimental conditions. This method can be utilized to investigate the specific features of peritonitis pathogenesis in an acute experimental setting, as well as to assess the role of the local immune system in the elimination and prevention of peritonitis spread. Concurrently, in the zone of inflammation, there is proliferation of adipose tissue, which forms a thick layer isolating the inflammatory focus from the peritoneal cavity. We believe this mechanism explains why, during the three-day experimental period, no animals died, and subsequently all returned to their normal living conditions.

Therefore, this model is technically simple and rapid, while also demonstrating a high degree of reproducibility.

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СПОСОБ ИССЛЕДОВАНИЯ БОЛЬШОГО САЛЬНИКА БЕЛЫХ КРЫС ПРИ СЕПТИЧНОМ ПЕРИТОНИТЕ

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Резюме. Представлены результаты исследования проведенного с целью разработать способ экспериментального моделирования септического перитонита и исследовать реакцию большого сальника белых крыс на очаг воспаления. Исследование включало 15 половозрелых белых крыс самцов, массой $276,75 \pm 6,56$ грамм. Моделирование септического перитонита осуществлялось следующим образом: в стерильных условиях, экспериментальным животным под эфирным наркозом выполнялась средне-срединная лапаротомия 2-3 см, выводится в рану верхушка слепой кишки, далее с помощью инъекционной иглы размером G16 выполнялась перфорация передней ее стенки, полученное кишечное содержимое было удалено с помощью салфетки, слепую кишку погружали в брюшную полость, наложены швы капрон 2/0 на рану.

Исследование показало, что при использовании предложенной методики для изучения большого сальника у белых крыс в условиях септического перитонита создаются условия для возникновения септического воспаления в перитонеуме. Предложенная экспериментальная методика является простой, стандартизированной, быстрой и экономически эффективной, что делает её пригодной для использования в соответствующих исследованиях. предложенный способ исследования большого сальника белых крыс при септическом перитоните предполагает инициацию интраперитонеального септического воспаления брюшины, а также способ технически простой, стандартизированный, быстро воспроизводимый в экспериментальных условиях.

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