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ЗАГАЛЬНА ХІРУРГІЯ

Surgical treatment of patients with combined combat thermomechanical injuries and long-bone gunshot fractures

Stapled hemorrhoidopexy – complications management in acute perirectal or abdominal bleeding

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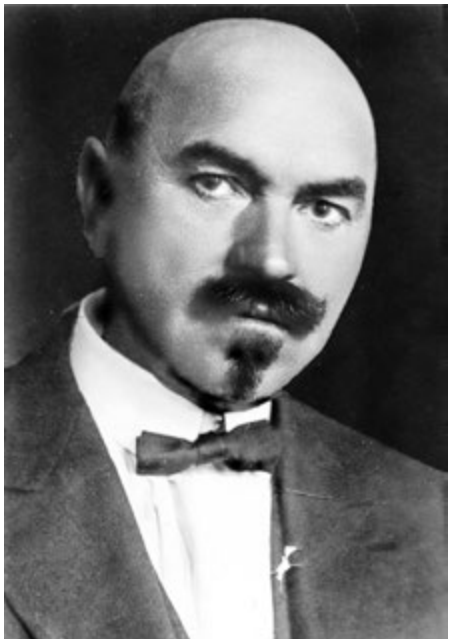
A life dedicated to surgery: Serhii Tymofieiev's contribution to medicine and education

Serhii Lukianovych Tymofieiev (1875—1943) was a renowned physician, surgeon, scientist, and teacher in the history of Ukrainian medicine. Continuous education and practice shaped his professional career, which began in the Kherson province. Tymofieiev became a Doctor of Medical Sciences after defending his dissertation on the pathogenesis of renal edema. His contribution covers several medical fields, including orthopedics, traumatology, urology, and military surgery. Serhii Lukianovych founded the Department of Traumatology and Orthopedics at the Kyiv Medical Institute, which became the basis for the development of modern Ukrainian orthopedics. He developed innovative approaches to the treatment of injuries, reconstructive surgery, and the training of future doctors. During World War I, Tymofieiev headed the surgical department of the Kyiv Military Hospital, where he treated gunshot wounds. His pedagogical activity was focused on improving the teaching of military field surgery, a topic that is particularly relevant during times of military conflicts. Tymofieiev not only worked tirelessly but also educated a generation of doctors who continued his legacy. Having written more than 90 scientific works, he became one of the founders of Ukrainian surgery and medical education. His life path is an example of high professionalism, extensive scientific knowledge, and commitment to the medical profession. Tymofieiev made a significant contribution to the history of medicine, and his legacy continues to inspire modern doctors.



Serhii Lukianovych Tymofieiev was born on September 25, 1875, in the family of a paramedic in the Kherson province (village of Glodosy). In 1893, he successfully graduated from the Kyiv Military Paramedic School and was appointed a junior paramedic at the Kyiv Military Hospital. The education gained at the Military Paramedic School did not qualify students for university admission. Instead, they needed a gymnasium certificate. Serhii Lukianovych Tymofieiev, known for his perseverance, independently completed the classical gymnasium course. In 1897, he successfully passed the final exams and received a certificate of maturity. The same year, he entered the medical faculty at St. Volodymyr University. During his student years, beginning in the third year and continuing after graduation, he actively worked in the surgical pathology laboratory under the guidance of Professor Alexander Dmitrovich Pavlovsky, where he completed his doctoral dissertation.

Serhii Lukianovych Tymofieiev graduated with honours from St. Volodymyr University on October 15, 1902. According to the terms of his state-funded studies, he was required to serve three years in the military. S. L. Tymofieiev, a young doctor, had a heavy workload. He had to gain medical experience, learn surgical skills, do shifts in the hospital and clinic, write a doctoral dissertation, and partially perform the duties of a junior doctor in the regiment. S. L. Tymofieiev successfully addressed all of these challenges.

On November 19, 1908, Serhii Lukianovych Tymofieiev advanced in his scientific career by defending his doctoral dissertation on the theme «On the question of the pathogenesis of renal edema». This defence was not merely an academic accomplishment but also an important turning point in the evolution of his scientific method. After successfully defending his doctoral dissertation, Serhii Lukianovych continued to serve in the army.

Throughout his career, Serhii Lukianovych Tymofieiev was an active member of the Kyiv Surgical Society. He presented the greater part of his research and results at the society's regular meetings. Tymofieiev approached M. M. Volkovych in December

1911, requesting permission to serve as a part-time resident at the surgical clinic of the Department of Faculty Surgery at St. Volodymyr University, and he received approval. Before World War I, S. L. Tymofieiev resigned from the Military Department and completely transferred to the Ministry of Public Education. His introductory lecture, «Surgical Clinic Requirements for Modern Anesthesia», was published in «University News» in 1914. Serhii Lukianovych Tymofieiev was mobilized into the 19th Infantry Division in 1914, at the outbreak of World War I, and was appointed head of the surgical department of the Kyiv Military Hospital on December 23, 1914.

Tymofieiev, using his urological expertise and experience, became a pioneer in the field of surgery and treatment of gunshot wounds to the urinary system during military operations. On February 15, 1916, S. L. Tymofieiev presented his accumulated experience and material on gunshot wounds to the bladder at a meeting of the Kyiv Surgical Society. His high level of professionalism and understanding of the problems distinguished him among other medical practitioners, and his contribution to the development of urology and military surgery remains noteworthy.

On August 1, 1918, Tymofieiev held the position of head of the surgical department at the Kyiv Clinical Hospital. According to the staff list, he received a promotion to senior resident of the surgical department on September 2, 1919, during a period when surgical departments were referred to as departments.

Having experienced the years of World War I and the Civil War, Serhii Lukianovych Tymofieiev actively engaged in important medical work and military paramedic training. At that time, he was interested in the issues of training and the lives of military paramedics.

In 1920, Serhii Lukianovych Tymofieiev received the title of private associate professor at the Department of Hospital Surgical Clinic, and in 1923 he was awarded the title of professor. In 1923, he founded the Department of Traumatology and Orthopedics at the Kyiv Medical Institute (now Bogomolets National Medical University). The department was based at the Kyiv Military Hospital. Serhii Lukianovych Tymofieiev demonstrated an extensive understanding of both the medical and social aspects of childhood injuries and musculoskeletal deformities. He stated that it is critical to include conservative and surgical orthopedic procedures in young doctor training programs so that the fight against this disease becomes not only a medical but also a state and social effort.

During the period from 1923 to 1932, the staff of the Department of Orthopedics and Traumatology published about 40 scientific papers. These publications concerned organizational aspects and improvements in the treatment of orthopedic and traumatological diseases, as well as new developments in the fields of shock treatment, bone plastic, and reconstructive orthopedic surgery. This indicates the great activity and high level of research conducted at the department during this period. In 1927, Professor S. L. Tymofieiev published a textbook-monograph entitled «Fundamentals of Orthopedic Surgery and Traumatology». This textbook became the main guide for students for many years, which indicates its significance and influence on training in the field of orthopedics and traumatology.

Serhii Lukianovych Tymofieiev was the first head of the Department of Military Field Surgery, established between 1932 and 1934. The prerequisite for the creation of the department was the order of the People's Commissariat of Education of Ukraine dated September 3, 1932: «In order to ensure the training of doctors graduated from the medical institute in military field surgery, to organize a department of military field surgery at the Kyiv Medical Institute and to propose to the management of the medical institute to provide for the 4th year the required number of hours in the curriculum, based on the department of military field surgery at the Institute of Emergency Care in Kyiv», an excerpt of which is cited by Tymofieiev in the 1935 article entitled «Teaching Military Field Surgery at the Kyiv Medical Institute».

Serhii Lukianovych was the head of the Department of Surgery of the Sanitary and Hygienic Faculty of the Kyiv Medical Institute from 1934 to 1941. During this period, Professor Tymofieiev and the staff of the department published the following scientific works: «To the methodology of studying histolysates» (Klin. Medicine,1935), «On thermal burns» (Soviet Medical Journal, 1936), among others.

S. L. Tymofieiev is the author of more than 90 scientific works on inguinal canal plastic surgery, bone plastic surgery in pseudoarthrosis, ulnar nerve displacement in traumatic neuritis, laparotomies in abdominal injuries, and gunshot wounds to bones.

A prominent figure in the history of Ukrainian medicine, professor Tymofieiev was an outstanding physician, surgeon, and scientist. His contribution to the development of surgery, orthopedics and traumatology in Ukraine is significant. Tymofieiev showed high skill as a surgeon and was a great organizer in the field of medical education. His works in the field of orthopedics and traumatology are recognized and respected. Through his scientific research and practical activities, he made a significant contribution to the development of surgery and the treatment of traumatic injuries.

Tymofieiev's pedagogical contribution is no less important. He not only overcame great difficulties during periods of difficult historical events but also managed to transfer his knowledge to the younger generation of doctors. He recognized not only the need for high-quality surgical treatment but also the importance of transferring his knowledge and experience to a new generation of doctors. Improving the teaching of military field surgery occupied a significant place in his life. He believed that this subject not only teaches students ingenuity and endurance but also prepares them to provide effective assistance in war conditions. His article «On the Teaching of Military Field Surgery at the Kyiv Medical Institute» testifies to a deep understanding and systematic approach to this direction. Through his pedagogical activities, he educated a whole generation of highly qualified medical specialists who continued his work. Tymofieiev's memoirs about studying and collaborating with professor Mykola Markiianovych Volkovych testify to the high erudition, deep medical thinking, and practical skills possessed by the scientist. Serhii Lukianovych Tymofieiev was a recognized and outstanding doctor, and he received high awards for his contribution to the development of surgery and medical practice. He was awarded the Orders of St. Volodymyr IV degree, St. Sviatoslav III degree, and II degree.

Serhii Lukianovych was an excellent teacher, mentor, and educator, as evidenced by his numerous students, three of whom (professors S. T. Novytsky, A. R. Shurynok, and A.Ya. Shteftel) headed the surgical departments of the Kyiv Medical Institute.

The overall picture of the life and work of Serhii Lukianovych Tymofieiev creates the image of an outstanding specialist who dedicated his life to medicine, teaching, and improving medical education and science in Ukraine.

Serhii Lukianovych Tymofieiev died on December 20, 1943. He was buried at the «Baykove» cemetery in the city of Kyiv.

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Життя, присвячене хірургії: внесок Сергія Тимофєєва в медицину та освіту

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Сергій Лук'янович Тимофєєв (1875—1943) — визначна постать в історії української медицини, відомий як видатний лікар, хірург, науковець і педагог. Його життєвий шлях розпочався в Херсонській губернії. Професійна кар'єра сформувалася завдяки наполегливій освіті та практиці. С. Л. Тимофєєв став доктором медичних наук, захистивши дисертацію про патогенез ниркових набряків. Він зробив внесок в ортопедію, травматологію, урологію та військову хірургію. Сергій Лук'янович заснував кафедру травматології та ортопедії в Київському медичному інституті, яка стала базою для розвитку сучасної української ортопедії. Розробив інноваційні підходи до лікування травм, реконструктивної хірургії та навчання майбутніх лікарів. Під час Першої світової війни очолював хірургічне відділення Київського військового шпиталю, лікував вогнепальні поранення. Удосконалив викладання воєнно-польової хірургії, що було актуально під час воєнних конфліктів. Професор Тимофєєв не лише самовіддано працював, а й виховав покоління лікарів, які продовжили його справу. Автор понад 90 наукових праць, він став одним із основоположників української хірургії та медичної освіти. Життєвий шлях Сергія Лук'яновича — це приклад поєднання професіоналізму, глибоких наукових знань і відданості медичній справі. Він залишив глибокий слід в історії медицини, а його спадок продовжує надихати сучасних лікарів.

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Peculiarities of a differentiated approach to surgical treatment of patients with combined combat thermomechanical injuries and long-bone gunshot fractures by the levels of patient care

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Objective — to improve treatment outcomes for wounded individuals with long-bone fractures and combined combat thermomechanical injuries (CCTMI) by developing and implementing a differentiated approach to surgical treatment at different levels of patient care.

Materials and methods. The surgical outcomes of 178 wounded individuals with long-bone fractures and CCTMI were investigated. The study employed general clinical, surgical, laboratory, biochemical, morphological, and statistical methods. The wounded individuals were divided into two clinical comparison groups: the main group and the control group. The main group included 91 wounded individuals with long-bone gunshot fractures who underwent surgical treatment according to a differentiated surgical approach that involved assessing the severity of CCTMI. The control group included 87 wounded individuals with long-bone gunshot fractures and CCTMI who received standard surgical treatment for burn and gunshot wounds. The comparative analysis was carried out based on age, the specific gravity of long-bone gunshot fractures, body surface area of the burn, type of wound tract, number of wounds, type of injury, time of admission, the effectiveness of organizational and medical interventions ($p > 0.05$).

Results. The analysis of treatment interventions revealed that the incidence of fasciotomies in the main group was 27.47 % compared to only 9.20 % in the control group. Additionally, the application of vacuum therapy reached 40.91 % versus 23.17 % in the control group ($p < 0.05$). In CCTMI with significant bone defects, the main group used more modern fragment-fixing procedures, including the Ilizarov apparatus and the two-stage Masquelet technique (84.09 % vs. 50.00 %, $p < 0.01$). The use of the admission trauma scale (AdTS-CCTMI) and the perfusion index in all cases of the main group facilitated the timely assessment of the patient's condition, improving treatment quality and preventing complications. In terms of early complications, the main group had considerably lower rates of anemia (62.64 % vs. 78.16 %, $p < 0.05$), resulting in fewer metabolic changes in the myocardium (23.08 % vs. 36.78 %) and acute renal failure (9.89 % vs. 14.94 %). The control group experienced nearly twice as many thromboembolic problems (12.64 % vs. 7.69 %, $p < 0.05$), highlighting the need for improved preventive measures. Among the late complications, postoperative wound suppuration and osteomyelitis remained significant challenges. However, these complications were less common in patients in the main group (9.89 % and 6.59 %, respectively) than in the control group (21.84 % and 16.09 %). 4.40 % of patients in the main group underwent limb re-amputations for gangrene or osteomyelitis compared to 10.34 % in the control group ($p < 0.05$).

Conclusions. The functional treatment outcomes, as measured by the Mattis-Lyuboshyts-Schwarzberg scale, demonstrated an increase in the proportion of good results from 39.08 ± 5.23 % to 56.98 ± 2.85 %, with a decrease in the relative number of unsatisfactory results from 18.39 ± 4.15 % to 6.24 ± 0.31 %, at $p < 0.05$. A differentiated surgical strategy with an objective assessment of injury severity at different levels of patient care resulted in a decrease in mortality from 10.34 % in the control group to 5.49 % in the main group, reflecting a reduction of 4.85 %.

Keywords
combined combat thermomechanical injury, gunshot wound, polytrauma, syndrome of mutual aggravation of injuries, traumatic shock, burns.

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Combined injuries, which occur during simultaneous or sequential exposure to several damaging factors, are the primary issue associated with weapon use [3, 14]. In the context of increasing armed conflicts in many countries, an urgent problem is the search for effective surgical strategies at different levels of patient care, which would contribute to the effective treatment and rapid rehabilitation of the wounded with combined combat thermomechanical injuries (CCTMI) in a short time [12].

Combined combat thermomechanical injuries with varying degrees of burns lead to disability, which has psychological, social, and economic repercussions for the wounded individuals in addition to physiological ones. One of the stages of CCTMI management is the treatment of dermal burns using biological and synthetic wound dressings [8]. The traditional methods for treating thermomechanical injuries locally and surgically and preventing complications do not adequately account for modern capabilities [10]. Therefore, new pathogenetically based strategies in the surgical management of CCTMI remain a significant medical and social challenge.

CCTMI may cause damage leading to the development and generalization of the infectious process. Such complications are always associated with thermomechanical skin damage, which is a three-dimensional mass of damaged tissues. The damaged area has three distinct zones: hyperemia, coagulation, and paranecrosis. Thermal and mechanical factors cause the microcirculatory bed and its endothelial barrier to become permeable to plasma and intravascular proteins. In this zone, blood circulation stops, microthrombi form and necrosis develops, the severity of which depends on the depth of the injury [7, 12]. Considering the characteristics of thermomechanical injury, various treatment strategies will reduce the risk of complications, particularly the syndrome of mutual aggravation, wherein the pathological process, caused by many factors, exhibits a more severe course than that of monofactorial damages.

In CCTMI, pathophysiological changes that cause homeostasis disorders play a key role [1, 5]. It is these mechanisms, along with stress factors, that lead to the development of infectious complications in wounded individuals [6].

Another problem in CCTMI management is ensuring effective surgical treatment at different levels of patient care since the earlier differentiated surgical strategy is employed, the fewer complications develop [15]. A differentiated approach to the surgical treatment of CCTMI at levels II, III, and IV care will significantly reduce the rate of complications and mortality. The search for new surgical techniques for the treatment of wounded individuals with CCTMI is relevant.

Objective — to improve treatment outcomes for wounded individuals with long-bone fractures and combined combat thermomechanical injuries by developing and implementing a differentiated approach to surgical treatment at different levels of patient care.

Materials and methods

The effectiveness of medical care was assessed for 178 people aged 18 to 60 years with CCTMI sustained during combat operations between 2017 and 2023. They were admitted to the burn department of Kyiv City Clinical Hospital No. 2, the injury clinic of the National Military and Medical Clinical Centre «The Main Military Clinical Hospital» (Kyiv), and the orthopedic and traumatology department of Kyiv City Clinical Hospital No. 8.

The study used general clinical (monitoring of the patient's overall state), surgical, laboratory (peripheral blood tests), biochemical (analysis of biochemical markers), morphological, and immunological (determination of cytokine and growth factor levels) methods.

Patients were divided into two clinical groups according to the level of patient care and surgical treatment: the main group and the control group.

The main group included 91 (51.12 %) wounded individuals with long-bone gunshot fractures who underwent treatment according to a differentiated surgical approach that involved assessing the severity of CCTMI. The admission trauma scale (AdTS-CCTMI) was used to assess trauma severity. We considered the course of burn disease and the characteristics of mechanical injury that were adequately managed using modern surgical techniques and additional treatments for burn and gunshot wounds, as well as means of stabilizing long-bone gunshot fractures (Fig. 1).

In case of minor trauma, patients with gunshot wounds and burns received comprehensive surgical care in the dressing room or operating room, depending on the need. This care included wound treatment, necrectomy of burn wounds, fasciotomy, infusion therapy, and modern medical technologies. At level II care, in case of severe and extremely severe trauma, the scope of surgical intervention was reduced to minimal and was consistent with damage control surgery protocols. It included control of external bleeding, anti-shock measures, fasciotomy, longitudinal incisions for circular burns of the limbs and body, and primary stabilization of long-bone fractures using a rod apparatus for external fixation.

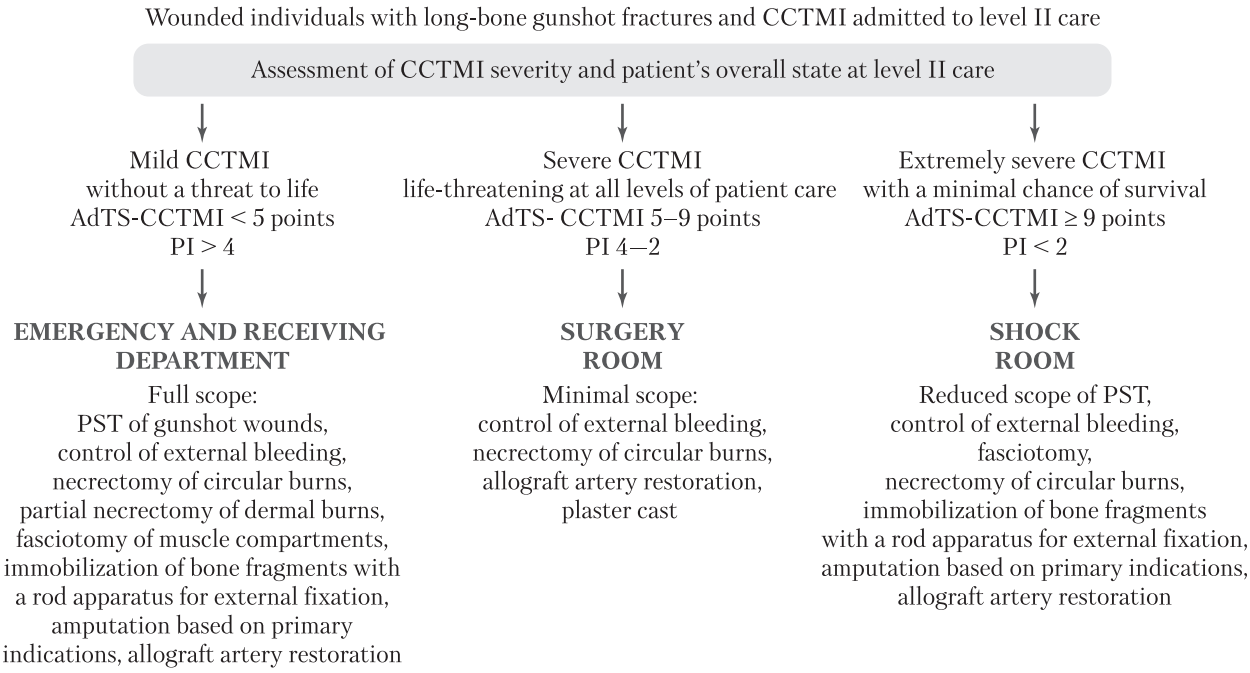

Figure 1. **Surgical strategy depending on the severity of combat surgical trauma**

The control group included 87 (48.88 %) wounded patients who received standard surgical treatment for burn and gunshot wounds without taking into account the severity of the condition according to AdTS-CCTMI and the course of burn disease.

An analysis of the causal factors contributing to CCTMI revealed that in the main group, 65 (71.4 %) wounded patients sustained thermomechanical injuries due to detonations from high-explosive mines, while 26 (28.6 %) incurred injuries from artillery shells impacting military equipment. In the control group, 61 (70.7 %) patients sustained CCTMI due to detonations from high-explosive mines, while in 26 (29.3 %) cases, the injuries resulted from artillery shells impacting military equipment.

Considering the characteristics of long-bone gunshot fractures and CCTMI, we observed 51 (56.04 %) patients with mild trauma (1—4 points) and 28 (30.77 %) patients with severe trauma (5—9 points) in the main group. The main group had the fewest patients with extremely severe trauma (> 9 points), with just 12 (13.19 %). Penetrating wounds prevailed (Table 1). The type of wound tract did not differ statistically significantly across the groups ($p > 0.05$).

In the main group, 50 (54.95 %) individuals had one gunshot wound, 25 (27.47 %) had two wounds, 10 (10.99 %) had three wounds, 5 (5.49 %) had four wounds, and only one (1.10 %) had five or more wounds. In the control group, 40 (45.98 %) individuals had one wound, 30 (34.48 %) had two wounds, 12 (13.79 %) had three wounds, 3 (3.45 %) had four wounds, and 2 (2.30 %) had five or more wounds.

The IIa-degree burns were most often diagnosed in the main group, accounting for 35 (38.46 %) of all wounded patients (Table 2). In the control group (n = 87), the number of wounded was slightly lower, with 30 (34.48 %) individuals. First-degree burns were observed in 20 (21.98 %) of the wounded in

Table 1. **Distribution of the wounded by comparison groups depending on the type of wound tract**

Type of wound tract	Main group (n = 91)	Control group (n = 87)
Penetrating	40 (44.0 %)	35 (40.2 %)
Perforating	51 (56.0 %)	52 (59.8 %)

Table 2. **Distribution of the wounded by burn depth**

Degree of burn	Main group (n = 91)	Control group (n = 87)
I	20 (22.0 %)	18 (20.7 %)
IIa	35 (38.5 %)	30 (34.5 %)
IIb	25 (27.5 %)	27 (31.0 %)
III	11 (12.1 %)	12 (13.8 %)

Table 3. **Distribution of the wounded by body surface area of the burn**

Affected area	Main group (n = 91)	Control group (n = 87)
< 10 %	40 (43.96 %)	35 (40.23 %)
10—39 %	35 (38.46 %)	40 (45.98 %)
≥ 40 %	16 (17.58 %)	12 (13.79 %)

the main group, somewhat more than in the control group, where 18 (20.69 %) were affected. The lowest proportion comprised extremely severe third-degree burns with extensive damage to the skin and underlying tissues. In the main group, such occurrences were recorded in 11 (12.09 %) individuals compared to 12 (13.79 %) in the control group.

An analysis of the wounded by body surface area of the burn (Table 3) revealed that the majority had burns covering < 10 % of the body: in the main group, 40 (43.96 %) individuals, and in the control group, 35 (40.23 %) individuals.

A differentiated approach was employed for the surgical treatment of the wounded in the main group, based on the assessment of injury severity using the AdTS–CCTMI scale.

In the primary surgical treatment (PST) of gunshot wounds and burn injuries, the wound was dissected, hemostasis was achieved, burn eschar and necrotic tissue were excised, and all branches of the wound tract and tissue «pockets» were drained. As required, open fasciotomy of all fascial sheaths was performed. Plaster cast immobilization was carried out, and a temporary rod apparatus for external fixation was used if necessary.

At level II care, amputations were conducted solely based on primary indications. Metal fragments located superficially in the body were removed using a magnet.

In the main group, the goal of the surgical treatment strategy was early necrectomy of burn and gunshot wounds to reduce further endointoxication of the body and minimize infectious complications with the fastest possible evacuation to level III care.

In the control group, patients received surgical care according to standard protocols without considering injury severity. Gunshot wounds and burns were treated sparingly. PST was conducted in a limited manner without excising tissues of questionable viability. Minimally invasive fasciotomy was carried out either prophylactically or decompressively. A rod apparatus for external fixation was usually installed permanently without further re-installation and conversion. No amputations were performed. All metal fragments were removed with a magnet. If necessary, ultrasound diagnostic devices and an electron-optical converter were used (Table 4).

The groups were comparable in age, frequency of long-bone gunshot fractures, body surface area of the burn, type of wound tract, number of wounds, type of injury, and time of admission to highly specialized treatment facilities of the Ministry of Defence and the Ministry of Health of Ukraine (Table 5).

The anatomical and functional treatment outcomes were evaluated using the Mattis-Lyuboshyts-Schwarzberg comprehensive scale (1980—1985), modified by Shevtsov (1995). The scale includes the following indicators: the presence of pain, the range of motion in the hip and knee joints, thigh shortening and deformation, radiological signs of fusion of the femur, muscle atrophy, vascular and neurological disorders, the presence of purulent complications and restoration of working capacity. A total index divided by 10 indicated a good anatomical and functional treatment result of

Table 4. **Treatment and organizational plan for selecting a surgical strategy at level II care**

Type of the procedure	Main group (n = 91)	Control group (n = 87)
PST of the wounds	Radical with removal of non-viable tissues and bone fragments	Sparing
Fasciotomy	Open	Minimally invasive
Installation of a rod apparatus for external fixation	With further correction	Without correction until conversion
Early necrectomy of dermal burns	Was performed	Was not performed
Primary amputations at level II care	According to MESS	Standard
Necrotomy of circular burns	Was performed	Was performed
Dressing of burn wounds	Hydrogel	Standard

Table 5. **Distribution of the wounded by the time of admission to the specialized department**

Timing of admission of the wounded to level IV care	Main group (n = 91)	Control group (n = 87)*
Up to 7 days from the moment of injury	70 (76.92 %)	65 (74.71 %)
After 7 days from the moment of injury	21 (23.08 %)	22 (25.29 %)

* $\chi^2 = 0{,}128$; $p_\alpha = 0{,}05$.

3.5—4.0 points, a satisfactory result of 2.5—3.5 points, and an unsatisfactory result of < 2.5 points.

The statistical processing and analysis of the obtained data were conducted using Statistica 8.0 and Microsoft Excel 2013.

We estimated the absolute (m) and frequency (p) values and calculated the arithmetic mean (M), standard deviation (σ), mean error, and confidence interval for the analyzed indicators. In cases where one of the alternatives was close to 0, the error was calculated using the Van der Waerden correction. At $p > 75\,\%$ or $p < 25\,\%$, the sampling fraction had a substantial error, and the general fraction's confidence interval exceeded the permitted limitations ($p_L < 0\,\%$ or $p_U > 100\,\%$). In such cases, the Fisher method was used to determine the confidence interval using the additional parameter ϕ. The general fraction's confidence interval was represented as a segment (p_L; p_U). Quantitative indicators were entered into the database unchanged.

The Pearson χ^2 criterion was used to assess the impact of each element on the overall feature under consideration. The Student t-criterion was used to conduct a more in-depth investigation of the factor's impact on individual gradations. The factor's impact on the feature was evaluated using the statistical significance threshold (p_α). The influence is statistically significant at $p_\alpha < 0.05$.

Results and discussion

A differentiated approach to surgical treatment of the wounded with CCTMI comprised an objective assessment of injury severity using the AdTS-CCTMI scale and the perfusion index with subsequent life-saving measures. This facilitated a reduction in the volume, duration, and traumatic nature of the first operation at level II care, allowing for the eventual restoration of organs and bodily structures if vital functions stabilized during the second operation at level III or IV care.

At level I care, CCTMI management included temporary control of external bleeding with the application of a tourniquet and an aseptic dressing to the burn wound (Fig. 2). Tight wound tamponade and infusion therapy of 800—1200 ml were performed. For this purpose, a 0.9 % sodium chloride solution, Ringer's lactate solution administered at 500 ml/h, and rheosorbilact were used. Transport immobilization was carried out using Kramer or SAM splints. Painkillers were delivered intramuscularly or intravenously. Antibiotic therapy and subcutaneous administration of toxoid in a dose of 1.0 ml were administered.

The basis of surgical treatment of the wounded with CCTMI at level II care was PST of gunshot and burn wounds to avoid or reduce the frequency of possible complications. Depending on the general condition of the wounded, blood parameters, SpO_2,

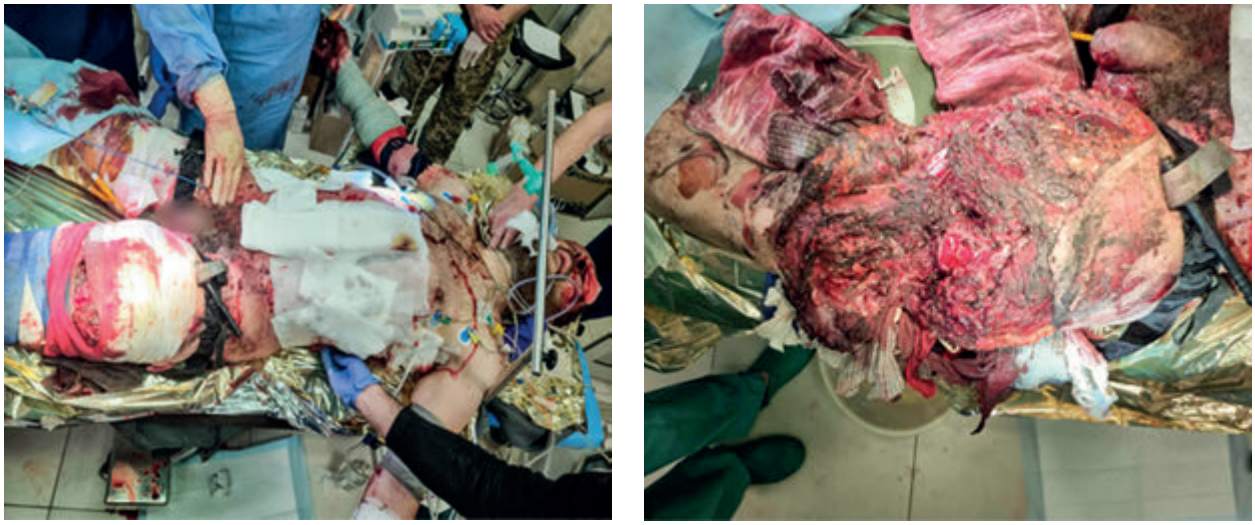

Figure 2. **Providing medical care to a patient with CCTMI**

PI, and surgical treatment were carried out in a full or reduced volume. In the latter case, a wide wound and decompression skin dissection and fasciotomy of the entire length of the sheaths in circular limb burns were performed (Fig. 3). The wound tract was revised. Blood clots, foreign bodies, and small bone fragments that were not connected to soft tissues were removed.

Autodermoplasty was performed on the hands, feet, and groin using a non-perforated autodermal graft. Individual atraumatic bandages for the fingers were necessarily used, adhering to the following requirements:

1. Non-adhesiveness of the first layer (paraffin mesh).
2. Maximum absorption of the layer.
3. Elastic fixation bandage.
4. In the event of an infectious process in the wound, an additional layer of antiseptic dressing was applied.

To prevent scarring, a perforated autodermal graft was used in a ratio of 1 : 1 or 1 : 1.5 relative to the skin, and to prevent mortality in cases of extensive deep burns, the ratio to the skin was 1 : 3 or 1 : 6.

If the burns were superficial epidermal, they were cleaned and coated with an atraumatic covering. For mild burns, a multilayer bandage was used to compress the autologous skin, while vacuum therapy was employed for severe burns. Local antibiotics were avoided due to their low effectiveness.

Long-bone fractures in the affected segment were stabilized using a rod apparatus for external fixation. Three Schantz screws were inserted proximally, followed by at least three screws distally relative to the long-bone fracture site beyond the wound surface (Fig. 4). If Schantz screws could not be inserted outside the wound, they were passed through it or, as an exception, the limb was immobilized with a plaster splint. The wounds were left open for drainage and dressed with a layer of fine-mesh gauze, as well as non-hermetic cotton-gauze secured with bandages to provide light compression.

Primary limb amputations were also performed according to indications, taking into account the MESS scale score (mangled extremity severity score), which is an aid in determining the indication for limb amputation. A score ≥ 7 on the MESS scale determined the need for limb amputation in 100 % of cases.

At levels III and IV care, medical care was provided in specialized departments (clinics) involving resuscitation specialists, traumatologists, burn surgeons, and other specialists. During further treatment, staged treatment was performed taking into account PI, which included repeated surgical procedures, and multiple early necrectomies of burn wounds with the application of vacuum dressings.

A VAC-technique for wound treatment made it possible to:

a) effectively cleanse the wound contents, including substances that slow down wound healing and cause local and systemic inflammation;

b) maintain a constant temperature in the wound, reducing the effects of hypothermia and a moist wound environment (Fig. 5).

In cases of infectious complications, further surgical interventions were conducted involving extensive dissection and thorough draining of abscesses. We employed necrosequestrectomy and physical wound debridement techniques, including mechanical debridement, pulse lavage, ultrasonic cavitation, vacuum therapy, and effective limb immobilization.

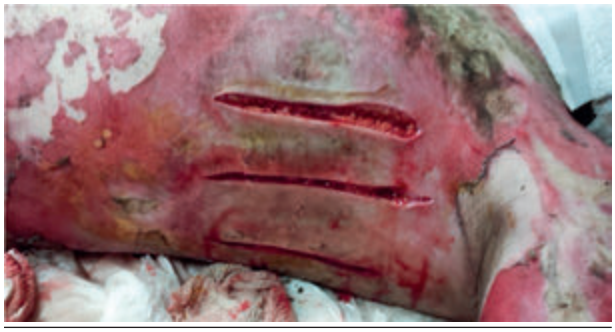

Figure 3. **Necrotomy of the injured body area in a patient with CCTMI**

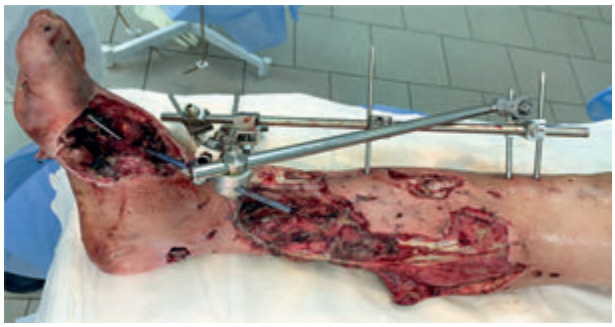

Figure 4. **Segment fixation (tibia-foot) with a rod apparatus for external fixation**

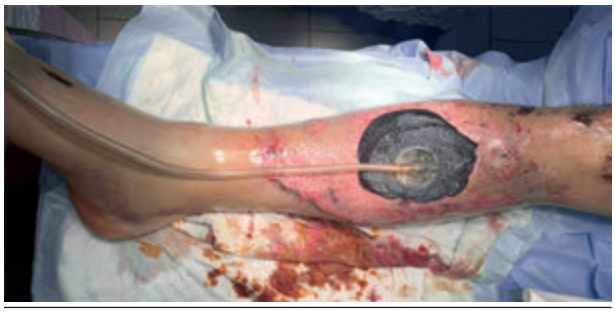

Figure 5. **VAC bandage applied to the damaged area of the lower leg**

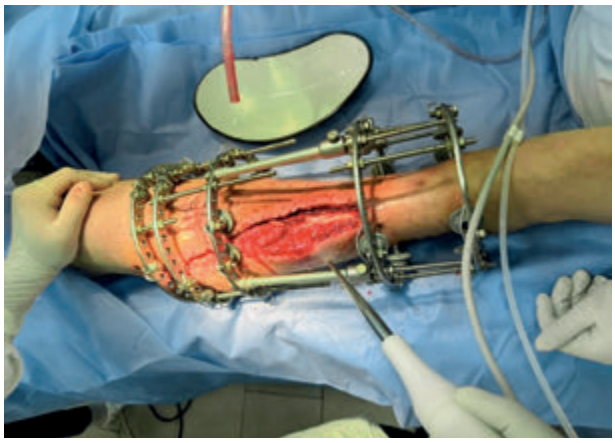

Figure 6. **Performing ultrasonic cavitation in a patient with CCTMI of the right tibia**

In the event of an extensive purulent lesion, we performed bone resection with osteosynthesis using the Ilizarov apparatus. When required, following the resolution of acute symptoms and stabilization of the patient's overall state, we conducted amputations for secondary causes and re-amputations. Various closure procedures were employed while cleaning purulent-necrotic wounds (Fig. 6).

After emergency care, rehabilitation procedures were carried out, as indicated by rehabilitation specialists, who thoroughly analysed and compiled a list of functional issues and disorders. After that, a personalized rehabilitation plan was developed. During the patient's stay in Ministry of Defence hospitals, they received rehabilitation care in inpatient departments, including intensive care units, surgery rooms, and/or dressing rooms. At level III care, the wounded individuals with CCTMI were treated in clinics for injuries or thermal trauma. Operations were performed for the same indications as at level II care. However, specialized treatment was provided by burn surgeons and traumatologists using modern diagnostic methods (spiral computed tomography and magnetic resonance imaging, angiography), medical equipment (orthopedic table, electron-optical converter, necessary instruments, and consumables), and full-scope intensive care. Repeated surgical procedures for musculoskeletal wounds were performed. With body surface area of the burn of more than 40 %, stepwise excisions were conducted over several days until all burn necrosis was excised. They were followed by temporary plastic surgery, including skin allografts or xenoderm implants and prophylactic or decompressive fasciotomy. Limbs were amputated or re-amputated based on the primary indications. Rod apparatuses for external fixation were installed to immobilize long-bone gunshot fractures for medical and transportation purposes.

Vacuum wound therapy was actively used in the treatment of gunshot wounds of soft tissues and burn wounds after necrectomy (Table 6).

Due to the extended treatment durations and the necessity for multiple surgical procedures, once injured patients with CCTMI stabilized, they were airlifted to the National Military and Medical Clinical Centre «The Main Military Clinical Hospital» for level IV care.

At level IV care, specialized therapy was administered by traumatologists, burn surgeons, plastic surgeons, and other specially qualified professionals. The surgical treatment protocol for patients with CCTMI persisted until the complete closure of soft tissue wounds, their healing, fracture consolidation, and stump formation after amputation and re-amputation. In the wounded individuals who received medical and transport immobilization, we performed the re-installation of a rod apparatus for external fixation. It was followed by the final

Table 6. **The scope of treatment interventions at level III care**

Treatment interventions	Main group (n = 91)		Control group (n = 87)		p
		SE		SE	
Repeated surgical treatment of wounds	85 (93.4 %)	2.40	72 (82.8%)	4.05	< 0.01
Fasciotomy	25 (27.5 %)	4.63	8 (9.2 %)	3.09	< 0.05
Installation/re-installation of a rod apparatus for external fixation	75 (82.4 %)	3.94	60 (69.0 %)	4.97	< 0.05
Vacuum therapy, irrigation-oxygen vacuum therapy	35 (38.5 %)	4.91	18 (20.7 %)	4.35	< 0.01
Autodermoplasty using full-thickness dermal fascial grafting with vascular pedicle flaps	18 (19.8 %)	4.02	6 (6.9 %)	2.67	< 0.05
Amputation	5 (5.5 %)	2.35	15 (17.2 %)	4.05	< 0.05

Table 7. **The scope of treatment interventions at level IV care**

Treatment interventions	Main group (n = 88)		Control group (n = 82)		p
		SE		SE	
Primary/secondary surgical treatment of wounds	79 (89.8 %)	3.28	64 (78.1 %)	4.48	< 0.05
Primary-delayed/secondary sutures	54 (61.4 %)	5.13	37 (45.1 %)	5.47	< 0.05
Re-installation of a rod apparatus for external fixation, installation of the Ilizarov apparatus using the two-stage Masquelet method	74 (84.1 %)	4.08	41 (50.0 %)	5.51	< 0.01
Conversion of osteosynthesis method	24 (27.3 %)	4.57	38 (46.3 %)	5.50	< 0.01
Vacuum therapy, irrigation-oxygen vacuum therapy	36 (40.9 %)	5.26	19 (23.2 %)	4.50	< 0.01
Ultrasound cavitation	34 (38.6 %)	5.14	18 (22.0 %)	4.50	< 0.05
Full-thickness dermal fascial grafting with vascular pedicle flaps	16 (18.2 %)	3.90	6 (7.3 %)	2.98	< 0.05
Autodermoplasty	26 (29.6 %)	4.69	13 (15.9 %)	3.97	< 0.05
Necrosequestrectomy	32 (36.4 %)	5.17	17 (20.7 %)	4.43	< 0.05
Re-amputation with a stump formation	7 (7.95 %)	2.87	17 (20.7 %)	4.48	< 0.05

repositioning of bone fragments or the dismantling and stable-functional osteosynthesis using modern medical technology as indicated (Table 7).

At level IV care, patients underwent reconstructive and restorative surgical interventions based on the principle of the «reconstructive ladder» — from simple to more complex. In the case of a long-bone defect of more than 5 cm, an antibacterial temporary cement spacer was installed using the two-stage Masquelet method (see Table 7). The temporary osteosynthesis method involving a rod apparatus for external fixation was converted into extra-focal transosseous distraction osteosynthesis using the Ilizarov apparatus.

After the final filling of the long-bone defect using the staged Masquelet method, the Ilizarov apparatus was maintained as the ultimate osteosynthesis method for at least 6 months. In the main group, this technique was used in 84.09 % ± 4.08 of cases, while in the control group, it was used in 50.00 % ± 5.51. This shows a systematic approach to osteosynthesis in the main group, especially with the emergence of notable foci after traumatic osteomyelitis. The Ilizarov apparatus was extensively used for the final treatment of the wounded in the main group, facilitating significant stability of bone fragments, even in substantial long-bone defects.

VAC therapy, irrigation-oxygen VAC therapy, and ultrasonic cavitation significantly accelerated wound healing and reduced the duration prior to suturing. If the wound could not be closed and soft tissue defects of the thigh could not be addressed by the aforementioned approaches, free autodermoplasty or plastic surgery with a rotational dermal fascial flap was performed (Fig. 7).

The treatment quality of the wounded was significantly higher in the main group than in the control group across all essential parameters, as measured by the Mattis-Lyuboszyc-Schwarzberg anatomical and functional outcome scale. The table shows statistics regarding the distribution of functional treatment outcomes in both groups. The main group had a markedly greater proportion of good functional outcomes, with 49 (56.98 %) patients, surpassing the corresponding figure in the control group, which recorded only 34 (39.08 %) patients. This disparity arises from the differentiated approach to diagnosis and treatment within the main group, alongside the implementation of modern osteosynthesis methods and the management of infectious complications.

The proportion of satisfactory results was comparable between the groups: in the main group, 31 (36.78 %) patients, and in the control group, 28 (32.18 %) patients. This indicates that even in the case of complicated injuries, the approved standards of care can yield adequate results.

The most significant difference between the groups was noted in unsatisfactory results. In the control group, there were 16 patients (18.39 %), however in the main group, there were only 6 patients (6.24 %), which is nearly three times fewer [2, 9].

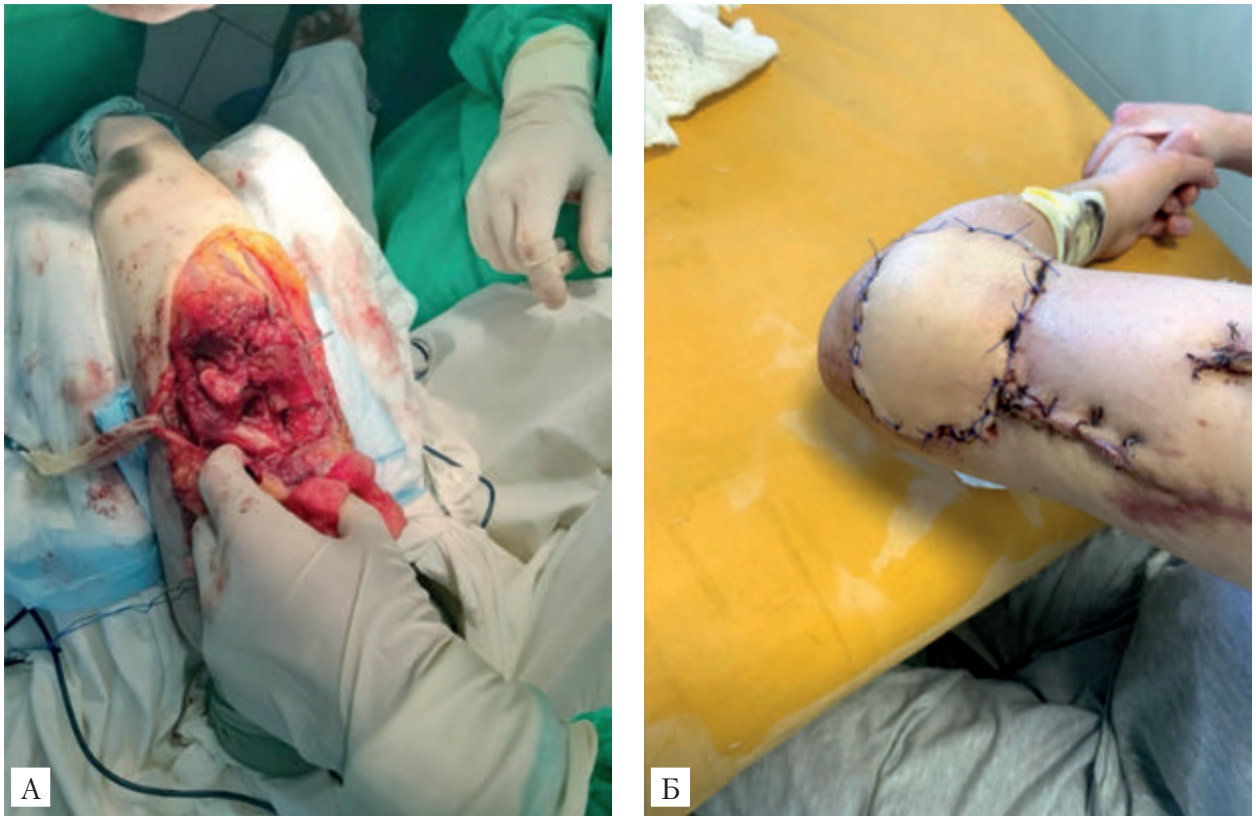

Figure 7. **Dermal fascial flap reconstruction of the soft tissue defect of the left elbow joint: before surgery (A) and after (B) surgery**

The general distribution of findings among the groups validates the statistical significance of the differences ($\chi^2 = 7.15$; $p < 0.05$). The differentiated surgical treatment strategy in the main group resulted in a nearly threefold reduction in unsatisfactory outcomes compared to the control group, confirming its effectiveness and facilitating a substantial enhancement in functional indicators (Table 8).

Complications and functional disorders in wounded individuals with long-bone gunshot fractures and CCTMI were divided into two groups: early and late.

Early complications in wounded individuals with long-bone gunshot fractures and CCTMI in comparison groups are characterized by a decrease in complications from 182.5 % in the control group to 140.1 % in the main group ($\chi^2 = 7.43$; $p < 0.01$). One of the early CCTMI complications was posthemorrhagic anemia, which occurred in 24 (26.37 %) patients in the main group and 37 (42.53 %) patients in the control group. In the main group, its frequency decreased due to active correction of blood circulation at the first levels of patient care. In some cases, anemia caused metabolic changes in the myocardium detected in 10 (10.99 %) patients in the main group and 26 (29.89 %) patients in the control group. These changes were manifested on the electrocardiogram by decreased tooth voltage and impaired myocardial repolarization (Table 9).

Table 8. **Comparison of the quality of treatment of the wounded according to the Mattis-Lyuboszyc-Schwarzberg anatomical and functional outcome scale**

Functional outcomes	Main group (n = 86)		Control group (n = 78)		Total (n = 164)	
		SE		SE		SE
Good	49 (57.0 %)	2.85	34 (39.1 %)	5.23	83 (50.6 %)	3.90
Satisfactory	31 (36.8 %)	1.84	28 (32.2 %)	5.01	59 (36.0 %)	3.75
Unsatisfactory	6 (6.2 %)	0.31	16 (18.4 %)	4.15	22 (13.4 %)	2.66

Table 9. **Early complications in the wounded with long-bone gunshot fractures and CCTMI in the comparison groups**

Complications	Main group (n = 91)	Control group (n = 87)	Total (n = 178)
Anemia	24 (26.4 %)	37 (42.5 %)	61 (34.3 %)
Metabolic changes in the myocardium	10 (10.99 %)	26 (29.9 %)	36 (20.2 %)
Acute renal failure	7 (7.69 %)	19 (21.8 %)	26 (14.6 %)
Thromboembolic complications	9 (9.9 %)	17 (19.5 %)	26 (14.6 %)
Disseminated intravascular coagulation	6 (6.59 %)	16 (18.4 %)	22 (12.4 %)
Pneumonia	18 (19.8 %)	32 (36.8 %)	50 (28.1 %)
Others	4 (4.4 %)	9 (10.3 %)	13 (7.3 %)
Total	78 (85.7 %)	156 (179.3 %)	234 (131.5 %)

Table 10. **Late complications in the wounded with long-bone gunshot fractures and CCTMI in the comparison groups**

Complications	Main group (n = 91)	Control group (n = 87)	Total (n = 178)
Post-operative wound suppuration	9 (9.9 %)	19 (21.8 %)	28 (15.7 %)
Phlegmons/abscesses	8 (8.8 %)	16 (18.4 %)	24 (13.5 %)
Osteomyelitis	6 (6.59 %)	14 (16.1 %)	20 (11.2 %)
Failed dermal grafts	5 (5.5 %)	12 (13.8 %)	17 (9.55 %)
Combined contractures of large joints	7 (7.69 %)	15 (17.2 %)	22 (12.4 %)
Re-amputation due to gangrene and osteomyelitis	4 (4.4 %)	9 (10.3 %)	13 (7.3 %)
Re-amputation for prosthetics	3 (3.3 %)	6 (6.9 %)	9 (5.1 %)
Total	42 (46.2 %)	91 (104.6 %)	133 (74.7 %)

Among the late complications (Table 10), post-operative wound suppuration and osteomyelitis remained significant challenges. However, in the main group, these complications occurred less frequently (9.89 % and 6.59 %, respectively) than in the control group (21.84 % and 16.09 %, respectively). Limb re-amputations due to gangrene or osteomyelitis were performed in 4.40 % of patients in the main group, which is significantly less than in the control group (10.34 %, $p < 0.05$) [4, 13].

The treatment duration of the wounded with long-bone gunshot fractures and CCTMI who survived reveals considerable benefits of the treatment strategy in the main group. The main group had an average hospitalization stay of 18.6 ± 2.0 days, compared to the control group's 23.4 ± 2.5 days, which was 20.5 % longer. The average treatment duration for mild wounds was 12.5 ± 1.2 days in the main group and 14.8 ± 1.5 days in the control group, with no recorded deaths. Inpatient care for severe wounds was reduced by 19.6 % in the main group (21.3 ± 2.3 vs. 26.5 ± 2.7 days), resulting in a drop in mortality from 14.3 % to 7.1 %. The average treatment duration for extremely severe injuries was reduced by 25.7 % (30.4 ± 3.1 days vs. 38.2 ± 3.8 days in the control group), and mortality decreased by 38.9 % (from 27.3 % to 16.7 %). The control group had a mortality rate of 10.3 % (9 cases), while the main group had only 5.5 % (5 cases) ($p < 0.05$). These findings support the effectiveness of a differentiated surgical treatment strategy in the main group, which reduces inpatient duration, lowers the probability of fatal cases, and improves clinical outcomes.

Conclusions

Based on a differentiated approach to the surgical treatment of long-bone gunshot fractures, we have substantiated, developed, and implemented an algorithm for osteosynthesis in wounded individuals with long-bone fractures and CCTMI at levels III and IV care. This strategy improved the functional treatment outcomes according to the Mattis-Lyuboshyts-Schwarzberg scale. It resulted in an increase in the proportion of good results from 39.08 ± 5.23 % to 56.98 ± 2.85 %, with a decrease in the relative number of unsatisfactory results from 18.39 ± 4.15 % to 6.24 ± 0.31 %, at $p < 0.05$.

A differentiated surgical strategy with an objective assessment of injury severity at different levels of patient care resulted in a decrease in mortality from 10.34 % in the control group to 5.49 % in the main group, reflecting a reduction of 4.85 %, the proportion of persistent contractures from 17.24 % to 7.69 %, rejection of dermal grafts from 13.79 % to 5.49 %, osteomyelitis from 16.09 % to 6.59 %, re-amputations of limbs from 6.90 % to 3.30 %, and hospital stay from 23.4 ± 2.5 to 18.6 ± 2.0 days, which is 20.5 % less ($p < 0.05$).

Declaration of interests

The authors declare no potential conflicts of interest.

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Ethics approval and written informed consent statements

The study was conducted in accordance with the Helsinki Declaration of Ethics. The study protocol was approved by the ethics committee of the Ukrainian Military Medical Academy.

Authors contributions

S. O. Korol: idea, design, formalization, conclusions; I. P. Palii, O. I. Zhovtonozhko, V. S. Honcharuk: design, materials and methods, data processing, statistics.

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Особливості диференційованого хірургічного лікування поранених із бойовою комбінованою термомеханічною травмою та вогнепальними переломами довгих кісток за рівнями медичного забезпечення

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Мета — покращити результати лікування поранених з переломами довгих кісток при бойовій комбінованій термомеханічній травмі (БКТМТ) шляхом розробки та впровадження диференційованої хірургічної тактики на різних рівнях медичного забезпечення.

Матеріали та методи. Проаналізовано результати хірургічного лікування 178 поранених з переломами довгих кісток та БКТМТ. У дослідженні використано загальноклінічні, хірургічні, лабораторні, біохімічні, морфологічні і статистичні методи. Поранені були розподілені на дві клінічні групи порівняння — основну та контрольну. Основна група включала 91 пораненого з вогнепальними переломами довгих кісток, яким хірургічне лікування проводили за диференційованою хірургічною тактикою, з урахуванням тяжкості БКТМТ. Та контрольна група, яка включала 87 поранених з вогнепальними переломами довгих кісток при БКТМТ, яким хірургічне лікування проводили з використанням традиційних методів лікування опікових та вогнепальних ран. Порівняння проводили за віком, питомою вагою вогнепальних переломів довгих кісток, опікових поверхонь, видом ранового каналу, кількістю ран, видом травми, терміном поступлення, аналізу ефективності організаційно-лікувальних заходів ($p > 0,05$).

Результати. Аналіз лікувальних заходів показав, що в основній групі частота виконання фасціотомій становила 27,47 %, тоді як у контрольній — лише 9,20 %, а виконання вакуумної терапії досягало 40,91 порівняно з 23,17 % у контрольній групі ($p < 0,05$). Використання сучасних підходів у фіксації уламків при БКТМТ з значними дефектами кісток, зокрема апаратів Ілізарова, з використанням двоетапної методики Masquelet також було значно поширенішим в основній групі (84,09 порівняно з 50,00 %, $p < 0,01$). Застосування шкали AdTS-CTMT та перфузійного індексу в усіх випадках основної групи сприяло своєчасній оцінці стану пацієнта, що дозволило підвищити якість лікування та уникнути ускладнень. Щодо ранніх ускладнень, частота анемії була значно нижчою в основній групі (62,64 порівняно з 78,16 %, $p < 0,05$), що сприяло зменшенню метаболічних змін міокарда (23,08 порівняно з 36,78 %) та гострої ниркової недостатності (9,89 порівняно з 14,94 %). Частота тромбоемболічних ускладнень у контрольній групі була майже вдвічі вищою (12,64 порівняно з 7,69 %, $p < 0,05$), що вказує на недосконалість профілактичних заходів. Серед пізніх ускладнень суттєвим викликом залишалися нагноєння післяопераційних ран та остеомієліт, однак у пацієнтів основної групи ці ускладнення зустрічалися рідше (9,89 % та 6,59 % відповідно), ніж у контрольній (21,84 та 16,09 %). Реампутації кінцівок через гангрену чи остеомієліт проводилися у 4,40 % пацієнтів основної групи, що значно менше ніж у контрольній (10,34 %, $p < 0,05$).

Висновки. Функціональні результати лікування за шкалою Маттіса—Любошиця—Шварцберга: збільшена питома вага добрих результатів — з (39,08 ± 5,23) до (56,98 ± 2,85) %, зменшена відносна кількість незадовільних — з (18,39 ± 4,15) до (6,24 ± 0,31) %, при $p < 0,05$. Впровадження диференційованої хірургічної тактики з урахуванням тяжкості травми на рівнях медичного забезпечення дозволило зменшити рівень летальності з 10,34 % контрольної групи до 5,49 % основної, різниця знизилась на 4,85 %.

Ключові слова: бойова комбінована термомеханічна травма, вогнепальне поранення, політравма, синдром взаємного обтяження, травматична хвороба, травматичний шок, опіки.

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Minimally invasive and standard operative techniques in the surgical treatment of acute complicated pancreatitis

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The surgical treatment of acute pancreatitis, particularly the choice of operative technique, is becoming increasingly relevant.

Objective — to develop a surgical approach for treating patients with acute complicated pancreatitis by determining the effectiveness of minimally invasive and traditional operative techniques, both independently and in combination.

Materials and methods. Surgical treatment was performed on 170 patients with acute complicated pancreatitis. In the main group (Group M) — 109 patients were predominantly treated with minimally invasive techniques (MITs), while in the comparative group (Group C) — 61 patients underwent standard operations. The age of hospitalized patients ranged from 22 to 74 years, including 36 women (33%) and 73 men (67%).

Results. MITs were performed as «final» in 62 cases (69%), «staged» in 16 cases (18%), and «stabilizing» in 12 cases (13%). The number of combined interventions was higher in Group M — 26% versus 12% in Group C ($p=0.04$), while standard operations dominated in Group C — 67% compared to 17% in Group M ($p<0.0001$). Primary laparotomy was performed in 41 patients (67%) in Group C and 19 patients (17%) in Group M ($p<0.0001$). The volume of standard operations in Group M mainly consisted of necrosectomy and the Beger procedure, including closed drainage — 26 cases (55%) and 15 cases (31%), respectively. Necrosectomy with subsequent staged debridement for general purulent-necrotic lesions did not differ statistically between the groups — 11 cases (23%) and 13 cases (26%) ($p>0.05$).

Conclusions. The developed approach to the surgical treatment of acute complicated pancreatitis with the independent and combined use of MITs and standard operations demonstrated a tendency to reduce the frequency of postoperative complications and postoperative mortality rates — from 13.1% to 8.3% and from 14.8% to 9.2%, respectively.

Keywords
acute complicated pancreatitis, operative techniques, minimally invasive interventions.

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Acute pancreatitis (AP) is one of the most complex, prognostically unfavourable, and often life-threatening acute abdominal conditions [1—3]. The challenge of treating this category of patients extends beyond purely medical aspects and encompasses an equally significant socio-economic context due to the predominance of working-age men among the affected population [4, 6].

The surgical approach remains one of the main issues for addressing AP, particularly in determining the potential and significance of minimally invasive techniques and the feasibility of their use both independently and in combination with standard open surgeries [7—9].

Objective — to develop a surgical approach for treating patients with acute complicated pancreatitis by determining the effectiveness of minimally invasive and standard operative techniques, both independently and in combination.

Materials and methods

A comprehensive examination and surgical treatment were conducted on 170 patients admitted to the City Pancreatic Centre in the Department of General Surgery at Danylo Halytsky Lviv National Medical University from 2019 to 2023. Acute complicated pancreatitis (ACP) was diagnosed based on clinical, laboratory-biochemical, radiological, and instrumental data. According to a previously formulated approach [13], this category included patients with local complications of the disease and manifestations of transient or persistent organ failure.

By the 2012 Atlanta Classification [8], the following types of pancreatic fluid collections (PFCs) were defined as local complications: acute peripancreatic fluid collection (APFC): aseptic fluid content without signs of necrosis, acute necrotic collection (ANC): fluid containing fragments of necrotic tissue resulting from pancreatic parenchymal necrosis and/or necrosis of peripancreatic fat, postnecrotic pancreatic/retropancreatic fluid collection (PNFC): containing fluid in the form of pus and necrotic tissue/debris, predominantly infected.

The age of hospitalized patients ranged from 22 to 74 years, including 36 women (33 %) and 73 men (67 %). All patients were divided into two groups. The main group included 109 patients treated with an emphasis on minimally invasive techniques (MITs) during the period of complete mastery of these modern interventional technologies. The comparative group included 61 patients primarily undergoing standard surgical interventions, as MITs were still being assimilated and implemented.

For the diagnosis and assessment of the patient's condition, clinical, laboratory, biochemical, and additional methods were used, including radiological methods (X-ray, ultrasonography, computed tomography), intraluminal methods (esophagogastroduodenoscopy), instrumental methods (videolaparoscopy), as well as bacteriological and pathomorphological examinations.

The analysis of the severity of ACP according to the 2012 Atlanta Classification in the main and comparative groups showed that the number of patients with severe ACP was 26 (24 %) in the main group and 11 (18 %) in the comparative group, with moderate severity — 83 (76 %) and 50 (82 %), respectively. The proportion of hospitalized patients with severe ACP did not differ significantly between the two groups ($p > 0.05$). Thus, the groups were comparable (statistically not different) in terms of etiology and severity of the clinical course of the disease.

The research results were calculated using the χ^2 criterion; differences were considered statistically significant at $p < 0.05$.

Results

All hospitalized patients underwent surgical treatment using various interventional techniques. In the main group, MITs predominated, performed as ultrasound-guided punctures, puncture-drainage methods, and videolaparoscopic techniques, classified as «final», «staged» and «stabilizing». Specifically, «final» techniques were applied in 62 (69 %) cases, «staged» in 16 (18 %) cases, and «stabilizing» — in 12 (13 %) cases.

The total number of surgical interventions in both groups did not differ significantly — 109 and 61 operations, respectively ($p > 0.05$). However, the structure of operative techniques differed. The proportion of combined (minimally invasive and standard) interventions was significantly higher in the main group — 26 % compared to 12 % in the comparative group ($p = 0.04$), whereas standard interventions predominated in the comparative group — 67 % versus 17 % ($p < 0.0001$) (Table 1).

In the main group, 29 (26 %) patients with acute peripancreatic fluid collections (APFC) underwent puncture under ultrasound guidance. 17 (16 %) patients with acute necrotic fluid collections (ANC) had an ultrasound-guided puncture-drainage. Additionally, 16 (15 %) patients with diffuse fluid collections in the form of enzymatic peritonitis/pancreatogenic ascites underwent videolaparoscopic debridement and drainage. These MITs facilitated a positive outcome, resulting in the complete recovery of patients.

Thus, in 62 (57 %) patients of the main group, the administration of MITs — puncture, puncture-drainage ultrasonography, and videolaparoscopy — ensured a favourable disease course without the need for open surgical intervention. In 6 (6 %) patients of this group with PNFC, despite the use of interventional ultrasonography, localized purulent-necrotic foci were verified and successfully treated through precise, minimally traumatic lumbar incisions. Additionally, in 10 (9 %) patients with centrally located purulent-necrotic lesions, mini-laparotomy with necrosectomy was performed, leading to full recovery of patients.

Table 1. **Frequency of minimally invasive and open surgical interventions in the study groups**

Type of surgical intervention	Main group (n = 109)	Comparative group (n = 61)
Standard	19 (17 %)	41 (67 %)
Minimally invasive	62 (57 %)	13 (21 %)
Combined	28 (26 %)	7 (12 %)

Therefore, in 16 (15 %) patients, the administration of MITs contributed to the containment and demarcation of purulent-necrotic foci, creating conditions for further sanitation and drainage through open surgery using small incisions. These interventions were classified as «staged» procedures.

In the main group, 12 (11 %) patients with severe ACP, characterized by unstable hemodynamics and manifestations of multiple organ failure, underwent interventional ultrasonography. This technique, combined with intensive infusion therapy, ensured stabilization of the condition within 2—3 days, allowing the performance of open surgical procedures under optimal conditions. Such interventions were classified as «stabilizing» procedures.

In the comparative group, standard laparotomic operations were performed as primary procedures in 41 (67 %) patients, whereas in the main group, they were performed in only 19 (17 %) patients ($p < 0.0001$). At the same time, in 28 (26 %) patients of the main group, such operations were carried out as combined procedures following staged (15 %) and stabilizing (11 %) interventions.

A fundamentally important technical element of laparotomic surgical interventions was the choice of the optimal surgical approach, ensuring proper exploration and creating conditions for comprehensive and adequate revision of both the pancreas and all potentially affected retroperitoneal areas. In the main group, the arc-shaped subcostal incision predominated (26 patients, 55 %), whereas in the comparative group, the upper midline laparotomy was used more frequently (37 patients, 76 %).

The surgical volume in the main group, compared to the comparative group, mainly included necrosectomy and the Beger procedure, with closed drainage used in 26 (55 %) cases and 15 (31 %) cases, respectively, as MTIs facilitated the development of localized purulent-necrotic lesions, for which debridement via this method proved effective (Table 2).

Table 2. **Types of open surgical interventions in the study groups**

Type of surgery	Main group (n = 109)	Comparative group (n = 61)
NSE + closed drainage	26 (55 %)	15 (31 %)
NSE + semi-open drainage	4 (9 %)	21 (43 %)
NSE + programmed relaparotomy	11 (23 %)	12 (26 %)
Lumbotomy lavage	6 (13 %)	0

Note. NSE — necrosequestrectomy.

A semi-open approach using tube and rubber drains or Penrose drains predominated in the comparative group — 21 cases (43 %) versus 4 cases (9 %) in the main group ($p = 0.0003$). Necrosectomy followed by staged debridement through planned relaparotomy for generalized purulent-necrotic lesions (involving more than two zones) was statistically similar between the groups — 11 cases (23 %) and 12 cases (26 %), respectively ($p > 0.05$).

The analysis of the main clinical and statistical indicators of treatment effectiveness in the main and comparative groups showed a trend toward a reduction in the number of postoperative complications from 13.1 % to 8.3 % and the postoperative mortality rate from 14.8 % to 9.2 %

Discussion

The issue of an adequate surgical approach for ACP remains a topic of considerable debate [10—12]. It primarily concerns the controversies surrounding the potential, significance, and appropriateness of MITs [5, 12]. Despite considerations supporting standard open surgeries due to their proven effectiveness, the justification for broader implementation of MITs is equally persuasive [4, 6, 11].

Evaluating their experience with such interventions in AP, some researchers have reported a reduction in complication rates to 5 %, open surgical procedures to 3 %, and mortality rates to 20 % [6]. Other publications indicate that minimally invasive techniques are generally effective in 60—84 % of cases, with complication rates up to 90 % and mortality up to 24 % [5]. However, these techniques are associated with the need for multiple CT scans, resulting in increased radiation exposure and higher treatment costs [9, 12].

Consequently, there are no conclusive guidelines for the application of specific surgical techniques in distinct clinical scenarios. The proposed method emphasizes the significance of MITs, used independently and in combination with standard surgeries.

Conclusions

The developed approaches based on minimally invasive techniques (interventional ultrasonography, videolaparoscopy) and standard methods for surgical management of ACP significantly increase the share of non-invasive interventions, both as independent procedures and in combination with open surgeries.

Laparotomy is effective for localized purulent-necrotic lesions of the pancreas and/or parapancreatic/paracolic tissue, with lavage of the inflamed

area and the Beger procedure, with closed drainage. For generalized processes, necrosequestrectomy with subsequent staged debridement through planned relaparotomy is indicated.

The proposed surgical approach, including MITs both independently and in combination with standard surgical interventions, demonstrates a trend toward reducing the frequency of postoperative complications and mortality rate.

Declaration of interests

The authors declare that they have no conflicts of interest.

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Ethics approval and written informed consent statements

The project has been reviewed and approved by the Committee on Human Rights Related to Research Involving Human Subjects of Kyiv City Clinical Emergency Hospital (Kyiv, Ukraine), based on the Declaration of Helsinki. Patient gave his written informed consent prior to study inclusion.

Authors contributions

Conception and design — V. P. Andriushchenko; acquisition and analysis of data — D. V. Andriushchenko, Y. S. Lysiuk, M. V. Prikupenko; statistical analysis — D. V. Andriushchenko; drafting the article — V. P. Andriushchenko, D. V. Andriushchenko; critical revision of the article — V. P. Andriushchenko, Y. S. Lysiuk, M. V. Prikupenko

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Малоінвазивні та традиційні операційні технології в хірургічному лікуванні гострого ускладненого панкреатиту

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Питання хірургічного лікування гострого панкреатиту, зокрема вибір оперативної техніки, набуває дедалі більшої актуальності.

Мета — розробити хірургічний підхід до лікування пацієнтів із гострим ускладненим панкреатитом шляхом з'ясування ефективності застосування малоінвазивних і традиційних оперативних технік як ізольовано, так і в поєднанні.

Матеріали та методи. Хірургічне лікування проведено 170 пацієнтам із гострим ускладненим панкреатитом. В основній групі (n=109) переважно застосовували малоінвазивні техніки, у групі порівняння (n=61) — традиційні операції. Вік пацієнтів становив від 22 до 74 років. Серед них було 36 (33%) жінок та 73 (67%) чоловіки.

Результати. Малоінвазивні техніки використали «як остаточні» у 62 (69%) випадках, як «етапні» — у 16 (18%), «для стабілізації стану пацієнта» — у 12 (13%). В основній групі частіше виконували поєднані втручання, ніж у групі порівняння (26 та 12% відповідно, p=0,04), тоді як традиційні — у групі порівняння (67 і 17%, p<0,0001). Первинну лапаротомію проведено 41 (67%) пацієнту групи порівняння та 19 (17%) в основній групі (p<0,0001). Обсяг традиційних операцій переважно передбачав некрсеквестректомію із закритим дренуванням за Бегером (26 (55%) випадків в основній групі та 15 (31%) у групі порівняння). За частотою некрсеквестректомії з подальшим етапним промиванням при загальних гнійно-некротичних ураженнях групи статистично значущо не відрізнялися (11 (23%) та 13 (26%) випадків відповідно, p>0,05).

Висновки. Використання запропонованого підходу до хірургічного лікування гострого ускладненого панкреатиту з ізольованим та поєднаним застосуванням малоінвазивних і традиційних операцій сприяло зменшенню частоти післяопераційних ускладнень із 13,1 до 8,3% та рівня післяопераційної летальності з 14,8 до 9,2%.

Ключові слова: гострий ускладнений панкреатит, оперативні технології, малоінвазивні втручання.

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Management of ventral hernias: treatment results based on the developed algorithm

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The surgical treatment of anterior abdominal wall hernias is one of the most common procedures in elective surgery. However, the rate of laparoscopic hernioplasty is lower when compared to open methods. Experience in treating large ventral hernias (≥ 10 cm) using minimally invasive techniques is limited due to the inability to compare the edges of the hernial defect without component separation.

Objective — to develop an algorithm for choosing a surgical treatment method for patients with ventral hernias and to evaluate the results of treatment.

Materials and methods. A prospective multicenter study was conducted, which included 534 patients with ventral hernias of various sizes. All patients were treated from September 2011 to November 2024. Preoperatively, patients with hernias ≥ 10 cm were injected with 100 Units of botulinum toxin type A (BTA) into the muscles of the anterior abdominal wall. The mean age of the patients was 56.49 ± 14.59 years, with 307 (57.5 %) women and 227 (42.5 %) men. All patients underwent hernia surgery using laparoscopic and open hernioplasty methods according to the developed algorithm.

Results. The algorithm classified patients into three groups based on their hernia size: group 1 — patients with hernias < 4 cm wide (n = 269; 50.4 %), group 2 — with a size of 4—10 cm (n = 173; 32.4 %), and group 3 — with a size of ≥ 10 cm (n = 92; 17.2 %). The mesh was placed intraperitoneally during laparoscopic hernia repair. In all three groups, laparoscopic hernioplasty demonstrated a significantly lower rate of complications and length of hospital stay compared to open procedures ($p < 0.01$). Seromas were among the most common complications in all three groups in our study (n = 19; 7.1 % vs n = 26; 15.0 % vs n = 14; 50 %), and their frequency increased with hernia defect size. In group 3, among patients with large hernias, BTA administration allowed for the reduction of the aponeurosis defect to ≤ 10 cm in size in 89.4 % of cases and the performance of laparoscopic surgery in patients who agreed to it. The recurrence rate after laparoscopic surgery was 0.8 %, while after open surgery, it was 1.1 %.

Conclusions. The use of the algorithm for selecting the hernioplasty method allows implementing a personalized approach to the surgical treatment of patients with ventral hernias. Laparoscopic hernioplasty with intraperitoneal mesh placement demonstrates significantly better results compared to open methods of hernia repair in terms of length of hospital stay and complication rate ($p < 0.01$). The use of BTA for hernias ≥ 10 cm in the preoperative period makes it possible to perform hernioplasty using laparoscopic techniques and minimize surgical trauma in case the patient refuses laparoscopy.

Keywords
postoperative hernia, ventral hernia, hernia repair, botulinum toxin type A.

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Anterior abdominal wall hernias are among the most common pathologies in surgery and are often caused by weakness of individual areas of the abdominal wall or increased intra-abdominal pressure. According to the classification of the European Hernia Society (EHS), primary ventral (umbilical, linea alba, and other locations) and incisional hernias (IH) are distinguished [16]. Primary ventral hernias occur almost twice as often as incisional ones [14]. The occurrence of the latter largely depends on the method of wound closure and associated factors, including healing of the surgical wound. Common risk factors

for hernia development include obesity, decreased physical activity and increased life expectancy, and previous surgical interventions [8, 21]. The presence of a hernial defect more than 10 cm wide makes it problematic to suture the hernia without tension and use additional methods, including separation of abdominal wall components [2].

Laparoscopic hernioplasty has proven its effectiveness in the treatment of anterior abdominal wall hernias and demonstrates a significant reduction in the time spent in the clinic and the duration of the patient's rehabilitation after surgery [18]. However, there are contradictory data from different authors regarding the frequency of recurrences after laparoscopic hernioplasty. Some studies show that hernia repair with intraperitoneal onlay mesh (IPOM) yields better [19], comparable [1], and even worse [23] results than the open hernia repair technique. At the same time, the use of a mesh in any of the selected hernioplasty methods is recommended when suturing hernial defects with a diameter of more than 1 cm [2]. The main factors influencing recurrence are advanced age, overweight and obesity, diabetes, smoking, and reduced immunity [17]. Surgical complications, such as seromas or infections, significantly increase the risk of hernia recurrence. In the case of umbilical hernias, recurrences are more common in large defects, reaching 30—40 %. The recurrence rate of IH can reach 37 % after 4 years. In fact, factors such as the type of mesh selected, its placement, adequate mesh overlap, defect closure, the use of separation techniques in hernia repair, and the alignment of aponeurosis edges influence the rate of hernia recurrence after surgery [2, 8, 12, 25]. A personalized approach to choosing a surgical treatment method for hernia repair can be crucial for minimizing the risk of hernia recurrence and postoperative complications.

Objective — to develop an algorithm for choosing a surgical treatment method for patients with ventral hernias and to evaluate the results of treatment.

Materials and methods

General characteristics of patients

A prospective multicenter study was conducted from September 2011 to November 2024 at the clinical sites of the Department of General Surgery No. 2 of Bogomolets National Medical University, namely at the Kyiv City Clinical Hospital No. 3 and the Leleka Medical Center. The study included 534 patients with ventral hernias (primary and incisional) who underwent preoperative preparation and had various types of scheduled surgical interventions for hernia repair. The average age of the patients was 56.49 ± 14.59 years, and among those examined, there were 307 (57.5 %) women and 227 (42.5 %) men. Detailed characteristics of the patients are given in Table 1.

Inclusion criteria for the study

The inclusion criteria included:

- age from 18 to 90 years;
- uncomplicated ventral hernias;
- compensated concomitant pathology;
- scheduled hernia surgery;
- consent to hernioplasty with mesh prosthesis;
- patient consent to hernioplasty with or without suturing of the hernia defect.

The possibility of performing laparoscopic prosthetic hernioplasty with IPOM was also agreed upon with the patients. In case of refusal of the proposed laparoscopic surgery, the patient underwent open hernioplasty.

Patients with hernial defects of 10 cm or greater in width were asked to provide additional consent or refusal to inject botulinum toxin type A (BTA) into the muscles of the anterior abdominal wall in the preoperative period. In this study, we administered BTA «off-label» using our patented methodology (Ukrainian patent for utility model No. 142997 dated 10.07.2020 «Method for treating large ventral hernias by injecting botulinum toxin type A into the muscles of the anterior abdominal wall»). BTA was injected 4—5 weeks before the operation

Table 1. **Demographic and pre-operative data (n = 534)**

Characteristic	Value
Women	307 (57.5 %)
Men	227 (42.5 %)
Age, years	56.49 ± 14.59
Body mass index, kg/m^2	30.27 ± 4.33
ASA score	
I	136 (25.4 %)
II	379 (71.0 %)
III	19 (3.6 %)
IV	0
Obesity	209 (39.1 %)
Smoker	108 (20.2 %)
Type of hernia	
Primary ventral	293 (54.9 %)
Incisional	241 (45.1 %)

Note. ASA — American Association of Anesthesiologists. Data are presented as M ± SD or abs. (%).

into the transverse, external, and internal oblique muscles of the abdominal wall under double control of the drug injection at 6 points, 3 on the right and 3 on the left, with a total volume of 100 Units (Botox, Allergan, USA).

Exclusion criteria from the study

Exclusion criteria included:

- patients under 18 or over 90 years old;
- complicated ventral hernias (including strangulated);
- decompensated concomitant pathology;
- urgent operation;
- refusal of mesh hernioplasty;
- subxiphoid or suprapubic localization of the hernial defect.

Algorithm for choosing the surgical treatment method for hernias

In all patients, during the perioperative period, the physical examination was supplemented with an ultrasound examination (US) of the abdominal cavity and anterior abdominal wall to determine/clarify the localization and size of the hernial defect, as well as the number of aponeurosis defects.

The EHS classification [16] divides primary ventral hernias (PVH) and IH into small, medium, and large hernias using several approaches. PVH is classified as having a hernial defect larger than 4 cm, and IH as having an average aponeurosis defect width of 4—10 cm. IH with a width of ≥ 10 cm is considered large. PVH of ≥ 10 cm is significantly less common than IH of similar size. However, a significant width of divergence in the edges of the aponeurosis poses a significant challenge in eliminating the hernia, irrespective of the cause of its occurrence [8]. Since the width of the hernial defect has a direct proportional effect on the tension in the area of suturing the edges of the aponeurosis, we chose to use the width of the hernia as the primary criterion for grouping patients based on treatment method.

According to the proposed algorithm, we divided patients into 3 groups based on the width of the hernial defect. Group 1 included patients with hernias (PVH and IH) < 4 cm in size (n = 269; 50.4 %), group 2 — with a size of 4—10 cm (n = 173; 32.4 %), group 3 — with a size of ≥ 10 cm (n = 92; 17.2 %).

In establishing the algorithm, we considered the patient's age, consent to laparoscopic intervention with intra-abdominal mesh placement, and consent to the introduction of BTA 4—5 weeks before surgery for hernia width ≥ 10 cm. Taking into account the literature data and our studies on the reliability of mesh fixation to the anterior abdominal wall, we proposed performing hernioplasty without suturing the hernia defect when choosing a laparoscopic option for surgery in patients over 65 years of age and in the presence of concomitant somatic pathology. This reduces surgery duration and intraoperative trauma [11]. Patients under the age of 65 were regarded as working, and when choosing a laparoscopic option for hernioplasty, we proposed suturing the hernia defect to preserve the functional activity of the anterior abdominal wall muscles. The proposed algorithm for choosing a surgical treatment method for hernias is presented in Figure.

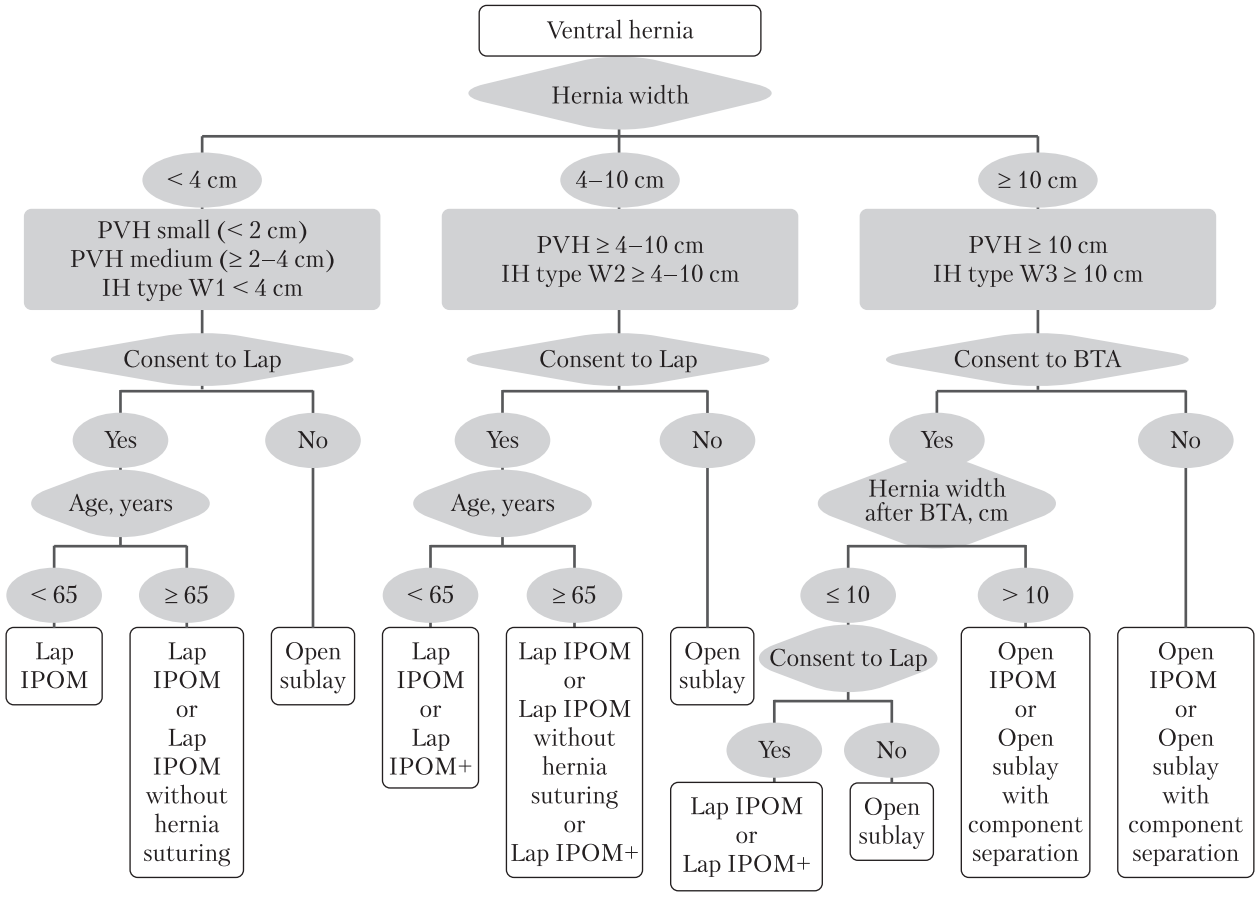
All patients who smoked were advised to quit 1 month before surgery. Patients with overweight and obesity were encouraged, if feasible, to follow a diet in an attempt to normalize their weight before surgery. All patients who were diagnosed with type 2 diabetes mellitus underwent appropriate conservative treatment in the preoperative period, if necessary, in order to stabilize their glycaemic levels and achieve diabetes compensation at the time of surgery.

Technique of surgical interventions

In each of the three groups of patients, the choice of hernioplasty technique was carried out according to the above algorithm. In all cases, hernioplasty was performed using a mesh. The size of the mesh was chosen according to the size of the hernial defect and the type of surgery. Thus, for open surgical interventions, the overlap of the edge of the hernial defect with the mesh was calculated to be at least 3 cm, and for laparoscopic ones, at least 5 cm [8, 9].

In case of the patient's consent to laparoscopic surgery, one of the options for its implementation was chosen according to the algorithm: laparoscopic hernioplasty using the IPOM method, which involved suturing the hernial defect before mesh placement (Lap IPOM); laparoscopic hernioplasty using the IPOM method without suturing the hernial defect (Lap IPOM without suturing); laparoscopic hernioplasty using the IPOM method with open suturing of the hernial defect through a mini-incision in the skin directly above the hernial hilum (Lap IPOM+). In the case of Lap IPOM+ in patients with IH, partial or complete excision of the old scar and excess skin of the hernial protrusion was performed to achieve a better cosmetic effect of the operation.

Laparoscopic surgery began with revision of the abdominal cavity. After determining the location, size, and number of hernial defects, the anterior abdominal wall was prepared for mesh installation, namely, viscerolysis, mobilization of the round and falciform ligaments of the liver as needed. When performing Lap IPOM, the hernial defect was sutured with non-absorbable sutures, capturing the



PVH — primary ventral hernia; IH — incisional hernia; Lap — laparoscopic hernia repair, IPOM — intraperitoneal mesh placement; IPOM+ — intraperitoneal mesh placement with open hernia suturing; BTA — botulinum toxin type A.

Figure. **Algorithm for choosing a surgical treatment method for ventral hernias**

entire thickness of the aponeurosis in order to avoid cutting through the sutures. After that, the pneumoperitoneum was deflated and the points of transaponeurotic mesh fixation were marked. Then, the pneumoperitoneum was restored, a composite mesh with an anti-adhesive coating was installed in the abdominal cavity, and it was fixed to the anterior abdominal wall at previously determined points with transaponeurotic sutures in order to avoid mesh displacement. After that, the main fixation of the mesh was performed directly with tackers using the «double crown» technique.

In Lap IPOM without suturing, the operation was performed similarly to the above-described technique, but without suturing the hernial defect. In this operation, after the stage of preparation of the anterior abdominal wall, the mesh was immediately fixed, controlling the minimum overlap of the mesh 5 cm from the most protruding edge of the aponeurosis from the center.

In Lap IPOM+, the difference in the performance of hernioplasty from Lap IPOM was that the stage of suturing the hernial defect was performed openly. After preparing the anterior abdominal wall, the pneumoperitoneum was deflated, and a mini-incision of the skin was performed directly above the hernial hilum. If necessary, the excess skin and the old postoperative scar were also excised. Then, the aponeurosis defect was sutured openly, with a continuous suture of non-absorbable double thread 1—0. After that, the laparoscopic stage was continued with the placement and fixation of the mesh, as mentioned above.

We performed open hernioplasty using one of three options. For hernias ≤ 10 cm in size, open hernioplasty was performed using the sublay method with the placement of a light macroporous polypropylene mesh retromuscularly preperitoneally and suturing the hernial defect (Open sublay). In the case of a hernial defect larger than 10 cm, one of the following two options was performed: hernioplasty using the sublay method with suturing the hernial defect and separation of the anterior abdominal wall components to minimize tension (Open sublay with CS); herniolaparotomy, mobilization of the edges of the hernial defect, with the placement of

a composite mesh with an anti-adhesive coating intraperitoneally, its fixation in at least 8 points with separate transaponeurotic sutures to the anterior abdominal wall, with, if possible, subsequent suturing of the aponeurotic defect with a continuous suture with non-absorbable double monofilament thread 1—0 (Open IPOM). If necessary, wound drainage according to Redon was performed during open hernioplasty.

Determination of possible postoperative complications

In order to objectify the detection of possible complications in all patients before discharge from the hospital, as well as during follow-up examinations in the clinic, the physical examination was supplemented with ultrasound of the abdominal cavity and anterior abdominal wall. If complications were detected, they were categorized according to the Clavien–Dindo classification [6].

The presence of seroma was determined in the case of local fluid accumulation, without signs of inflammation, in the thickness of the anterior abdominal wall, in the area of mesh placement and in the area of the hernia sac (after laparoscopic hernioplasty with IPOM or IPOM without suturing the hernia defect). During follow-up examinations in the postoperative period, if there was persistent pain in the area of mesh placement and no signs of inflammation, an ultrasound of this area was required to exclude/confirm possible fluid accumulation in this area. The type of seroma was determined according to the Morales-Conde classification [15].

Surgical site infections (SSIs) were assessed according to the criteria proposed by The United States Centers for Disease Control and Prevention (CDC) [10].

We defined hernia recurrence as the presence of a hernial protrusion in or around the surgical site, combined with a defect of the anterior abdominal wall in this area, which was confirmed both clinically and instrumentally. In patients who underwent laparoscopic hernioplasty using the IPOM technique without suturing the hernial defect, and who showed protrusion of the anterior abdominal wall without any signs of mesh displacement according to ultrasound, the situation was classified as mesh prolapse (bulging) without hernia recurrence.

Statistical analysis

Data were analysed with the statistical package IBM SPSS Statistics Base (version 22). All results were considered statistically significant at a value of $p < 0.05$. Quantitative data are presented as mean ± standard deviation (SD), unless otherwise stated. The normality of the data distribution was checked using the Shapiro-Wilk test ($p > 0.05$). For data not normally distributed, comparisons were made using the paired Student's t-test for related samples and the Student's t-test for unrelated samples. For data not normally distributed, comparisons were made using the Wilcoxon signed-rank test for related samples and the Wilcoxon-Mann-Whitney test for unrelated samples.

Results and discussion

A total of 534 patients with ventral hernias participated in the study. In group 1, among patients with a hernia defect up to 4 cm according to the EHS classification [16], there were 66 (12.4 %) patients with small PVH (< 2 cm), 125 (23.4 %) patients with medium PVH (2—4 cm) and 78 (14.6 %) patients with IH type W1 (< 4 cm). Group 2 included 74 (13.9 %) patients with large PVH and hernia defect width ≥ 4—10 cm, and 99 (18.5 %) patients with IH type W2 (≥ 4—10 cm). Group 3 included 28 (5.2 %) patients with large PVH and hernia width ≥ 10 cm and 64 (12 %) patients with IH type W3 (≥ 10 cm). More detailed treatment effectiveness indicators for each group of patients are presented in Table 2.

Given the variety of types of ventral hernias by location and the wide range of possible surgical options, which are presented in Table 2, it is statistically difficult to assess individual complication rates for each of the detailed samples. In order to analyze the effectiveness of the developed algorithm, the treatment results were assessed for each group, depending on the size of the hernial defect and not the cause of the hernia formation or its localization.

In group 1, 125 (46.5 %) patients chose laparoscopic surgery, while 144 (53.5 %) insisted on an open version of hernioplasty using the sublay method. Among patients who underwent laparoscopic surgery, there were 65 patients younger than 65 years old who underwent Lap IPOM with suturing of the hernial defect. There were also 60 patients in this group whose age was ≥ 65 years. 46 (76.7 %) of them underwent Lap IPOM without hernia repair, and 14 (23.3 %) patients ≥ 65 years of age underwent Lap IPOM with hernia repair.

In group 1, open surgeries resulted in a longer hospital stay than after laparoscopic procedures ($p < 0.001$). In patients ≥ 65 years of age, Lap IPOM without hernia repair resulted in comparable length of hospital stay ($p = 0.956$) compared to Lap IPOM with aponeurosis repair. At the same time, the frequency of complications in this age group when performing Lap IPOM without hernia repair was lower

Table 2. **Patient and hernia characteristics, and surgical outcomes (n = 534)**

Type of hernia	N	Type of operation	N	Hospital stay, day	Recurrence	Total complication	Seroma	Hematoma	SSI
Group 1, hernia size < 4 cm (n = 269)									
Small PVH (< 2 cm)	66 (12.4 %)	Lap IPOM	24	1.42 ± 0.58	0	0	0	0	0
		Lap IPOM WS	14	1.36 ± 0.50	0	0	0	0	0
		Open sublay	28	3.57 ± 0.69	0	1 (0.4 %)	1	0	0
Medium PVH (2—4 cm)	125 (23.4 %)	Lap IPOM	31	1.45 ± 0.57	0	4 (1.5 %)	4	0	0
		Lap IPOM WS	19	1.53 ± 0.51	0	0	0	0	0
		Open sublay	75	3.97 ± 0.99	0	8 (3.0 %)	5	2	0
IH type W1 (< 4 cm)	78 (14.6 %)	Lap IPOM	24	1.46 ± 0.51	0	3 (1.1 %)	3	0	0
		Lap IPOM WS	13	1.46 ± 0.52	0	2 (0.7 %)	2	0	0
		Open sublay	41	4.17 ± 0.92	0	8 (3.0 %)	4	3	1 (0.4 %)
Group 2, hernia size 4—10 cm (n = 173)									
Large PVH (4—10 cm)	74 (13.9 %)	Lap IPOM	15	1.40 ± 0.51	0	2 (1.1 %)	1	0	0
		Lap IPOM WS	13	1.46 ± 0.52	0	4 (2.3 %)	4	0	0
		Lap IPOM+	5	3.20 ± 0.45	0	2 (1.1 %)	0	2	0
		Open sublay	41	5.32 ± 0.99	1 (0.6 %)	15 (8.7 %)	7	5	2 (1.1 %)
IH type W2 (4—10 cm)	99 (18.5 %)	Lap IPOM	15	1.64 ± 0.63	0	3 (1.7 %)	3	0	0
		Lap IPOM WS	22	1.73 ± 0.55	1 (0.6 %)	1 (0.6 %)	1	0	0
		Lap IPOM+	7	3.29 ± 0.49	0	0	0	0	0
		Open sublay	55	5.04 ± 1.11	2 (1.1 %)	19 (11.0 %)	10	14	5 (2.9 %)
Group 3, hernia size ≥ 10 cm (n = 92)									
Large PVH (≥ 10 cm)	28 (5.2 %)	Lap IPOM	13	1.69 ± 0.79	0	1 (1.1 %)	1	0	0
		Lap IPOM+	11	3.73 ± 0.64	0	0	0	0	0
		Open sublay	0	-	0	0	0	0	0
		Open IPOM	3	3.67 ± 0.58	0	0	0	0	0
		Open sublay with CS	1	5	0	1 (1.1 %)	1	0	0
IH type W3 (≥ 10 cm)	64 (12.0 %)	Lap IPOM	12	1.75 ± 0.62	1 (1.1 %)	3 (3.3 %)	3	0	0
		Lap IPOM+	20	3.35 ± 0.81	0	1 (1.1 %)	0	0	1 (1.1 %)
		Open sublay	3	3.67 ± 0.58	0	1 (1.1 %)	1	0	0
		Open IPOM	5	3.8 ± 0.84	0	2 (2.2 %)	2	0	0
		Open sublay with CS	24	6.79 ± 1.35	0	14 (15.2 %)	6	3	3 (3.3 %)

Note. WS — without suturing; IPOM+ — intraperitoneal mesh placement with open hernia suturing; CS — component separation.

Table 3. **Postoperative complications (the Clavien–Dindo classification)**

Group	Hernia size	N	Complications						
			Total	Grade I	Grade II	Grade IIIa	Grade IIIb	Grade IVa	Grade IVb
1	< 4 cm	269	26 (9.6 %)	17 (6.3 %)	8 (2.9 %)	1 (0.4 %)	0	0	0
2	4—10 cm	173	46 (26.5 %)	21 (12.1 %)	20 (11.5 %)	3 (1.7 %)	2 (1.2 %)	0	0
3	≥ 10 cm	92	23 (25.0 %)	12 (13.0 %)	7 (7.6 %)	4 (4.4 %)	0	0	0
Total		534	95 (17.8 %)	50 (9.4 %)	35 (6.5 %)	8 (1.5 %)	2 (0.4 %)	0	0

(n = 2; 4.3 %) than after Lap IPOM with defect repair (n = 1; 7.1 %), and in both cases the complications were represented by seromas (Grade I).

The overall incidence of complications in group 1 after laparoscopic operations was 3.3 %; after open sublay, it was 6.3 %. Only in 1 case of hematoma development after open sublay was there a need for surgical treatment with hematoma evacuation, which we classified as Grade IIIa according to the Clavien–Dindo classification. In all other cases, complications were classified as Grade I and Grade II. The distribution of complications according to the Clavien–Dindo classification, identified in each group, is presented in Table 3. Superficial infections in the postoperative wound area were observed in 1 (0.37 %) case. In addition to the SSI indicated in Table 2, there was also 1 (0.37 %) case of urinary tract infection after open sublay in this group. In both cases, the administration of antibacterial drugs was effective in eliminating the infection and did not require additional interventions. We did not observe any hernia recurrences within 12 months after surgery in this group.

Similar to group 1, group 2 patients were more likely to choose open hernioplasty using the sublay method (n = 96; 55.5 %) over laparoscopic IPOM (n = 77; 44.5 %). Given the larger hernial protrusion in this group compared to group 1, 12 (15.6 %) patients opted for Lap IPOM+ among laparoscopic methods, motivating this by the desire to remove excess skin over the protrusion and the old scar in the hernia area. The duration of the operation was the shortest in the Lap IPOM without suturing and Lap IPOM groups; the duration of Lap IPOM+ and Open sublay was significantly longer ($p < 0.001$). The lowest complication rate was observed in the Lap IPOM group without suturing (14.3 %); complications after Lap IPOM with hernia repair and Lap IPOM+ were comparable (16.6 % vs. 16.6 %; $p > 0.05$), and the highest complication rate was after Open sublay (35.4 %). In the age group ≥ 65 years, Lap IPOM without suturing also demonstrated a lower complication rate (n = 5; 14.3 %) compared to laparoscopic hernioplasty methods with hernia defect suturing (n = 4; 22.2 %). It is worth noting that all these complications were Grade I (n = 8) and Grade II (n = 1), were represented by seromas (n = 7) and hematomas (n = 2), and were eliminated by puncture under ultrasound control. While after Open sublay, a wide range of complications was observed: superficial SSI (n = 5; Grade II), deep SSI (n = 2; Grade IIIb), urinary tract infections (n = 1; Grade II), seromas (n = 17; Grade I — 12, Grade II — 5) and hematomas (n = 9; Grade II — 6, Grade IIIa — 3).

In group 2, after Lap IPOM without suturing the hernial defect, mesh prolapse (bulging) was observed in 2 (5.7 %) patients. According to Liang et al., postoperative bulging occurs in 21.5 % of patients after laparoscopic hernioplasty, while after open intervention this figure is only 1.3 % [13]. At the same time, the development of bulging did not require repeated surgical intervention. Ultrasound examination of the anterior abdominal wall confirmed the absence of latent hernia recurrence.

There were also 4 (2.3 %) recurrences in this group, 1 after Lap IPOM without hernia repair and 2 after Open sublay. In all cases, patients reported an episode of excessive physical exertion before the onset of signs of hernia recurrence, and in 1 case after Open sublay, superficial SSI also occurred in the postoperative period.

Group 3 included patients with a hernia width of ≥ 10 cm. In this group, the possibility of performing laparoscopic operations was considered only after preliminary preoperative preparation, namely, the introduction of BTA 4—5 weeks before the operation. 66 (71.7 %) patients agreed to the introduction of BTA before the operation. At the same time, in 59 (89.4 %) patients, the hernia defect decreased to ≤ 10 cm postoperatively, thereby enabling the offer of laparoscopic hernioplasty to these patients. The high trauma of traditional open operations for large hernias prompts the search for possible options to minimize surgical trauma [20] and demonstrates the patients' commitment to laparoscopy. Given this, as well as the lower prevalence of these hernias and

their concentration mainly in specialized centers, we observed the highest rate of laparoscopic operations (n = 56; 60.9 %) in group 3 compared to open (n = 36; 39.1 %) operations among all three groups of patients. In this group, we noted the widest range of possible surgical options, which is presented in Table 2. For example, all patients who refused BTA (n = 26; 28.3 %) or whose hernia size remained more than 10 cm after BTA (n = 7; 7.6 %) were offered Open IPOM or Open sublay with CS. At the same time, all patients after BTA underwent Open IPOM at their insistence, and all of them refused Open sublay with CS. Among patients who refused BTA, only 1 patient underwent Open IPOM and 25 patients were treated by Open sublay with CS.

In group 3, three patients with a defect width reduced to ≤ 10 cm after BTA (n = 59) refused laparoscopic surgery and instead underwent Open sublay with hernial defect closure without tension and without the need for component separation. Laparoscopic surgery was performed in 56 patients, of which 25 (44.6 %) patients underwent Lap IPOM with hernia closure and 31 (55.4 %) patients underwent Lap IPOM+. We believe that the higher percentage of Lap IPOM+ selection is due to the patient's desire to improve the cosmetic appearance of the anterior abdominal wall by removing excess skin over a large hernial protrusion and postoperative scar, which is observed in the vast majority of cases with large hernias.

Patients in group 3 experienced the shortest hospital stay duration following Lap IPOM with hernia suturing. Patients who underwent Lap IPOM+ and Open IPOM had a longer postoperative hospital stay compared to those who underwent Lap IPOM, but comparable to each other ($p > 0.05$). This may be due to the presence of an open stage of surgery in Lap IPOM+ and less intraoperative trauma to the anterior abdominal wall in Open IPOM, compared to sublay techniques. Open sublay with CS required the longest hospital stay for the patient after surgery, as its implementation requires extensive dissection of the anterior abdominal wall tissues.

The complication rate in group 3 was lower among patients who underwent BTA (n = 7; 10.6 %) compared to those who refused this procedure (n = 16; 61.5 %). When comparing laparoscopic and open operations, the complication rate after laparoscopic operations was also lower (n = 5; 8.9 % vs n = 18; 50.0 %). Thus, after Lap IPOM, 4 cases of seroma (Grade I — 3; Grade II — 1) were observed, and after Lap IPOM+, 1 case of superficial SSI (Grade II) was seen. After open operations, the spectrum of complications was much wider. The largest number of cases was observed after Open sublay with CS (n = 15), namely: superficial SSI — 3 (Grade II), urinary tract infections — 2 (Grade II), seromas — 7 (Grade I — 5, Grade IIIa — 2), and hematomas — 3 (Grade I — 1, Grade IIIa — 2). After Open sublay, there was only 1 case of seroma (Grade I), but it should be noted that the number of cases observed in this group was limited (n = 3). The group of patients who underwent Open IPOM was also small (n = 8), but considering the volume of intervention for large hernias, the complication rate was significantly lower than that after Open sublay with CS (n = 2; 25.0 % vs n = 15; 60.0 %). Complications after Open IPOM were represented by seromas (n = 2; Grade I).

In group 3, a 65-year-old patient (1.1 %) was diagnosed with hernia reccurence 11 months after Lap IPOM with suturing of the L3-L4 type of IH after an episode of excessive physical exertion. During reoperation, the suture of the aponeurosis was found to be intact at the site of the previous defect. However, there was a separation of the edge of the aponeurosis of the abdominal oblique muscles, resulting in the formation of a hernial defect adjacent to and below the previously addressed defect, accompanied by the migration of the lower edge of the mesh into the hernial sac. A partial resection of the mesh in the hernial sac was performed, followed by open suturing of the aponeurosis defect and the laparoscopic placement of an additional mesh using the IPOM+ method.

No mortality was observed in all three groups. Repeated surgical interventions under general anesthesia within 30 days after surgery were also avoided.

Summarizing our results, it is worth noting that the presence of a wide range of possible surgical interventions for ventral hernias [2, 4, 20], as well as the variety of hernia locations on the anterior abdominal wall according to the EHS classification [16], prompts the search for a unified approach to the choice of surgical operation. Professional organizations provide specific surgical treatment guidelines for PVH and IH [8, 9, 21], as well as general guidelines for both types of ventral hernias [2—5]. For example, according to the recommendations of the European and American Hernia Societies for the treatment of PVH, hernias larger than 4 cm should be treated similarly to the treatment tactics for IH [9]. That is why, when developing an algorithm for choosing a treatment method, we chose the size of the hernia defect as the main criterion and not the etiological factor.

In our study, we chose the IPOM for laparoscopic mesh placement, as it is the most studied and the advantages of its use have been proven in practice, unlike other laparoscopic hernioplasty methods, the experience of which is currently being accumulated [9].

In all three observation groups, laparoscopic operations demonstrated a significantly lower rate of complications and length of hospital stay compared to open methods of hernioplasty ($p < 0.01$). Our data on a significantly shorter hospital stay coincide with the data from other studies [2, 22, 26]. There is no consensus in the literature on the overall rate of complications after laparoscopic hernioplasty compared to open surgery. For example, a significantly lower frequency of wound infection after laparoscopic interventions has been proven, but a higher percentage of intraoperative intestinal damage and the development of intestinal fistulas, compared to open methods of hernia repair [2, 4, 24, 26]. In all 3 groups, we did not observe any cases of intraoperative complications, including intestinal damage. However, it is worth noting that all laparoscopic operations were performed by surgeons with advanced skills in laparoscopy.

Seromas are one of the most frequent complications in ventral hernia repair [15]. This tendency was also observed in all three groups (n = 19; 7.1 % vs. n = 26; 15.0 % vs. n = 14; 50 %), and the frequency of seromas increased with increasing hernia defect size. Hematomas were also found in all three groups (n = 5; 1.9 % vs. n = 11; 6.3 % vs. n = 3; 3.0 %), but mostly after open sublay hernioplasty, and only in 1 case in group 2 after Lap IPOM+. In all cases, fluid accumulations were not observed on ultrasound for more than 3 months and were classified as Type I and Type IIa according to the Morales-Conde classification.

The prevalence of laparoscopic methods of surgery in the treatment of hernias, in addition to the complication rate, may be influenced by their higher economic cost [22]. In groups 1 and 2, we observed a lower frequency of choosing the laparoscopic version of hernioplasty compared to the open one (46.5 % vs. 53.5 % and 44.5 % vs. 55.5 %). However, our rates of laparoscopy are higher than in the analysis of 161,415 cases of ventral hernia hernioplasty in the United States presented by B. Fry et al. in the period 2010 to 2020. For example, the frequency of laparoscopic hernioplasty during this period decreased from 23.8 % to 11.9 %, and the frequency of open hernioplasty — from 74.2 % to 66.2 % [7].

In group 3, we observed a higher prevalence of laparoscopic operations compared to open ones (60.9 % vs. 39.1 %). The use of BTA in the preoperative period allowed for a reduction in the initial width of the hernia defect and the introduction of minimally invasive operations in the category of patients with large hernias (≥ 10 cm). Laparoscopic operations are usually considered as an alternative to open procedures only for hernias < 10 cm [4], or even < 8 cm [5]. The rapid recovery of the patient after surgery and a reduction in the period of hospital stay, compared with open traumatic operations, may provide significant justification when considering the economic feasibility of choosing laparoscopy. At the same time, according to B. Fry et al., there is a tendency toward an increase in the number of expensive robotic-assisted hernia repairs against the background of a decrease in the number of laparoscopic and open operations, while the recurrence rate is highest for robotic-assisted hernioplasty [7].

The recurrence rate in our study after laparoscopic operations was 0.8 %, and after open operations, it was 1.1 %, which is a comparable indicator. This may indicate both the effectiveness of the selected algorithm for choosing a treatment method, precise preparation in the preoperative period with minimization of risk factors, and the need for a longer observation period.

Limitations of our study are the limited duration of observation (in most patients within 12 months), a limited sample of patients in certain subgroups and the study of the effectiveness of a single dose of BTA (100 Units) with preoperative administration in patients with hernias of ≥ 10 cm. Additionally, there were no patients with hernias wider than 20 cm in our study, most likely because these hernias are extremely rare according to the literature. In the study, we observed a low rate of hernia recurrence and a low rate of complications after laparoscopic operations. In order to further study the influence of individual factors (hernia type, localization) on the level of complications and hernia recurrences with different hernioplasty techniques, we consider it advisable to continue observation in a more distant period and increase the sample of patients.

Conclusions

The use of the algorithm for selecting the hernioplasty method allows implementing a personalized approach to the surgical treatment of patients with ventral hernias. Laparoscopic hernioplasty with intraperitoneal mesh placement demonstrates significantly better results compared to open methods of hernia repair in terms of length of hospital stay and complication rate ($p < 0.01$). The use of BTA for hernias ≥ 10 cm in the preoperative period makes it possible to perform hernioplasty using laparoscopic techniques and minimize surgical trauma in case the patient refuses laparoscopy.

Declaration of interests

The authors declare that they have no conflicts of interest.

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Authors contributions

O. Y. Ioffe: work concept and design, critical review;
T. V. Tarasiuk: work concept and design, data collection and analysis, statistical analysis, writing the manuscript;
M. S. Kryvopustov: statistical analysis, critical review;
O. P. Stetsenko: critical review.

Ethics approval and written informed consents statements

The study followed the Ethical Principles of Medical Research Involving Humans, set forth in the Declaration of Helsinki of the World Medical Association and current regulatory acts of Ukraine. The study protocol was approved by the ethics committee of the Bogomolets National Medical University. Written informed consent was obtained from all patients.

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Менеджмент вентральних гриж: результати лікування на основі розробленого алгоритму

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Хірургічне лікування гриж передньої черевної стінки є одним із найпоширеніших у плановій хірургії, але частота застосування лапароскопічної герніопластики є меншою порівняно з відкритими методами. Досвід лікування вентральних гриж великих розмірів (≥ 10 см) із використанням малоінвазивних технологій є обмеженим через неможливість з'єднання країв грижового дефекту без сепарації її компонентів.

Мета — розробити алгоритм вибору методу хірургічного лікування пацієнтів із вентральними грижами та оцінити результати лікування.

Матеріали та методи. Проведено проспективне багатоцентрове дослідження із залученням 534 пацієнтів із вентральними грижами різного розміру. Пацієнти проходили лікування з вересня 2011 р. до листопада 2024 р. Пацієнти з грижами розміром ≥ 10 см у доопераційний період отримували ін'єкції ботулотоксину типу А (БТА) у дозі 100 МО в м'язи передньої черевної стінки. Середній вік пацієнтів становив (56,49 ± 14,59) року. Серед них було 307 (57,5 %) жінок і 227 (42,5 %) чоловіків. Усім пацієнтам проведено оперативне втручання з приводу грижі з використанням лапароскопічних та відкритих методів герніопластики відповідно до розробленого алгоритму.

Результати. При розробці алгоритму вибору методу лікування основним критерієм було обрано розмір грижового дефекту, відповідно до якого пацієнтів розподілили на три групи: група 1 — ширина грижі < 4 см (n = 269; 50,4 %), група 2 — 4—10 см (n = 173; 32,4 %), група 3 — ≥ 10 см (n = 92; 17,2 %). При лапароскопічних операціях з ліквідації грижі сітку розміщували інтраабдомінально. У всіх групах лапароскопічні операції продемонстрували статистично значущо меншу частоту ускладнень і тривалість перебування в стаціонарі порівняно з відкритими методами герніопластики ($p < 0,01$). Сероми були одним з найчастіших ускладнень у всіх групах (n = 19; 7,1 %, n = 26; 15,0 %, n = 14; 50 % відповідно). Цей показник зростав у міру збільшення розміру грижового дефекту. У групі 3 уведення БТА у 89,4 % випадків дало змогу зменшити дефект апоневрозу до ≤ 10 см і виконати лапароскопічну операцію в пацієнтів, які дали на неї згоду. Частота рецидиву після лапароскопічних операцій становила 0,8 %, після відкритих — 1,1 %.

Висновки. Використання алгоритму вибору методу герніопластики дає змогу імплементувати в практику персоналізований підхід до хірургічного лікування пацієнтів із вентральними грижами. Лапароскопічна герніопластика з інтраабдомінальним розміщенням сітки демонструє статистично значущо кращі результати порівняно з відкритими методами ліквідації грижі при оцінці тривалості перебування в стаціонарі та частоти розвитку ускладнень ($p < 0,01$). Використання в доопераційний період БТА при грижах розміром ≥ 10 см дає змогу виконати герніопластику за допомогою лапароскопічних методик і мінімізувати операційну травму в разі відмови пацієнта від лапароскопії.

Ключові слова: післяопераційна грижа, вентральна грижа, герніопластика, ботулотоксин типу А.

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Treatment outcomes for grades I-II chronic hemorrhoids using the bipolar vaporization method

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Minimally invasive methods for the treatment of chronic hemorrhoids are a crucial component of modern proctology. However, they do not always provide optimal outcomes due to recurrences, complications, and the need for repeat procedures. Some methods have limited accessibility due to high requirements for physician expertise and expensive equipment, highlighting the need for improved approaches.

Objective — to evaluate the efficacy and safety of bipolar vaporization for treating grades I—II chronic hemorrhoids.

Materials and methods. The study included 32 patients (19 men and 13 women) aged from 19 to 70 years with chronic hemorrhoids of grades I—II that were resistant to conservative treatment. The duration of chronic hemorrhoids ranged from 1 to 20 years, with an average of 6.8 ± 4.5 years. The bipolar vaporization procedure was performed using the Ukrainian-made bio-welding generator EK-300M «Sarmed.» The primary endpoints included assessment of hemorrhoid symptoms, complications, patient satisfaction with treatment outcomes, and recurrence rates.

Results. Persistent bleeding and/or node thrombosis were the primary indications for surgery in 100 % of patients, affecting 14 patients (43.8 %). Intraoperative blood loss did not exceed 20 ml, with an average of 8.3 ± 3.7 ml. The mean duration of the procedure was 44.3 ± 7.1 minutes. The average number of ketorolac doses on the first postoperative day was 1.4 ± 0.9 doses (ranging from 1 to 4 doses), and on the second day, 1.8 ± 0.8 doses (ranging from 1 to 3 doses). The mean hospital stay was 2.3 ± 0.5 days (2 to 3 days), and the average period of incapacity for work was 5.8 ± 0.7 days (5 to 7 days). On the 7th postoperative day, 65.6 % of patients reported pain, but its intensity was low (1.62 ± 0.7 points, p = 0.003). At 6 weeks and 1 year postoperatively, none of the patients reported pain. After one year, 96.9 % of patients were free of prolapse, itching, or soiling, and bleeding was absent in all cases. Patient satisfaction after one year averaged 8.31 ± 0.74 points. Recurrence occurred in 3.1 % of patients.

Conclusions. Bipolar vaporization is an effective and safe method for treating chronic hemorrhoids of grades I—II, providing significant symptom relief, minimal blood loss, and a short recovery period. The method demonstrates a high level of patient satisfaction and a low recurrence rate. The study results confirm the high efficacy and safety of this method, making it a promising approach for the treatment of chronic hemorrhoids.

Keywords
chronic hemorrhoids, treatment, minimally invasive technologies, bipolar vaporization method, outcomes.

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Chronic hemorrhoids (CH) are among the most common anorectal disorders worldwide. According to a national medical survey in China, standardized detection rates for hemorrhoids were 17.7 % among men and 43.7 % among women [29]. In 1990, hemorrhoids affected 5 % of the U. S. population, while more recent studies report an incidence rate of 13—16 % [9, 12, 20]. In Austria, 38.93 % of the population is affected by hemorrhoids [30]. The peak age for hemorrhoid development is 45—65 years, with up to 50 % of individuals over 50 experiencing problems related to hemorrhoidal disease [15, 31]. Among patients undergoing colonoscopy as part of colorectal cancer screening programs, the prevalence of hemorrhoids was 38—39 %, with 55 % of cases being asymptomatic [27, 30].

According to Goligher's classification [6, 16], the majority of CH patients have grade I (72.89 %) and grade II disease (18.42 %), while grades III and IV account for 8.16 % and 0.53 %, respectively [30].

Guidelines and recommendations emphasize three main categories for CH treatment: conservative, instrumental, and surgical approaches [3, 9, 10, 13, 34, 35]. Conservative treatment is considered an integral part of managing all CH grades. However, definitive treatment often requires additional interventions.

Following medical treatment, the next therapeutic step for patients with symptomatic persistent grades I and II hemorrhoids resistant to conservative management typically involves minimally invasive procedures performed in either outpatient or inpatient settings. These procedures include rubber band ligation [29], sclerosing injections [14], transanal hemorrhoidal dearterialization [37], emborrhoid therapy [4], and thermal destruction methods such as infrared photocoagulation [33], laser coagulation [22, 23], radiofrequency ablation [21], and bipolar coagulation [32].

These methods reduce the vascularization of hemorrhoidal tissues, eliminate excess tissue, and minimize prolapse through ablation or fixation to the rectal wall.

Despite their effectiveness, these techniques have several specific drawbacks. They may require multiple sessions, cause pain or complications, and are often costly, technically demanding, and associated with high recurrence rates [3, 9, 10, 13, 34, 35].

As a result, there is currently no consensus on the prioritization of specific minimally invasive techniques for treating grades I—II CH, emphasizing the need for further research in this area.

Vaporization, also known as tissue evaporation, is a method of thermal tissue destruction used in medicine. This method has gained wide application in urology [8, 18] and gynecology [1], demonstrating excellent results. There is also evidence of its high efficacy in treating varicose veins in the lower extremities [5]. Given its technical characteristics and energy delivery mechanism, this method could potentially be applied for hemorrhoid treatment. However, the currently available research lacks data on the use of vaporization for this purpose.

Objective — to evaluate the efficacy and safety of the bipolar vaporization method for treating grades I—II hemorrhoids.

Materials and methods

The study included 32 patients: 19 men (59.4 %) and 13 women (40.6 %), aged from 19 to 70 years (mean age: 43.3 ± 14.7 years), with complicated CH grade I (10 patients, 31.3 %) and grade II (22 patients, 68.8 %) resistant to conservative treatment. The duration of CY history ranged from 1 to 20 years, with a mean duration of 6.8 ± 4.5 years.

Bipolar vaporization procedure

Ukraine has developed a unique energy source for bipolar coagulation, the bio-welding generator «Svarmed» EK-300M (Fig. 1, 2). Its technical characteristics facilitate the vaporization of hemorrhoidal nodes (HNs).

For the bipolar vaporization (BPV) of HNs, patients were placed on the operating table in the lithotomy position. Anesthesia was provided using spinal (22 patients) or epidural anesthesia (8 patients). In cases where these methods were contraindicated, general anesthesia was used (2 patients).

Antibiotic prophylaxis was performed in all patients by administering a single dose of broad-spectrum antibiotics 40 minutes before surgery and again in the evening on the day of surgery. The surgical field was prepared using a 10 % solution of

Figure 1. **Bipolar single-shaft electrode**

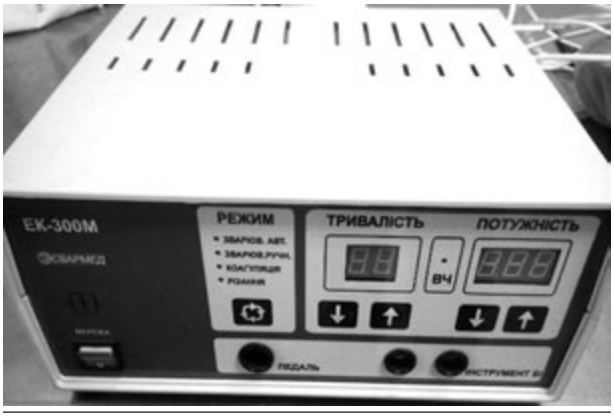

Figure 2. **Tissue welding device «Svarmed» EK-300M**

betadine or povidone-iodine, or a 0.05 % aqueous solution of chlorhexidine bigluconate.

The procedure began with the creation of a hydroanesthetic cushion at the typical locations of hemorrhoidal complexes, corresponding to the positions of 3, 7, and 11 o'clock on a standard clock face. This step improved the conductivity of the bipolar energy effect and enhanced the visualization of hemorrhoidal complex structures during the procedure.

The next stage involved sphincter dilatation using a rectal speculum, followed by antiseptic treatment of the rectal lumen with appropriate solutions. After identifying the HNs, a rectal speculum or a hemispherical anoscope was introduced into the anal canal.

The «vascular pedicle» of the HN was observed 1—2 cm from the dentate line or 3—4 cm from the transitional fold of the anal verge. It was ligated into the mucosal and submucosal layers of the rectal wall using absorbable monofilament sutures. Suturing was performed sequentially, twice from top to bottom, with 1.0—1.5 cm spacing between the stitches. After tying the suture, the «pedicle» of the node contracted, elevating the node by 1.0—1.5 cm upward, as schematically illustrated in Fig. 3.

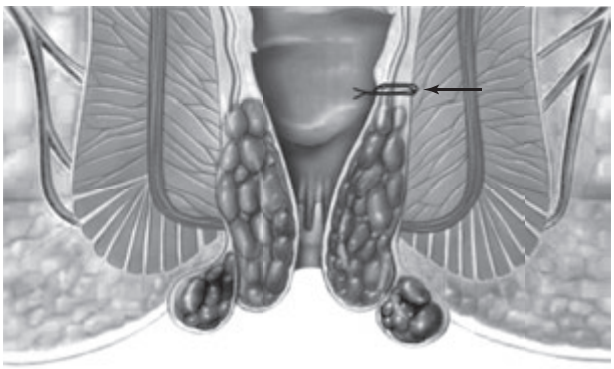

Figure 3. **Schematic representation of the dearterialization suture. Ligature on the pedicle of the hemorrhoidal complex is indicated by arrow**

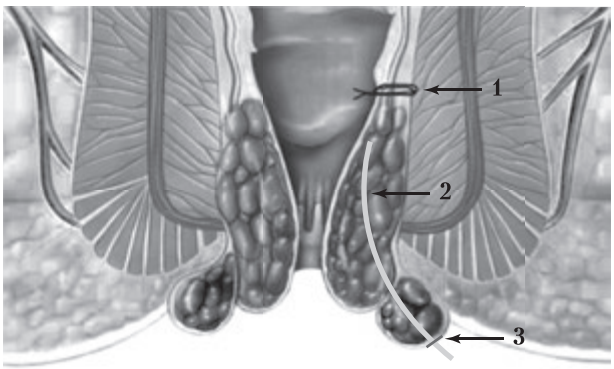

Figure 4. **Schematic representation of the placement of the bipolar electrode:** 1 — BPV of the hemorrhoidal node with a ligature on the vascular pedicle; 2 — a specialized bipolar electrode inserted into the hemorrhoidal complex; 3 — skin incision allowing electrode insertion into the hemorrhoidal complex

It should be noted that extending the suture beyond the dentate line is not recommended, as it can provoke postoperative pain syndrome.

Next, a linear incision of the skin, approximately 3—4 mm, was made at the external edge of the hemorrhoidal complex. Under manual guidance, a specialized bipolar electrode was inserted into the hemorrhoidal complex (Fig. 4).

The stage of direct BPV of the hemorrhoidal complex was performed using the «Svarmed EK-300M» device (see Fig. 2).

Vaporization was performed in the automatic welding mode pre-programmed in the device's system, with an exposure time of 20 seconds. The electrode was gradually withdrawn from the HN with careful movements to ensure complete vaporization of all vascular structures within the hemorrhoidal complex.

The completion of the vaporization cycle was pre-set by the manufacturer, and the device provided an automatic signal upon completion.

For pain management in the early postoperative period, ketorolac was prescribed. A single dose of ketorolac consisted of 30 mg of the medication.

Inclusion criteria

- Symptomatic CH of grades I—II according to Goligher's classification [6, 16], resistant to conservative treatment.
- Age 18 years or older.
- Absence of severe comorbid conditions (ASA class 4).
- Patient consent for surgical treatment and outpatient follow-up in the postoperative period.

Exclusion criteria

- History of infectious or undifferentiated colitis within the last six months prior to screening.
- Malignant neoplasms of the rectum and anal canal; inflammatory diseases of the rectum.
- Exacerbation of other chronic gastrointestinal diseases, such as pancreatitis, cholecystitis, hepatitis, gastritis, colitis, or acute surgical pathology.
- Positive HIV/AIDS status.
- Chronic diseases of the nervous system.
- Chronic diseases of the circulatory system.
- Systemic diseases.
- Endocrine pathology.
- Mental disorders.
- Autoimmune diseases.
- Cardiac and renal failure.
- Unstable psychological readiness of the patient to undergo the study.

- Presence of harmful habits (substance abuse).
- Logistical issues (failure of patients to attend timely examinations) or non-compliance with the recommended diagnostic and treatment plan.

The effectiveness of BPV of HNs was evaluated using parameters established for hemorrhoidal disease treatment in the international Delphi study [36].

The primary endpoint of the study was the «Hemorrhoid symptoms» domain, which included pain, prolapse, itching, soiling (leakage or discharge of small amounts of mucus, liquid stool, or contamination of the perianal skin), and bleeding (presence of blood in stool during defecation).

Secondary endpoints included the following domains: «Complications» (incontinence, abscess, urinary retention, anal stenosis, and fistula), «Recurrence»: the reappearance of initial symptoms reported by the patient and «Satisfaction»: patient satisfaction with surgical outcomes.

The «Hemorrhoid symptoms» domain was scored on a scale from 0 (no symptoms) to 9 (maximum discomfort).

The «Complications» domain included: incontinence: assessed using the Wexner incontinence Scale [19]; abscess and anal stenosis: determined via physical examination; urinary retention: diagnosed using ultrasound; fistula: identified with MRI in cases of inconclusive physical examination results.

The «Satisfaction» domain was scored from 0 (no satisfaction with the procedure) to 9 (maximum satisfaction with surgical outcomes).

«Recurrence» was defined as the reappearance of initial symptoms reported by the patient.

Evaluation time points for «Symptoms» and «Satisfaction» domains were evaluated at the following time points: pre-procedure (baseline), 7 days, 6 weeks, and 1 year after the procedure. Abscess and urinary retention were assessed 7 days after the procedure. Anal stenosis, incontinence, and fistula were evaluated 1 year after the procedure. «Recurrence» was determined at 1 year after the procedure.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics 22.0.

For comparing two independent samples, the Student's t-test was applied for normally distributed variables, and the Mann–Whitney U test was used for non-normally distributed variables. For comparing two dependent samples, the paired t-test or Wilcoxon signed-rank test was employed, as appropriate. For categorical variables, the chi-square test or Fisher's exact test was used. Categorical variables are presented as the number of cases and percentage, while quantitative values are presented as mean and standart deviation (M ± SD).

The null hypothesis of equality between variables was rejected at $p < 0.05$.

Results

The primary reasons prompting patients to undergo surgery were persistent hemorrhoidal bleeding (100.0 %) and/or a history of HN thrombosis (Table 1).

During the BPV procedure, shrinkage and a one-third reduction in the volume of HNs were observed, accompanied by the characteristic crackling sound typical of vaporization. The color and structure of the mucous membrane of the anal canal and HN remained unchanged. Completion of the vaporization process resulted not only in the reduction of the HNs but also in their retraction into the anal canal.

The duration of BPV ranged from 32 to 55 min, with an average of 44.3 ± 7.1 min. Perioperative

Table 1. **Baseline characteristics of patients with grades I—II chronic hemorrhoids**

Index	Value
Men Women	19 (59.4 %) 13 (40.6 %)
Age, years	43.3 ± 14.7 (19—70)
BMI, kg/m^2	27.4 ± 3.8 (19.5—36.7)
Duration of disease, years	6.8 ± 4.5 (1—20)
History of hemorrhoidal thrombosis	14 (43.8 %)
Cluster «Hemorrhoid Symptoms»	
Pain	18 (56.3 %)
Pain score	2.72 ± 1.4 (1—6)
Prolapse	22 (68.8 %)
Prolapse score	4.6 ± 1.3 (3—7)
Itching	9 (28.1 %)
Itching score	2.8 ± 0.7 (2—4)
Soiling	8 (25.5 %)
Soiling score	3.1 ± 0.8 (2—4)
Bleeding	32 (100.0 %)
Bleeding score	4.7 ± 1.1 (3—7)

Note. Categorical variables are presented as the number of cases and percentage, while quantitative indicators are presented as M ± SD (Min–Max). Mean scores are calculated based on the number of patients who exhibited the corresponding symptoms.

blood loss did not exceed 20 ml, averaging 8.3 ± 3.7 ml. Submucosal hematomas (up to 1 cm in diameter) were observed in 7 patients (21.9 %).

All patients required pain relief after the procedure. The average number of ketorolac doses on the first postoperative day was 1.4 ± 0.9 (ranging from 1 to 4 doses), and on the second day, 1.8 ± 0.8 (ranging from 1 to 3 doses). The average hospital stay was 2.3 ± 0.5 days (ranging from 2 to 3 days), and the mean time to return to work was 5.8 ± 0.7 days (ranging from 5 to 7 days).

Seven days after the procedure, the number of patients experiencing pain increased compared to the preoperative level, reaching 21 (65.6 %), p = 0.422. However, the mean pain score significantly decreased to 1.62 ± 0.7; p = 0.003. At 6 weeks and 1 year postoperatively, no patients reported pain (Table 2).

Prolapse was observed in one patient (3.1 %) one year after surgery, which was significantly lower than the preoperative level (p < 0.001). The patient rated the condition at 3 points.

One patient (3.1 %) reported itching, scoring it at 2 points. The frequency of itching was significantly reduced compared to the preoperative level (p = 0.006).

Soiling was noted by 10 patients (31.3 %) on the 7th day after surgery, which did not differ statistically from the preoperative level (p = 0.022). However, the mean soiling score was lower at 2.2 ± 0.2 compared to 3.1 ± 0.8 preoperatively (p = 0.022). At 6 months and one year after surgery, only one patient reported soiling, scoring it at 2 points.

No bleeding was reported in any patient throughout the follow-up period.

One week postoperatively, the satisfaction score averaged 6.8 ± 0.4 points. A quarter of the patients rated the results as moderately successful, while 24 patients (75 %) rated the outcome as successful. However, at this time point, no patients rated the surgical results at 8 or 9 points (Fig. 5).

Table 2. **Frequency of symptoms in the «Hemorrhoid symptoms» cluster at follow-up time points**

Symptom	Preoperative	Day 7	Day 42	Day 360
Pain	18 (56.3 %)	21 (65.6 %)	0*	0*
Prolapse	22 (68.8 %)	0*	0*	1 (3.1 %)*
Itching	9 (28.1 %)	0*	0*	1 (3.1 %)*
Soiling	8 (25.5 %)	10 (31.3 %)	1 (3.1 %)*	1 (3.1 %)*
Bleeding	32 (100.0 %)	0*	0*	0*

Note. * The difference compared to preoperative values is statistically significant (p < 0.05).

By 6 weeks (Day 42), a significant improvement in the satisfaction domain was observed, both in the distribution of scores and in the mean score (p < 0.001). At this stage, all patients considered the results successful, with 29 (90.6 %) rating their satisfaction at 8 or 9 points. The mean satisfaction score at 6 weeks was 8.34 ± 0.65 points.

One year postoperatively, the satisfaction scores did not differ statistically from those recorded at 6 weeks. Specifically, 29 (90.6 %) patients rated their satisfaction at 8 or 9 points. However, one patient with a recurrence rated their satisfaction at 6 points. The mean satisfaction score one year after the procedure was 8.31 ± 0.74 points.

From the «Complications» domain, assessed on day 7, an abscess was observed in 1 patient (3.1 %), and partial urinary retention occurred in 2 patients (6.2 %). At one year postoperatively, 2 patients (6.2 %) reported incontinence, specifically gas incontinence. Both cases were classified as mild incontinence, with a Wexner score of 3. No cases of anal stenosis or fistula were observed.

A recurrence of hemorrhoidal disease occurred in 1 patient (3.1 %) one year after surgery. The recurrence manifested as prolapse, itching, and soiling. The patient opted not to undergo repeat minimally invasive intervention.

Discussion

Chronic hemorrhoids remain a significant medical and social issue due to their high prevalence in the population and substantial impact on patients' quality of life [12, 17, 30].

The majority of CH patients present with grade I (72.89 %) and grade II disease (18.42 %), while

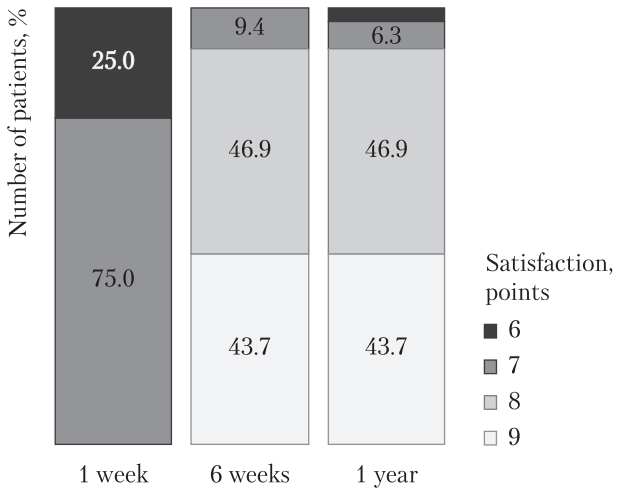

Figure 5. **Distribution of patients by satisfaction score at follow-up time points**

stages III and IV account for 8.16 % and 0.53 %, respectively [30].

Patients with symptomatic persistent hemorrhoids of grades I and II, resistant to conservative therapy, typically require minimally invasive interventions performed in outpatient or inpatient settings [3, 34, 35].

Existing minimally invasive methods, such as rubber band ligation (RBL), sclerotherapy (SI), transanal hemorrhoidal dearterialization (THD), and endovascular embolization of the superior rectal artery (Emborrhoid therapy), demonstrate high efficacy in patients with grades I—II CH. However, these methods are associated with certain drawbacks, including pain, risk of recurrence, and the need for repeat procedures [7, 11, 24, 28, 38].

Moreover, the technical complexity of procedures like THD and Emborrhoid therapy limits their availability in facilities with insufficient technical resources.

Thermal destruction methods, including laser coagulation, radiofrequency ablation, and bipolar coagulation, have demonstrated high success rates in reducing prolapse and vascularization of HNs. However, these techniques often require expensive equipment, and specialized staff training, and carry the risk of complications such as scarring and stenosis [10, 23, 25].

The method of infrared photocoagulation, while more accessible, shows relatively low treatment success rates, ranging from 75 % to 80 % one year after the procedure [2, 26].

Tissue vaporization, previously shown to be effective in urology [8, 18], gynecology [1], and the treatment of varicose veins [5], holds potential for application in the treatment of CH.

In our study, we employed the BPV method for grades I—II hemorrhoids using the Ukrainian-manufactured EK-300M «Svarmed» bio-welding generator in 32 patients with grades I—II CH. To our knowledge, no prior studies have investigated the use of BPV for hemorrhoid treatment. The method demonstrated high effectiveness and safety. Intraoperatively, a reduction and shrinkage of hemorrhoidal nodes by one-third of their volume were observed. The procedure had an average duration of 44.3 ± 7.1 minutes with minimal blood loss (8.3 ± 3.7 ml).

The average postoperative hospital stay was 2.3 ± 0.5 days, and the average time to return to work was 5.8 ± 0.7 days.

The outcomes assessed following the recommendations established for hemorrhoidal disease treatment in the international Delphi study [36] indicate a consistent resolution of symptoms, such as pain, prolapse, itching, and bleeding, in 96.9 %–100.0 % of patients during one year of follow-up, with minimal postoperative complications.

Patient satisfaction with treatment outcomes was high, with 90.6 % rating their results at 8—9 points six weeks and one year after the procedure, while the remainder rated their satisfaction at 7 points. A recurrence occurred in only one patient (3.1 %).

The BPV method demonstrates promise as an effective and safe instrumental technique for treating grades I—II CH. Further research should focus on exploring long-term outcomes, optimizing equipment specifications, and integrating the method into broader clinical practice. The inclusion of vaporization in comprehensive therapy for CH could significantly improve treatment outcomes and patient quality of life. The study has certain limitations, including a small sample size, single-center design, and a relatively short follow-up period. While the results of BPV in treating grades I—II hemorrhoids are promising, further studies are needed with larger cohorts and comparisons with other minimally invasive methods. Additionally, its efficacy and safety should be evaluated for treating grade III hemorrhoids.

Conclusions

Bipolar vaporization is an effective and safe method for treating grades I—II CH, providing significant symptom relief, minimal blood loss, and a short recovery period. The method achieves high levels of patient satisfaction and low recurrence rates. The findings support its high efficacy and safety, positioning it as a promising approach for treating CH.

Declaration of interests

The authors declare no conflict of interest.

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Authors contributions

L. S. Bilianskyi: conception and design, critical revision of the article; I. V. Voloshyn: acquisition, analysis and interpretation of data, statistical analysis, drafting, critical revision of the article, L. Y. Markulan: statistical analysis, drafting the article.

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Результати лікування хронічного геморою I—II ступеня з використанням методу біполярної вапоризації

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Малоінвазивні методи лікування хронічного геморою є важливим компонентом сучасної проктології, однак вони не завжди забезпечують оптимальні результати через рецидиви, ускладнення та необхідність повторних процедур. Деякі з них обмежено доступні через високі вимоги до кваліфікації лікаря та дороге обладнання, що свідчить про потребу в удосконаленні підходів.

Мета — оцінити ефективність і безпечність методу біполярної вапоризації для лікування хронічного геморою I—II ступеня.

Матеріали та методи. У дослідження було залучено 32 пацієнти (19 чоловіків та 13 жінок) віком від 19 до 70 років із хронічним гемороєм I—II ступеня, резистентним до консервативного лікування. Тривалість хронічного геморою становила від 1 року до 20 років, у середньому — (6,8 ± 4,5) року. Для проведення біполярної вапоризації використовували вітчизняний біозварювальний генератор «ЕК-300М Свармед». Основними кінцевими точками були оцінка симптомів геморою та ускладнень, задоволення пацієнтів результатами лікування і частота рецидивів.

Результати. У всіх пацієнтів основними причинами операції були кровотечі, що персистують, та/або тромбоз вузлів (14 (43,8 %)). Об'єм інтраопераційної крововтрати не перевищував 20 мл (у середньому — (8,3 ± 3,7) мл). Середня тривалість процедури становила (44,3 ± 7,1) хв. Середня кількість доз кеторолаку в першу добу — 1,4 ± 0,9 (1—4), на другу — 1,8 ± 0,8 (1—3). Середній ліжко-день становив (2,3 ± 0,5) доби (2—3), середній термін втрати працездатності — (5,8 ± 0,7) доби (5—7). На 7-й день після операції біль відчували 65,6 % пацієнтів, але його інтенсивність була невисокою ((1,62 ± 0,7) бала за візуально-аналоговою шкалою болю, p = 0,003). Під час контрольних оглядів через 6 тиж та 1 рік жоден хворий на біль не скаржився. Через рік 96,9 % пацієнтів не мали пролапсу, свербіжу чи забруднень, а кровотечі були відсутні в усіх. Задоволення пацієнтів процедурою через рік становило в середньому (8,31 ± 0,74) бала за 10-ти бальною шкалою, де 0 — немає задоволення, 9 — максимальне задоволення. Рецидив виник у 3,1 % пацієнтів.

Висновки. Біполярна вапоризація є ефективним і безпечним методом лікування хронічного геморою I—II ступеня, що суттєво зменшує симптоми, об'єм крововтрати й період відновлення. Метод асоціюється з високим рівнем задоволеності пацієнтів і низьким показником рецидивів. Результати дослідження свідчать про високу ефективність і безпечність цього методу, що робить його перспективним методом у лікуванні хронічного геморою.

Ключові слова: хронічний геморой, лікування, малоінвазивні технології, метод біполярної вапоризації, результати.

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Endoscopic stent placement in the management of esophagojejunal anastomosis leakage

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Objective — to evaluate the effectiveness of endoscopic stent placement compared to surgical methods for the management of esophagojejunal anastomosis leakage (AL) after gastrectomy at the National Cancer Institute (NCI) from November 2017 to November 2019.

Materials and methods. The study included patients receiving treatment at the Upper Gastrointestinal Oncology Department of the National Cancer Institute between November 2017 and November 2019. Throughout this period, 186 total gastrectomies were performed. 13 (6.9 %) patients developed an anastomotic leak in the postoperative period. All patients had Roux-en-Y esophagojejunostomy. 6 patients (46.1 %) underwent endoscopic stent placement in the AL area, along with perianastomotic drainage positioning and enteral feeding via a naso-intestinal tube. Of the remaining patients, 7 (53.9 %) underwent surgical treatment, including esophagostomy or esophageal stump formation with a nutritional jejunostomy. This manuscript employed methods of descriptive statistics.

Results. Endoscopic stent placement was successful for 5 patients. Complete defect closure following stent placement was confirmed in 5 patients (83.3 %) using endoscopic and radiological methods. The mean hospital stay in the stent group was 15.4 days (range: 9—22 days). The mean time for endoscopic stent removal during rehospitalization was 49.5 (33—62 days) days after initial placement. Complications associated with AL, specifically sepsis resulting from infection in the AL area, led to the death of 1 (16.7 %) patient in the stent group. Surgical treatment was successful in 5 patients (71.4 %). 2 patients (28.6 %) died due to infectious complications and multiple organ failure syndrome. The average hospital stay for surgical patients was 32.8 (19—40) days. Mortality rates were 16.7 % and 28.6 % for the stent placement and surgical groups, respectively.

Conclusions. Endoscopic endoluminal stent placement in the area of AL using self-expandable metallic stents combined with local drainage and enteral nutrition is a promising method for treating esophagojejunal anastomotic leakage after total gastrectomy. This study demonstrates that endoscopic stent placement reduces hospital stay and mortality rates compared to surgical methods. Endoscopic stent placement provides effective defect closure with fewer complications. However, surgical treatment remains indispensable in cases of severe sepsis or failure of conservative methods, despite the high mortality risk. Further studies are needed to develop standardized approaches for selecting treatment methods based on leak size and the patient's overall condition.

Keywords
gastric cancer, total gastrectomy, anastomotic leakage, intraluminal stent.

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Gastric cancer is the fifth most commonly diagnosed malignancy worldwide and the third leading cause of cancer-related mortality [5, 29]. Globally, over one million new cases of gastric cancer are diagnosed annually [11]. Surgical intervention remains the cornerstone of treatment, particularly when combined with perioperative chemotherapy, which improves five-year recurrence-free survival rates to approximately 40 % and overall five-year survival rates to 45 % [2]. The standard surgical approach involves tumour resection through total gastrectomy or distal subtotal gastrectomy, accompanied by systematic lymphadenectomy [1, 19].

The complexity and extent of these surgical procedures are associated with a significant risk of postoperative complications and mortality. Esophagojejunal anastomotic leakage (AL) is a severe complication of total gastrectomy and an independent prognostic factor for reduced survival following gastric cancer surgery [9, 26, 30]. The incidence of AL ranges from 3.3 % to 9.8 % among patients undergoing surgical treatment [4, 18, 20]. This complication often delays the initiation of adjuvant chemotherapy, thereby reducing the overall efficacy of oncological treatment and negatively impacting long-term survival. Additionally, AL imposes a substantial financial burden on both patients and healthcare systems [13].

While surgical intervention is one option for managing AL, it is associated with high mortality rates and frequently results in long-term disability [3, 28]. Advances in technology have enabled the adoption of minimally invasive and endoscopic techniques [23, 24]. The use of metallic stents, combined with drainage of the anastomotic defect area, was first introduced in the 1990s and has demonstrated success rates of 69 %–77 % [14]. Esophageal stenting has become an established method for managing dysphagia in patients with locally advanced or metastatic esophageal cancer [8]. Currently, there is no standardized protocol for the management of AL. However, minimally invasive approaches are generally favoured due to their potential to improve both immediate and long-term outcomes [6, 7]. Surgical treatment is typically reserved for cases involving severe sepsis or failure of alternative methods, despite its high associated mortality rates [12, 25]. When conservative therapy fails, timely surgical intervention remains crucial.

Objective — to evaluate the effectiveness of endoscopic stent placement compared to surgical methods for the management of esophagojejunal anastomosis leakage (AL) after gastrectomy at the National Cancer Institute (NCI) from November 2017 to November 2019.

Materials and methods

The study included patients receiving treatment at the Upper Gastrointestinal Oncology Department of the National Cancer Institute between November 2017 and November 2019. Throughout this period, 186 total gastrectomies were performed. 13 (6.9 %) patients developed an anastomotic leak in the postoperative period. All patients had Roux-en-Y esophagojejunostomy.

6 patients (46.1 %) underwent endoscopic stent placement in the AL area, along with perianastomotic drainage positioning and enteral feeding via a naso-intestinal tube. Of the remaining patients, 7 (53.9 %) underwent surgical treatment, including esophagostomy or the formation of an esophageal stump with a nutritional jejunostomy.

All patients included in this study had undergone total gastrectomy for the treatment of gastric cancer. Patients presenting with leakage of gastrointestinal or esophagocolonic anastomoses were excluded from the study.

This manuscript employed methods of descriptive statistics.

Patient characteristics

13 patients were retrospectively included in this study and categorized into two groups: those who underwent surgical intervention and those treated with endoscopic stent placement (Table). All patients had histologically confirmed gastric adenocarcinoma and received neoadjuvant chemotherapy followed by total gastrectomy performed through an abdominal approach.

Treatment approach

Stent placement or surgical treatment were both available options for AL treatment. The method of treatment depended on orifice dimensions, the clinical status of patients, the results of blood tests, and the radiological and endoscopic data for each particular patient.

Results

Endoscopic stent placement was successful for 5 patients. Complete defect closure following stent placement was confirmed in 5 patients (83.3 %) using endoscopic and radiological methods. The mean hospital stay in the stent group was 15.4 days (range: 9—22 days). The mean time for endoscopic stent removal during rehospitalization was 49.5 (33—62 days) days after initial placement. Complications associated with AL, specifically sepsis resulting from infection in the AL area, led to the death of 1 (16.7 %) patient in the stent group.

Table. **Characteristics of patients**

No	Age, years	Gender	TNM	Defect size, mm	Time for stent removal, day	Treatment	Localization of anastomosis leakage	Treatment outcome
1	67	Male	$T_{4a}N_1M_0$	7	38	Stent placement	Intra-abdominal	Sepsis, MODS
2	39	Male	$T_{4a}N_1M_0$	10	49	Stent placement	Intra-abdominal	Complete closure of the defect
3	71	Male	$T_3N_1M_0$	14	–	Surgical treatment	Intrathoracic	Complete closure of the defect
4	54	Male	$T_3N_1M_0$	14	–	Surgical treatment	Intrathoracic	Complete closure of the defect
5	51	Male	$T_{4a}N_1M_0$	4	–	Surgical treatment	Intra-abdominal	Complete closure of the defect
6	57	Male	$T_3N_3M_0$	5	33	Stent placement	Intra-abdominal	Complete closure of the defect
7	67	Male	$T_{4a}N_1M_0$	10	–	Surgical treatment	Intrathoracic	Sepsis, MODS
8	69	Female	$T_3N_1M_0$	5	56	Stent placement	Intra-abdominal	Complete closure of the defect
9	60	Female	$T_{4a}N_0M_0$	3	–	Surgical treatment	Intrathoracic	Complete closure of the defect
10	41	Male	$T_3N_0M_0$	14	–	Surgical treatment	Intra-abdominal	Complete closure of the defect
11	70	Male	$T_2N_2M_0$	7	62	Stent placement	Intra-abdominal	Complete closure of the defect
12	62	Female	$T_{4a}N_2M_0$	13	–	Surgical treatment	Intra-abdominal	Sepsis, MODS
13	57	Male	$T_3N_0M_0$	6	59	Stent placement	Intrathoracic	Complete closure of the defect

Surgical treatment was successful in 5 (71.4 %) patients. 2 (28.6 %) patients died due to infectious complications and multiple organ failure syndrome. The average hospital stay for surgical patients was 32.8 (19—40) days. Mortality rates were 16.7 % and 28.6 % for the stent placement and surgical groups, respectively.

A total of 6 self-expanding metallic stents (SEMS) were placed during the study period. 3 patients required stent repositioning or replacement due to complications, including stent migration (2 cases) and bleeding at the stent site (1 case).

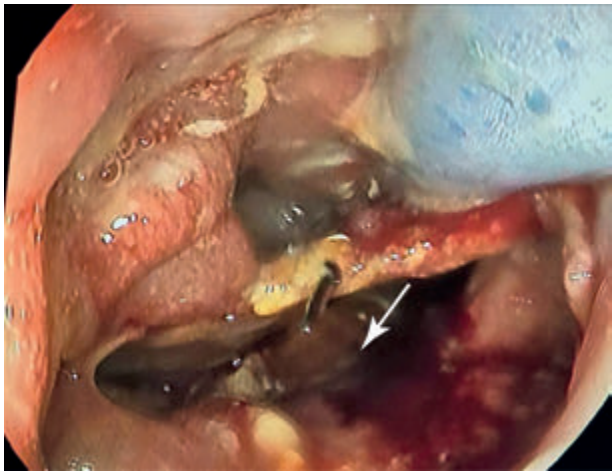

Figure 1. **Endoscopy of the AL**

Informed consent was obtained from all patients before undergoing endoscopic stent placement, drainage procedures, or surgical interventions. Adequate drainage of the leakage site was achieved intraoperatively or postoperatively under computed tomography (CT) guidance.

Self-expanding nitinol stents with a working diameter of 22 mm and a length of 120 mm were utilized for endoscopic stent placement, which was performed under general anesthesia.

8 identified anastomotic were located intra-abdominally, and five were found intrathoracically. All patients presented in a moderate clinical condition and did not require respiratory or cardiovascular support.

Diagnosis of anastomotic leakage

The diagnosis of esophagojejunal anastomosis leakage was made using CT imaging with oral iodine-based contrast agent and endoscopic evaluation (Fig. 1—3). Defect sizes, ranging from 3 mm to 14 mm, were measured endoscopically in millimetres. AL was confirmed through the identification of air or contrast outside the anastomotic lumen on CT imaging or visualization of the defect during endoscopy. In addition, drain output was assessed following oral administration of a dye to confirm the presence of leakage.

Mortality rates were 16.7 % and 28.6 % for the stent placement and surgical groups, respectively.

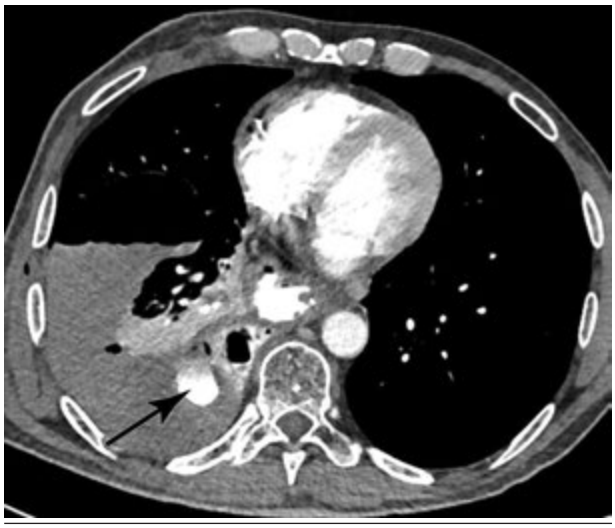

Figure 2. **CT imaging with oral iodine-based contrast agent: leakage through a defect to the right pleural cavity**

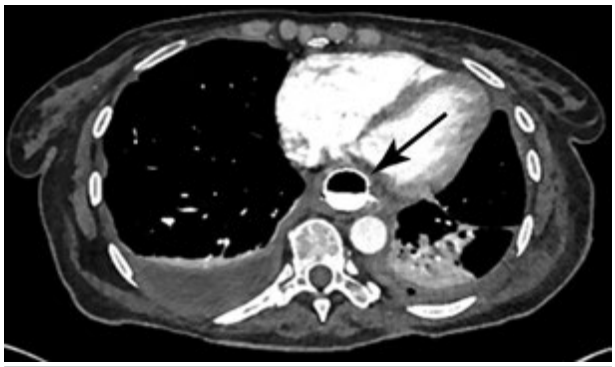

Figure 3. **CT with intravenous and oral contrast after stent placement**

Discussion

Esophagojejunal anastomosis leakage remains a formidable complication associated with the surgical management of gastric cancer, requiring substantial resources and imposing significant burdens on medical staff, patients, and their families.

According to current literature, the indications for endoscopic stenting are typically limited to defects less than 20 mm in size or involving less than 70 % of the anastomotic circumference, as well as the time elapsed from leakage diagnosis to intervention [16, 17]. In this study, endoscopic stent placement was performed for defects measuring 5—10 mm, aligning with established recommendations. However, no universally accepted minimal or maximal defect size thresholds exist to predict the effectiveness of stenting in achieving better control of perianastomotic infections or shorter healing times.

Feith et al. reported that complete defect closure was achieved after endoscopic stent placement in 70 % of 115 patients with AL following gastrectomy. In our cohort, the success rate of endoscopic stent placement was 83.3 % [10]. Nonetheless, the retrospective nature and relatively small sample size of our study underscore the need for larger prospective studies to validate these findings.

Mortality rates associated with surgical management of AL are markedly higher compared to endoscopic treatment. For instance, mortality following Torek's procedure has been reported to reach 63.0 %, whereas mortality with endoscopic stenting is approximately 28.6 % [21]. It is important to recognize that surgical treatment is often reserved for critically ill patients and is typically considered a second-line option when conservative approaches fail. In our study, surgical treatment achieved a success rate of 71.4 %, with a mortality rate of 28.6 %.

The mean duration of stent placement in our study was 49.5 days (range: 33—62 days), exceeding the average reported in other studies, which ranges from 7 to 120 days, with a mean of 33 days [15]. This difference may reflect limited prior experience with the procedure and the absence of other specialized centres in the region. As a result, stent removal was delayed in cases where the anastomotic seal appeared stable.

Study limitations

This study has several limitations. It represents a retrospective review of a small, heterogeneous cohort of patients with a rare clinical condition. Additionally, the findings reflect the experience of a single centre. Critical variables, such as the time from AL diagnosis to treatment initiation and standardized criteria for selecting specific treatment strategies, were not systematically addressed.

Future research should focus on developing standardized treatment protocols and identifying optimal timing and patient selection criteria for various management approaches to AL.

Conclusions

Endoscopic endoluminal stent placement in the area of AL using SEMS combined with local drainage and enteral nutrition is a promising method for treating esophagojejunal anastomotic leakage after total gastrectomy. This study demonstrates that endoscopic stent placement reduces hospital stay and mortality rates compared to surgical methods. Endoscopic stent placement provides effective defect closure with fewer complications. However, surgical treatment remains indispensable in cases of severe sepsis or failure of conservative methods, despite the high mortality risk.

Further studies are needed to develop standardized approaches for selecting treatment methods based on defect size and the patient's overall condition.

Declaration of interests

The authors declare that there are no conflicts of interest associated with this study.

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Authors contributions

Each author of the article participated in the retrospective data collection, statistical analysis, and manuscript writing. All the authors have reviewed and approved the finalized manuscript.

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Ендоскопічне стентування при неспроможності стравохідно-єюнальних анастомозів

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Мета — оцінити ефективність лікування неспроможності езофагоєюнального анастомозу після гастректомії за допомогою ендоскопічного стентування порівняно з хірургічними методами у відділенні пухлин стравоходу та шлунка Національного інституту раку за період з листопада 2017 р. до листопада 2019 р.

Матеріали та методи. Ретроспективне дослідження проведене в Національному інституті раку з листопада 2017 р. до листопада 2019 р. У дослідження залучили пацієнтів, яким у відділенні пухлин стравоходу та шлунку було виконано 186 тотальних гастректомій з езофагоентеростомією за Ру. У 13 із них (9 чоловіків та 4 жінки віком від 39 до 71 року) підтверджено неспроможність анастомозу (6,9%). Ендоскопічне стентування анастомозу з додатковим дренуванням зони дефекту анастомозу та ентеральним харчуванням за допомогою назоінтестинального зонда проведено 6 (46,1%) пацієнтам, решта отримали хірургічне лікування в обсязі езофагостомії або формування кукси стравоходу та нутритивної єюностоми. Ендоскопічне стентування або хірургічне лікування були доступними варіантами для лікування неспроможності анастомозу. Вибір методу лікування залежав від розміру дефекту неспроможності анастомозу, клінічного стану пацієнта, результатів лабораторних, радіологічних та ендоскопічних обстежень. Для обробки даних використано методи описової статистики.

Результати. Ендоскопічне стентування було успішним у 5 пацієнтів. Ендоскопічне видалення стенту виконано в середньому через 49,5 дня (33—62 дні) під час повторної госпіталізації. Повне закриття дефекту після стентування зареєстрували в 5 пацієнтів (83,3%), що підтверджено за допомогою ендоскопічних і радіологічних методів. Один (16,7%) пацієнт, якому було виконано стентування, помер через ускладнення, пов'язані з неспроможністю анастомозу (сепсис, спричинений інфекційним процесом ділянки анастомозу). Хірургічне лікування було успішним в 5 (71,4%) пацієнтів, 2 (28,6%) пацієнти померли внаслідок сепсису та синдрому поліорганної недостатності. Середня тривалість перебування хворих у стаціонарі в групі стентування становила 15,4 дня (9—22 дні), у групі хірургічного лікування — 32,8 дня (19—40 днів). Летальність становила 16,7 і 28,6% відповідно.

Висновки. Ендоскопічне стентування анастомозу із застосуванням металевих стентів, що саморозширюються (SEMS), у поєднанні з локальним дренуванням і ентеральним харчуванням є перспективним методом лікування неспроможності стравохідно-єюнальних анастомозів після тотальної гастректомії. Наше дослідження демонструє, що використання цього методу зменшує тривалість госпіталізації та рівень летальності порівняно з хірургічними методами. Ендоскопічне стентування забезпечує успішне закриття дефекту анастомозу при меншій частоті ускладнень порівняно з хірургічним втручанням. Однак хірургічне лікування залишається незамінним у випадках тяжкого сепсису або неефективності консервативних методів, незважаючи на високий ризик летального наслідку. Необхідно провести додаткові дослідження, що дасть змогу розробити стандартизовані підходи до вибору методу лікування залежно від розмірів дефекту та загального стану пацієнта.

Ключові слова: рак шлунка, тотальна гастректомія, неспроможність анастомозу, ендоскопічне стентування.

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The role of clinical and genealogical study in the examination of patients with chronic venous insufficiency

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Objective — to demonstrate the role of heredity in the development of varicose veins using a clinical-genealogical study, analyze family cases of varicose veins of the lower extremities, determine the type of disease inheritance in the examined patients, and assess the possible outcomes of genetic inheritance for their descendants.

Materials and methods. The study involved 64 patients, mostly women — 52 (81.3 %), with different clinical classes of varicose veins. The clinical-genealogical method of pedigree analysis was used to establish the type of inheritance. We determined the nature of the disease trait (hereditary or non-hereditary) and the type of inheritance (autosomal dominant, autosomal recessive, or gender-linked).

Results. Among the 64 examined patients, 28 (43.8 %) had familial cases of varicose veins. In our clinical-genealogical study of the pedigrees of patients with chronic venous insufficiency, we found an autosomal dominant inheritance of this pathology, not linked to gender. Direct inheritance across generations was observed.

Conclusions. The analysis of the pedigrees of patients with varicose veins of the lower extremities and other manifestations of chronic venous insufficiency revealed the familial nature of disease inheritance, characterized by an autosomal dominant inheritance type and a high degree of gene expression. In these families, children are more likely to show signs of the disease. A hereditary predisposition to certain forms of varicose veins has also been noted. Consequently, in individuals with reticular varicose veins, the main veins of the lower extremities exhibited no alterations with age, whereas reticular varicose veins simply increased in prevalence.

Keywords
varicose disease, chronic venous insufficiency, reticular varicose veins, clinical and genealogical study.

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Functional disorders of the veins of the lower extremities that cause swelling, skin changes, or venous ulcers are clinically known as chronic venous insufficiency (CVI).

The most common manifestation of CVI is varicose veins, or varicose vein disease of the lower extremities (VDLE). In Western countries, approximately one-third of the adult population suffers from varicose veins [11].

Despite its significant prevalence, the etiology of varicose veins remains incompletely understood.

Throughout the history of the study of VDLE, the importance of heredity has always been pointed out. In questionnaires of patients with varicose veins, it was found that at least 25 % of patients had close relatives who suffered or are suffering from one of the forms of this disease [5]. This is probably due to the inheritance of a certain connective tissue defect, which is confirmed by the frequent combination of varicose veins and hemorrhoids, hernia of the anterior abdominal wall, and flat feet. Unfortunately, cases of hereditary predisposition to varicose veins are not always easy to detect, since not only a tendency to general weakness of connective tissue can be inherited, but also isolated weakness of the vein walls or even individual venous valves [1—3].

Population studies conducted in the last century in France showed that a history of varicose veins in

a first-degree relative is the most important risk factor for both men and women. Patients with varicose veins were 21.5 times more likely to report a positive family history [4]. A similar study conducted in Japan found that almost half of patients with varicose veins had a family history, compared to only 14 percent of patients without the condition [6]. Although no gene has been identified as specific for the development of varicose veins, there is evidence in the literature of other gene mutations associated with the formation of varicose veins [9, 10, 13]. For example, *FOXC2* mutations, which are commonly found in patients with lymphedema-distichiasis. In a study of patients with a *FOXC2* mutation, all 18 had large saphenous vein reflux on duplex ultrasound compared with only one case of reflux in 12 patients without the mutation [10]. However, understanding the role of genetic factors in the development of VDLE is a complex task and requires further study.

The role of heredity in the development of varicose veins can also be proven using a fairly simple and long-known clinical-genealogical study method. The clinical-genealogical method is the main approach for studying human genetics. This method became widespread and popular in the 20th century and made it possible to understand the genetic nature of many diseases. This method identifies familial cases of the disease in patients with CVI, determines the type of disease inheritance in the examined patients, and assesses the prognosis of inheritance for descendants [5, 7, 12].

Objective — to demonstrate the role of heredity in the development of varicose veins using a clinical-genealogical study, analyze family cases of varicose veins of the lower extremities, determine the type of disease inheritance in the examined patients, and assess the possible outcomes of genetic inheritance for their descendants.

Materials and methods

The study involved 64 patients, mostly women — 52 (81.3 %), with different classes of varicose veins according to the CEAP (Clinical-Etiology-Anatomy-Pathophysiology) classification: C0-C1 were 27 (42.2 %) patients, C2-C3 — 21 (32.8 %) patients, C4-C6—16 (25 %) patients. The inclusion criteria were the presence of reticular varicose veins (C0–C6 varicose veins classes according to the CEAP classification), the presence of a family history of at least 3 generations, and the patient's consent to participate in the study. The exclusion criteria included the patient's disagreement and the absence of family history data.

During the family history collection process, 28 (43.8 %) patients had first-degree relatives with VDLE of any class according to CEAR. To establish the type of inheritance in the identified cases, we applied the clinical-genealogical method of pedigree analysis.

This method can clearly identify the presence or absence of similar diseases in the family. The genealogical method is a pedigree-based approach used when a hereditary pathology is suspected [8].

Currently, the method allows us to solve a number of important issues, in particular:

- to establish if a specific symptom or disease is unique to a family or if there are several cases of this pathology;
- identify individuals suspected of having this disease and develop a plan for their examination to clarify the diagnosis;
- determine the type of inheritance and find out which line, maternal or paternal, the disease is transmitted through;
- identify individuals who need medical and genetic counseling, determine the clinical prognosis for the proband and his sick relatives, taking into account the characteristics of the disease and its genetic characteristics;
- develop a treatment and prevention algorithm taking into account individual and family characteristics of the disease;
- predict the likelihood of hereditary pathology in subsequent generations depending on the type of inheritance.

The pedigree analysis reveals:

1. Nature of the trait or disease (hereditary or non-hereditary).

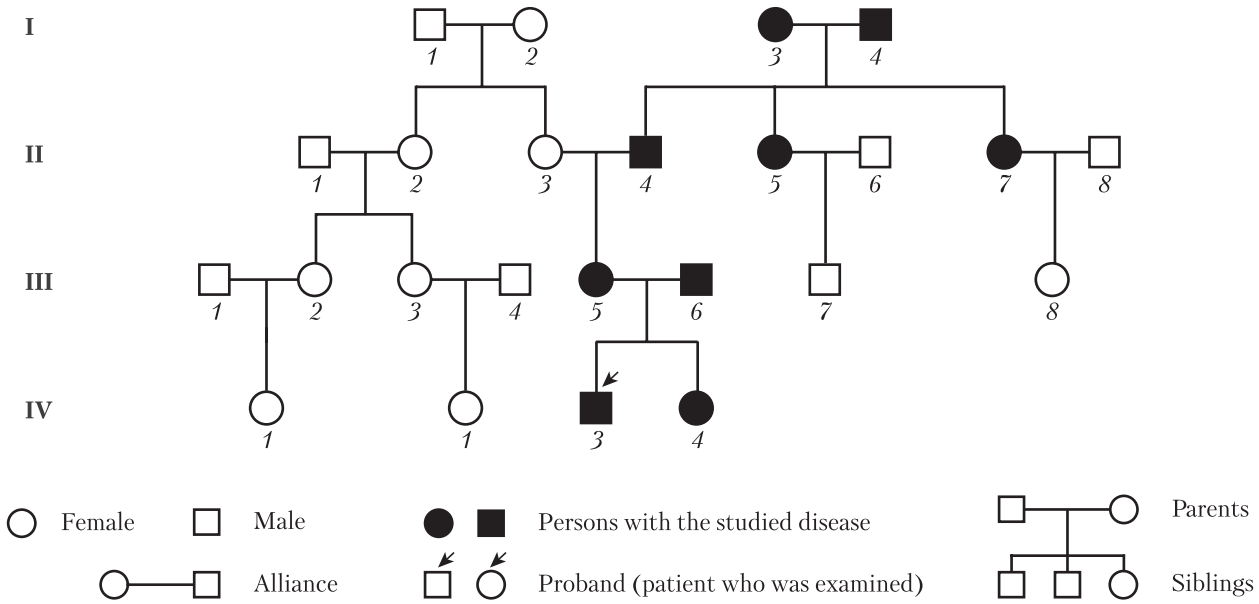
2. Type of inheritance: autosomal dominant, autosomal recessive, gender-linked.

For the autosomal dominant type of inheritance, it is typical that one of the parents of each patient is sick; the probability of the disease occurring in the offspring is 50 % and depends on the degree of manifestation of this gene in generations [8, 12].

Only in families where both parents carry the genes in a heterozygous state can we identify recessive genes in pedigrees with an autosomal recessive type of inheritance. Children with the autosomal recessive type inherit the disease in 25 % of cases with full expression of the gene.

When linked to the gender (X chromosome), the mother is a carrier of the gene, and half of her sons inherit the disease [8].

In the clinical examination of patients with VDLE, duplex mapping of the venous system was used to establish the type of CVI and the clinical class of the disease.



Roman numerals denote generations, and Arabic numerals denote the number and numbering of individuals in each generation of a family.

Figure 1. **The pedigree of family P. with autosomal dominant inheritance, case history No. 18252**

Results and discussion

Among the 64 examined patients, 28 (43.8 %) were found to have a familial nature of the disease, which is a fairly high indicator. Our clinical-genealogical study of the pedigrees of patients with CVI revealed the inheritance of this pathology according to the autosomal dominant type. There is direct inheritance across generations. The tendency to develop varicose veins is passed down from generation to generation without any gaps. The following pedigrees serve as an example (Fig. 1, 2).

The P. family pedigree (see Fig. 1) is unique to our study because we collected data from all four generations of this family. This pedigree clearly demonstrates the inheritance of the disease according to the autosomal dominant type. Proband IV (3), his mother and father III (5, 6), grandfather II (4), great-grandmother and great-grandfather I (3, 4) — had CVI. Thus, the proband inherited this pathological gene in accordance with the autosomal dominant type of inheritance, exhibiting a high degree of manifestation.

The analysis of the M. family pedigree, revealed that the disease (propensity to develop various forms of CVI) is passed down in this family in an autosomal dominant type (see Fig. 2). The gene manifests itself in three generations (I (2,4), II (2,4,5), III (2,3,4)). With a high degree of manifestation. Thus, in the examined proband III (3), her sister and brother have different manifestations of CVI, the mother also has a severe form of CVI of both lower extremities with repeated surgical interventions due to relapses, the proband's father has VDLE on the right lower extremity, and both grandmothers had different manifestations of CVI. A high degree of gene expression is noted in this family.

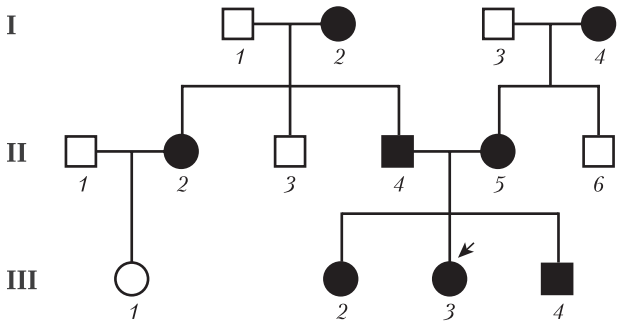


Figure 2. **The pedigree of family M. with an autosomal dominant type of inheritance, case history No. 846**

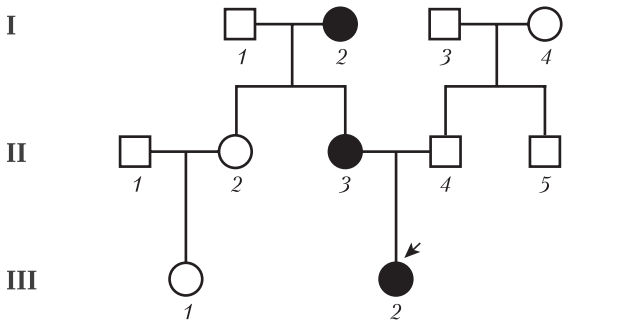


Figure 3. **The pedigree of family K. with autosomal dominant type of inheritance of reticular varicose veins, case history No. 1636**

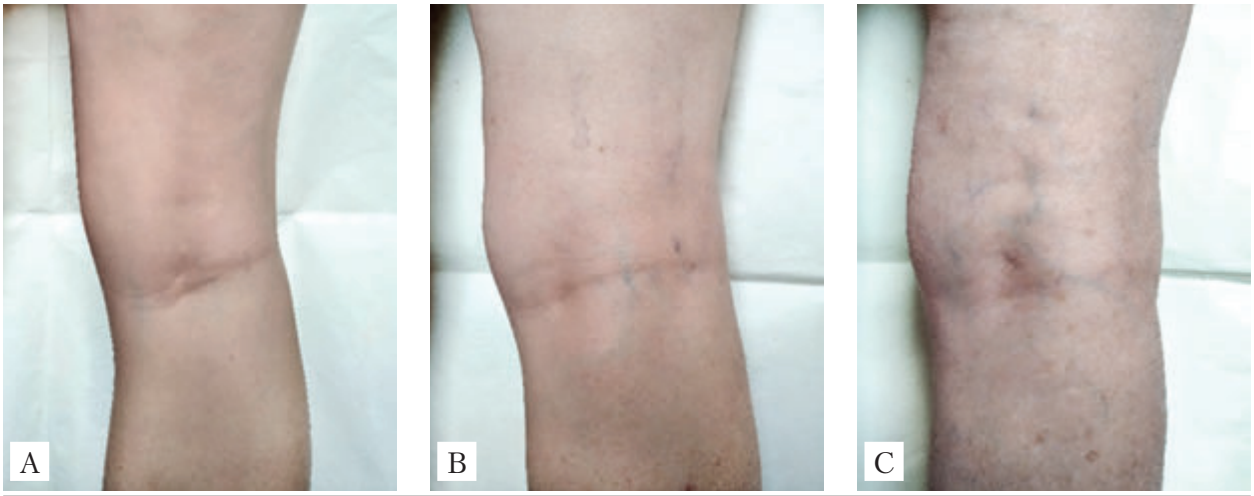


Figure 4. **Manifestations of reticular varicose veins and telangiectasias in three generations of family K.: A — proband, 28 years old; B — proband's mother, 59 years old; C — proband's grandmother, 81 years old**

In the examined families, there is a high risk of having children with varicose veins or other manifestations of CVI.

Also, when analyzing the obtained data, we drew attention to the fact that certain classes of varicose veins have a separate family inheritance pattern. Thus, three patients with reticular varicose veins (class C1 according to the CEAR classification) have direct relatives (mother and grandmother) who also suffer from them. An example of such a pedigree can be found in the case history No. 1636 of family K. (Fig. 3). In this family, reticular varicose veins become more common over the years, but other manifestations of CVI do not develop, and the disease does not progress according to the CEAR classification classes (Fig. 4).

These three families with distinct manifestations of reticular varicose veins underwent duplex mapping of the lower extremity veins, which revealed no changes in the main veins, their diameter, or any reflux. This shows that reticular varicosities follow a separate family pattern of inheritance and are inherited independently of other forms of VDLE. Furthermore, reticular varicose veins were exclusively observed in women in these families, indicating that the gene responsible for the development of this type of varicose vein may also be associated with gender.

There is also a familial pattern in the anatomical structure of the venous system. We identified 6 (9.4 %) probands among the examined patients, exhibiting strong branching of the superficial venous network and pronounced varicose changes in the tributaries across all three generations of their families. We detected varicose changes in the lateral femoral vein in two family cases (3.1 %). Upon collecting patient histories, we discovered that 9 (14.1 %) patients had a family history of other diseases associated with connective tissue weakness, such as hernias and hemorrhoids, in addition to varicose veins.

Conclusions

The pedigree analysis of 64 patients with CVI revealed that 28 (43.8 %) patients had first-degree relatives with VDLE of any class according to CEAR, which indicates the familial nature of disease inheritance, characterized by an autosomal dominant inheritance type and a high degree of gene expression. In the examined families, there is a high risk of having children with varicose veins or other manifestations of CVI. A hereditary predisposition to certain forms of VDLE has also been noted. Consequently, in patients with reticular varicose veins, the main veins of the lower extremities exhibited no alterations with age, whereas reticular varicose veins simply increased in prevalence.

Declaration of interests

The authors have no conflicts of interest to declare.

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Ethics approval and written informed consents statements

The assessment and usage of all clinical data was approved and permitted before the study by the ethics committee of Bogomolets National Medical University. The study protocol conformed to the ethical guidelines of the «World Medical Association (WMA) Declaration of Helsinki — Ethical Principles for Medical Research Involving Human Subjects» adopted by the 18th WMA General Assembly, Helsinki,

Finland, June 1964 and amended by the 59th WMA General Assembly, Seoul, South Korea, October 2008. Written informed consent was obtained from all individual participants included in the study.

Authors contributions

I. V. Kolosovych: work concept and design, critical review; K.O. Korolova: work concept and design, data collection and analysis, writing the manuscript; Z.V. Korolova: work concept and design, critical review.

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Роль клініко-генеалогічного методу в обстеженні хворих на хронічну венозну недостатність

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Мета — використовуючи клініко-генеалогічний метод обстеження, продемонструвати роль спадковості у розвитку варикозної хвороби, проаналізувати сімейні випадки варикозної хвороби нижніх кінцівок, визначити тип успадкування захворювання в обстежених пацієнтів і прогноз успадкування для нащадків.

Матеріали та методи. У дослідження було залучено 64 хворих, переважно жінок (52 (81,3 %)), з різними клінічними класами варикозної хвороби. Для встановлення типу успадкування застосовували клініко-генеалогічний метод дослідження родоводів. Визначали характер хвороби (спадкова чи неспадкова), тип успадкування (автосомно-домінантний, автосомно-рецесивний, зчеплений зі статтю).

Результати. З 64 обстежених пацієнтів у 28 (43,8 %) виявлено сімейний характер варикозної хвороби. У нашому дослідженні родоводів хворих на хронічну венозну недостатність за допомогою клініко-генеалогічного методу виявлено успадкування цієї патології за автосомно-домінантним типом. Зафіксовано пряме спадкування за поколіннями.

Висновки. Аналіз родоводів хворих на хронічну венозну недостатність виявив сімейний характер успадкування хвороби, автосомно-домінантний тип успадкування із високим ступенем вияву гена. У цих родинах існує високий ризик народження дітей, які матимуть хронічну венозну недостатність. Відзначено спадкову схильність до певних форм варикозу. У пацієнтів із ретикулярним варикозом із віком не відбувалися зміни в магістральних венах нижніх кінцівках, а ретикулярний варикоз набував більшого поширення.

Ключові слова: варикозна хвороба, хронічна венозна недостатність, ретикулярний варикоз, клініко-генеалогічний метод обстеження.

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Postoperative quality of life in patients with chronic slow-transit constipation according to the PAC-QOL scale

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Chronic constipation is a common heterogeneous condition affecting all population groups, with its prevalence increasing with age. The prevalence of chronic constipation varies from 3 % to 27 % in the general population. Worldwide, the average prevalence of constipation is 16 %, with a prevalence of 33.5 % in adults aged 60—110 years. Information about the quality of life in patients with chronic slow transit constipation (CSTC) in Ukraine is very limited.

Objective — to assess the quality of life in patients with chronic slow transit constipation using the Patient Assessment of Constipation Quality of Life Questionnaire (PAC-QOL) scale after surgical treatment.

Materials and methods. 107 patients with CSTC were examined and treated at the surgical department of the Saint Michael Clinical Hospital in the period 2011—2023.

Results. Significant improvements in all PAC-QOL scale indicators were observed one year after surgery. The physical component score decreased from 2.78 ± 0.52 to 1.01 ± 0.32; $p < 0.01$; the psychological component score decreased from 1.90 ± 0.48 to 0.83 ± 0.41; $p < 0.01$; the anxiety component score decreased from 1.99 ± 0.31 to 0.72 ± 0.34; $p < 0.01$; and the satisfaction component score decreased from 2.35 ± 0.60 to 0.84 ± 0.47. The total PAC-QOL score decreased from 2.14 ± 0.23 to 0.82 ± 0.35; $p < 0.01$. A reduction in the PAC-QOL score was observed one year after surgery, with an average improvement of 61.5 ± 14.9 % (ranging from 6.2 % to 77.2 %). The highest percentage of improvement was registered in the «Satisfaction» component, with an increase of 81.2 ± 15.0 % (ranging from 33.3 % to 88.2 %), while the lowest improvement was in the psychological component, 56.7 ± 16.1 % (ranging from 0.0 % to 78.6 %). For the physical component, the percentage of improvement was 63.14 ± 11.23 % (ranging from 30.0 % to 81.82 %), and for the worries component, it was 64.0 ± 15.75 % (ranging from 0.0 % to 77.2 %).

Conclusions. According to the PAC-QOL scale, surgical treatment involving colectomy improves quality of life significantly in the long-term postoperative period in patients with CSTC who are resistant to conservative therapy. Overall PAC-QOL scores improved by 61.51 %, as did all components: physical (63.14 %), psychological (56.73 %), anxiety (64.0 %), and satisfaction (81.2 %).

Keywords
chronic slow-transit constipation, PAC-QOL score, quality of life.

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Chronic constipation (CC) is a common heterogeneous condition affecting all population groups, with its prevalence increasing with age. The prevalence of chronic constipation varies from 3 % to 27 % in the general population [11]. Worldwide, the average prevalence of constipation is 16 %, with a prevalence of 33.5 % in adults aged 60—110 years [2].

Millions of dollars are spent annually on laxatives. The prevalence of constipation among adults in Australia is 24 % according to the Rome criteria [16]. In Brazil, prevalence ranges from 14 % to 26 % according to previous studies [3—11].

Chronic constipation negatively affects various aspects of patients' quality of life and may

be accompanied by psychological disorders [10, 13—15]. The impact of different treatment methods on quality of life in patients with chronic constipation was insufficiently observed in the modern literature, and the effects of surgical treatment remain controversial.

Traditionally, the SF-36 (not disease-specific) scale [14, 15], was used to assess quality of life in patients with chronic slow transit constipation (CSTC). Recently, some studies recommended the disease-specific Patient Assessment of Constipation Quality of Life Questionnaire (PAC-QOL) scale to evaluate quality of life in patients with CSTC [8, 10].

However, there are currently no studies evaluating the impact of surgical treatment on the quality of life (QoL) in patients with CSTC using the PAC-QOL scale.

Table. **Main characteristics of patients**

Index	Value
Men	5 (4.7 %)
Women	102 (95.3 %)
Age, years	43.1 ± 13.6 (16—78)
Height, cm	166.8 ± 6.1 (150—183)
Weight, kg	63.3 ± 11.9 (40—90)
Body mass index, kg/m^2	22.9 ± 4.5 (14.8—41.1)
Weight loss	29 (27.1 %)
Onset of constipation, years	21.5 ± 16.3 (1—67)
Duration of constipation before surgery, years	20.7 ± 13.2 (5—53)
Interval between bowel movements, days	9.4 ± 5.1 (3—30)
Abdominal bloating and pain	80 (74.8 %)
Feeling of incomplete evacuation	101 (94.4 %)
Feeling of blockage in the rectum > 1/4 of defecations	97 (90.7 %)
Manual assistance during defecation > 1/4 of defecations	60 (56.1 %)
Stool consistency according to the Bristol Stool Scale [4]	
Type 1	67 (62.6 %)
Type 2	28 (26.2 %)
Type 3	8 (7.5 %)
Type 4	3 (2.8 %)
Type 5	1 (0.9 %)

Note. Categorical variables are presented as the number of cases and percentage, while quantitative indicators are presented as M ± SD (Min—Max).

A standardized patient assessment is essential for evaluating and treating chronic constipation.

Information about the quality of life in patients with CSTC in Ukraine is very limited. Appropriate treatment should aim to alleviate individual symptoms and improve the quality of life for such patients.

Objective — to assess the QoL in patients with chronic slow transit constipation using the PAC-QOL scale after surgical treatment.

Materials and methods

107 patients with CSTC were examined and treated at the surgical department of the Saint Michael Clinical Hospital in the period 2011—2023.

The main characteristics of the patients are presented in Table.

Rome IV criteria [1] were used to diagnose CSTC.

Inclusion criteria

- Age over 18 years.
- CSTC that does not respond or poorly responds to modern conservative treatment methods for at least 6 months.
- Low QoL.
- Consent for surgical treatment.
- Consent to complete a QoL questionnaire.

Exclusion criteria

- Age under 18 years.
- Severe comorbidities.
- Patients with mental disorders.
- Pregnancy.
- Oncological diseases.
- Harmful habits.
- Refusal to complete the QoL questionnaire.
- Proctogenic constipation.
- Irritable bowel syndrome and/or constipation of secondary specific etiology (associated with an underlying condition).
- Drug-induced constipation.

Quality of life assessment

The quality of life was evaluated using the disease-specific PAC-QOL questionnaire, developed and validated by Marquis et al. [8] in 2005. The questionnaire includes 28 items grouped into 4 subscales:

- Worries and concerns (11 items),
- Physical discomfort (4 items),
- Psychosocial discomfort (8 items), and
- Satisfaction with treatment (5 items).

Each item is assessed using a 5-point Likert scale ranging from 0 (not at all/never) to 4 (very much/all the time) over the previous 2-week period.

A higher score indicates a worse QoL due to constipation.

Total PAC-QOL scores and subscale scores were calculated according to the original PAC-QOL documentation for every patient [7]. QoL was assessed before surgery and one year after the surgery.

Subtotal colectomy was performed in 29 (27.1 %) patients, total colectomy in 57 (53.3 %) patients, and colectomy with low rectal resection in 21 (19.6 %) patients.

Open surgery was performed in 70 (65.4 %) patients, while laparoscopic access was used in 37 (34.6 %) patients [5].

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics, version 22. Descriptive statistics were calculated. Mean values were presented as M ± SD. Categorical data were expressed as counts (%).

Data normality was assessed using the Shapiro-Wilk test. The Student's t-test was used to compare variables between groups when the data distribution was normal; in other cases, the Wilcoxon test was used.

Comparisons of relative frequencies were performed using Pearson's chi-square test. The null hypothesis of equality of variables was rejected at $p < 0.05$.

Results

Significant improvements in all PAC-QOL scale indicators were observed one year after surgery. The physical component score decreased from 2.78 ± 0.52 to 1.01 ± 0.32; $p < 0.01$; the psychological component score decreased from 1.90 ± 0.48 to 0.83 ± 0.41; $p < 0.01$; the anxiety component score decreased from 1.99 ± 0.31 to 0.72 ± 0.34; $p < 0.01$; and the satisfaction component score decreased from 2.35 ± 0.60 to 0.84 ± 0.47. The total PAC-QOL score decreased from 2.14 ± 0.23 to 0.82 ± 0.35; $p < 0.01$ (Figure).

Overall, a reduction in the PAC-QOL score was observed one year after surgery, with an average improvement of 61.5 ± 14.9 % (ranging from 6.2 % to 77.2 %). The highest percentage of improvement was registered in the «Satisfaction» component, with an increase of 81.2 ± 15.0 % (ranging from 33.3 % to 88.2 %), while the lowest improvement was in the psychological component, 56.7 ± 16.1 % (ranging from 0.0 % to 78.6 %).

For the physical component, the percentage of improvement was 63.14 ± 11.23 % (ranging from 30.0 % to 81.82 %), and for the worries component, it was 64.0 ± 15.75 % (ranging from 0.0 % to 77.2 %).

Discussion

The primary aims of colectomy in patients with CSTC were to relieve constipation and increase the frequency of bowel movements.

Total colectomy has been proven to be effective for patients with CSTC, with some studies reporting satisfaction rates exceeding 80 % in this group of patients [6, 9, 12].

In this study, we analyzed the QoL in patients with CSTC before and after surgical treatment using the PAC-QOL questionnaire. We found limited information regarding the use of the PAC-QOL questionnaire in patients with CSTC before and after colectomy, as reported by different authors.

Different questionnaires were used to assess the severity of constipation. In a study published in 2015, both PAC-QOL and SF-36 questionnaires were used to analyse patients with chronic functional constipation and irritable bowel syndrome (IBS) with constipation according to the Rome III criteria. The study included PAC-QOL data from 43 patients (14 % with IBS with constipation predominance, 37 % with functional constipation, and 49 % with unclassified constipation) and SF-36 data from 93 patients (23 % with IBS with constipation predominance, 27 % with functional constipation, and 51 % with unclassified constipation).

The SF-36 questionnaire revealed that patients with irritable bowel syndrome (IBS) had a poorer quality of life compared to the functional constipation and unclassified constipation groups. Statistically significant differences were observed between IBS patients and those with functional constipation in the fatigue/energy subscale, favouring the latter, and in the pain subscale between IBS patients with constipation predominance and those with unclassified constipation.

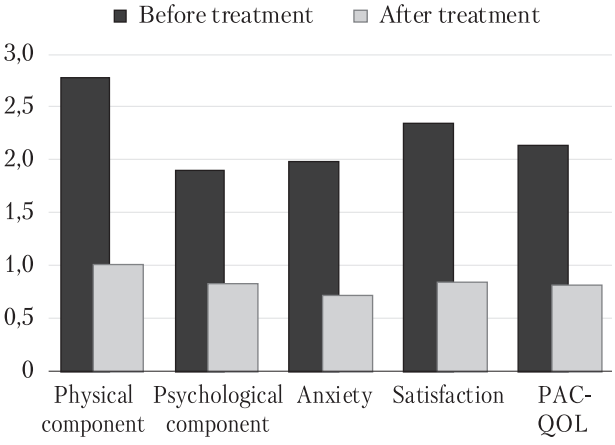

Figure. **Average scores for individual PAC-QOL subscales before and after surgical treatment in patients with CSTC**

The PAC-QOL questionnaire also revealed that IBS patients performed worse than those with functional constipation in the following components: physical, psychological, worries, satisfaction, and total PAC-QOL score [10].

In our study, significant improvements in QoL for PAC-QOL subscales were observed in patients with CSTC following surgical treatment, demonstrating the effectiveness of using this disease-specific scale. Unlike the data described by M. C. Ruiz-López, other authors evaluated the QoL in 30 patients with CSTC after colectomy using the Gastrointestinal Quality of Life Index (GIQLI) and SF-36 questionnaires.

The GIQLI scores were found to improve significantly ($p < 0.05$) over the entire follow-up period (3 months, 6 months, 1 year, and 2 years) as follows: 77.8 ± 17.5 before surgery, 109.7 ± 21.2 at 3 months, 115.0 ± 20.7 at 6 months, 121.3 ± 20.3 at 1 year, and 123.6 ± 17.5 at 2 years.

The SF-36 results demonstrated significant improvements in six health domains at 3, 6, 12, and 24 months post-colectomy: physical role, emotional role, physical pain, vitality, mental health, and general health status.

Thus, this study demonstrated that total or subtotal colectomy for CSTC is not only an effective method for relieving constipation-associated symptoms but also significantly improves patients' QoL [15].

Some authors also report a decline in QoL according to the SF-36 scale following total colectomy with ileorectal anastomosis in patients with inert colon. The results of total colectomy in 17 women with an inert colon were analysed. The follow-up period was 58.3 ± 27.3 months. SF-36 scores were significantly lower compared to the general population ($p < 0.005$). Despite substantial improvements in constipation symptoms, the quality of life deteriorated significantly.

In univariate regression analysis, postoperative abdominal pain was a predictive factor for lower scores in the general health and vitality domains, while the need for manual assistance was predictive of lower scores in the physical function, social functioning, and emotional role limitation domains. Thus, postoperative pain and functional impairments are predictors of lower QoL scores [14].

Conclusions

According to the PAC-QOL scale, surgical treatment involving colectomy improves QoL significantly in the long-term postoperative period in patients with CSTC who are resistant to conservative therapy. Overall PAC-QOL scores improved by 61.51 %, as did all components: physical (63.14 %), psychological (56.73 %), anxiety (64.0 %), and satisfaction (81.2 %).

Declaration of interests

The authors declare that they have no conflicts of interest.

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The work was performed in accordance with the research plan of the Department of Surgery with the course of Emergency and Vascular Surgery at Bogomolets National Medical University.

Authors contributions

Conception and design, statistical analysis — I. M. Leshchyshyn, L. Y. Markulan; acquisition and interpretation of data — I. M. Leshchyshyn, O. I. Okhotska, P. L. Byk; drafting the article — I. M. Leshchyshyn; critical revision of the article — I. M. Leshchyshyn, P. L. Byk.

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Якість життя за шкалою PAC-QOL пацієнтів із хронічним повільнотранзитним запором після хірургічного лікування

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Хронічний запор є поширеною гетерогенною патологією, що вражає всі групи населення, а його поширеність зростає з віком. У загальній популяції поширеність хронічних запорів становить від 3 до 27 %, у середньому — 16 %, серед осіб віком від 60 років — 33,5 %. Інформація про якість життя хворих на хронічний повільнотранзитний запор (ХПТЗ) в Україні дуже обмежена.

Мета — оцінити якість життя хворих на хронічний повільнотранзитний запор за шкалою PAC-QOL (Patient Assessment of Constipation Quality of Life Questionnaire) після хірургічного лікування.

Матеріали та методи. У хірургічному відділенні Свято-Михайлівської клінічної лікарні в 2011—2023 рр. обстежено та проліковано 107 хворих на ХПТЗ.

Результати. Через рік після операції зафіксували значне поліпшення всіх показників шкали PAC-QOL. Показник фізичного компонента знизився з (2,78 ± 0,52) до (1,01 ± 0,32) бала ($p < 0,01$), показник психологічного компонента — з (1,90 ± 0,48) до (0,83 ± 0,41) бала ($p < 0,01$), показник компонента тривожності — з (1,99 ± 0,31) до (0,72 ± 0,34) бала ($p < 0,01$), показник компонента задоволеності — з (2,35 ± 0,60) до (0,84 ± 0,47) бала. Загальний бал PAC-QOL зменшився з 2,14 ± 0,23 до 0,82 ± 0,35 ($p < 0,01$). Через рік після операції оцінка за PAC-QOL у середньому поліпшилася на (61,5 ± 14,9) % (від 6,2 до 77,2 %). Найбільше поліпшився компонент задоволеності — на (81,2 ± 15,0) % (діапазон — 33,3—88,2 %), найменше — психологічний компонент — (56,7 ± 16,1) % (діапазон — 0—78,6 %). Для фізичного компонента відсоток поліпшення становив 63,14 ± 11,23 (діапазон — 30,0—81,82 %), для компонента тривожності — 64,0 ± 15,75 (діапазон — 0,0—77,2 %).

Висновки. Хірургічне лікування з колектомією у хворих із резистентним до консервативної терапії ХПТЗ забезпечує статистично значуще поліпшення якості життя за шкалою PAC-QOL у віддалений післяопераційний період. Поліпшення зареєстровано як за загальним показником PAC-QOL (61,51 %), так і за всіма компонентами: фізичним (63,14 %), психологічним (56,73 %), тривожності (64,0 %) і задоволеності (81,2 %).

Ключові слова: хронічний повільнотранзитний запор, шкала PAC-QOL, якість життя.

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26-Year perspective on stapled hemorrhoidopexy – insights into managing severe complications. Two case reports and literature review

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Stapled Hemorrhoidopexy, first introduced by Longo in 1998, has become a widely adopted surgical method for treating hemorrhoidal disease. This innovative procedure gained popularity due to reduced postoperative pain, shorter hospital stays, and faster recovery. However, it is not without risk and is associated with rare but severe complications that can significantly affect patient outcomes. This study describes two illustrative clinical cases of such complications. The first case involves a 41-year-old male patient who developed a perirectal hematoma accompanied by acute abdominal bleeding caused by mesenteric vessel rupture at the rectosigmoid junction. Urgent surgical intervention and intensive postoperative care were required. The second case concerns a 49-year-old female patient who experienced anal stenosis and subsequent fecal incontinence, necessitating both surgical correction and prolonged rehabilitative therapy to restore bowel function and improve quality of life. These cases emphasize the critical importance of early recognition and effective management of complications associated with stapled hemorrhoidopexy. They also highlight the necessity of a multidisciplinary approach involving colorectal surgeons, general surgeons, and gastroenterologists to optimize patient care.

A comprehensive literature review identifies key risk factors for complications, including patient comorbidities, technical nuances of the procedure, and the careful selection of candidates. Best practices for preventing and managing complications are also discussed, focusing on surgical technique refinement, thorough preoperative evaluation, and enhanced staff training. These insights aim to equip clinicians with essential knowledge to minimize risks, enhance patient safety, and maintain the advantages of this innovative method.

Keywords
stapled hemorrhoidopexy, Longo procedure, perirectal hematoma, anal stenosis, rectal stenosis, complications management.

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Hemorrhoids, vascular structures in the anal canal, become symptomatic when swollen or inflamed. When conservative treatments fail, surgical intervention becomes necessary, particularly for grade 3 and 4 hemorrhoids, where prolapse and irreducibility are common. Stapled hemorrhoidopexy (SH), introduced by Antonio Longo in 1998, has now been used for over 26 years as a minimally invasive technique to treat hemorrhoids [11, 12]. Compared to traditional excisional hemorrhoidectomy, the procedure offers less postoperative pain and faster recovery [3, 7]. SH is recommended as a treatment option for patients with grades 2 to 4 hemorrhoidal prolapse that is unresponsive to medical therapy

(a strong recommendation (grade 1A) based on high-quality evidence) [3].

A variety of early and late complications have been documented in the literature following SH. In his pioneering study, Longo reported remarkably favourable outcomes, including minimal postoperative pain (mean visual analogue scale score: 2), a mean operative time of just 6 minutes, and an absence of postoperative rectal bleeding, sepsis, strictures, or incontinence among 186 patients [11]. However, contemporary data provide a more nuanced picture. According to recent literature, the overall perioperative complication rate following SH is reported at 16.9 %, with serious adverse events occurring in 5.1 % of cases and an equivalent reoperation rate of 5.1 % [17]. Early complications include perianal bleeding, hematoma formation at the stapling site, presacral hematoma, perirectal hematoma (PH), abdominal bleeding, urinary retention, sepsis, rectovaginal fistula, incomplete stapling, rectal perforation, and rectal necrosis [6, 8, 16, 18, 19]. These early complications often necessitate prompt diagnosis and management to prevent further morbidity. In contrast, late complications, such as anal stenosis, chronic anal pain, reduced rectal compliance, defecation disorders, and incontinence, may develop over time, impacting the patient's long-term quality of life. This evolving evidence highlights the need for a balanced assessment of SH, considering both its initial promise and the potential for significant complications.

Case presentation 1 from Fuerstenfeldbruck: perirectal hematoma

A 41-year-old male patient, father of eight children, who arrived in Germany as a refugee from Afghanistan, presented to our clinic with grade 4 hemorrhoids. His medical history included an unknown perianal surgery performed in Afghanistan 5 years prior and a long-standing history of anemia. Due to rectal bleeding and an acute exacerbation of anemia, the patient had received a rectoscopy and hemorrhoidal ligation procedure four months prior, along with a transfusion of two units of blood. Preoperatively, the patient underwent gastroscopy, which revealed *Helicobacter pylori*-positive gastritis, and colonoscopy for further evaluation of anemia.

The patient underwent SH and was discharged on the first postoperative day without any complaints. However, five hours after discharge, he presented to the emergency room following an episode of syncope. Postoperative computed tomography of the abdomen revealed a significant amount of free intraperitoneal fluid and distension at the rectosigmoid junction (Fig. 1). A diagnostic abdominal puncture confirmed the presence of fresh blood. An emergency laparotomy was performed, which identified a rupture of the mesentery and serosa at the rectosigmoid junction as the source of bleeding, resulting in intra-abdominal hemorrhage. Intraoperative proctoscopy confirmed an intact and normal suture line. The patient underwent hemostasis and oversewing of the rectosigmoid junction. Intraoperatively, due to hemodynamic instability and substantial blood loss, the patient received a cell saver transfusion along with a massive transfusion protocol.

Early outcome

In the immediate postoperative period, the patient developed acute kidney insufficiency, likely due to hemodynamic instability, fluid overload, and oxidative stress following massive blood transfusions during surgery. These factors contributed to reduced renal perfusion and subsequent kidney injury. As a result, the patient spent 21 days in the intensive care unit, requiring continuous veno-venous hemodialysis for 10 days. Given the suspicion of coagulopathy, the patient was treated with 4000 IU of Factor VIII, 9600 IU of von Willebrand factor concentrate, 4 units of packed red blood cells, 2000 IU of prothrombin complex concentrate, desmopressin, and intermittent tranexamic acid therapy. The patient's condition stabilized, and on postoperative day 34, he was transferred to a nephrology clinic for further management of his renal insufficiency and evaluation of any underlying coagulopathy contributing to the bleeding complications. Further testing revealed von Willebrand syndrome type 2N, with significantly reduced Factor VIII activity (12 %).

Follow-up

A follow-up assessment was conducted nine months after discharge when the patient returned to our clinic due to subileus, which was treated conservatively. The patient reported no local residual symptoms and had resumed normal daily activities. His recovery was considered complete, and no additional interventions were required. However, the patient subsequently developed chronic kidney insufficiency, classified as KDIGO (Kidney Disease: Improving Global Outcomes) stage G4A2, characterized by persistent proteinuria, metabolic acidosis, and multifactorial renal anemia. He is currently under regular nephrological and coagulation follow-up care.

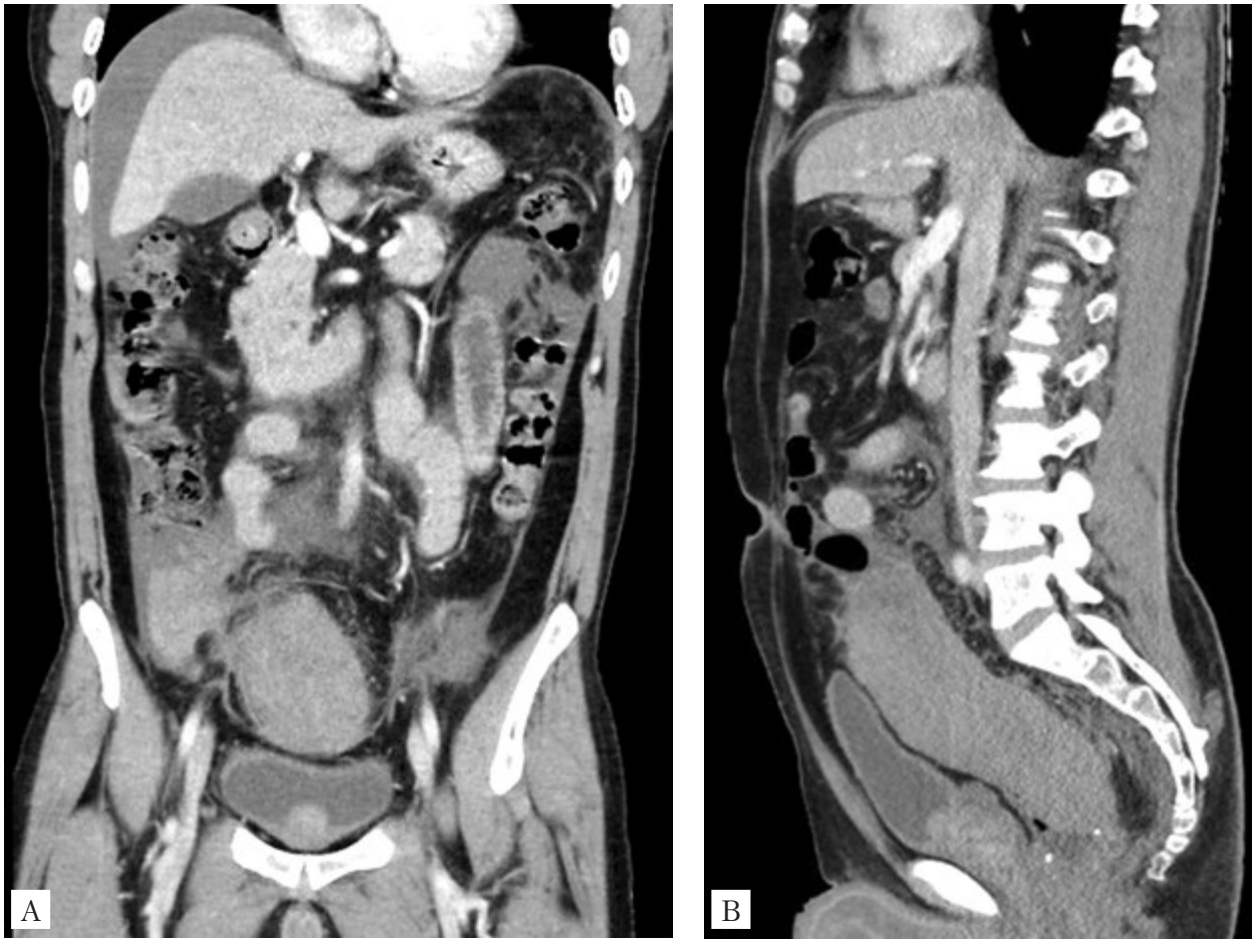

Figure 1. **Postoperative imaging: computed tomography scan of the abdomen revealed a significant amount of free fluid in the abdomen (A); distension of the rectosigmoid junction (B)**

Case presentation 2 from Munich: anal stenosis

A 49-year-old female patient presented to our surgical outpatient clinic with complaints of fecal incontinence, pelvic pain, and anal discomfort, two months after undergoing stapled hemorrhoidopexy for grade 3 hemorrhoidal disease and anal prolapse at an external medical facility. Her medical history included autoimmune thyroiditis, autoimmune gastritis, and migraine.

Preoperative history and surgery in an external clinic

The patient had a long-standing history of recurrent anal vein thrombosis, which was managed conservatively with heparin ointment. During her pregnancy, she developed hemorrhoidal prolapse, which was treated non-surgically. Preoperative rectoscopy confirmed grade 3 hemorrhoids and anal prolapse, leading to the decision to perform stapled hemorrhoidopexy. Postoperatively, she reported an immediate sensation of rectal pressure, described as a tampon-like feeling. Although her initial follow-up showed no significant findings, she later developed symptoms of incontinence, initially misinterpreted as diarrhea.

Clinical course and evaluation

Over time, her symptoms worsened, with persistent fecal incontinence, cramping rectal pain, and significant deterioration in quality of life. Despite her intact sensation of the urge to defecate, she struggled with stool control, resulting in frequent soiling. Attempts to manage her symptoms with increased doses of loperamide were only partially effective. She reported an inability to stand or sit for extended periods due to pelvic discomfort.

A comprehensive evaluation in our proctology clinic revealed a circular anal stricture approximately 1 cm from the anal verge (Fig. 2*A*), detected during digital rectal examination, with the area barely passable by finger. The rectal ampulla was completely filled with fecal stones, necessitating manual evacuation to relieve the impaction (Fig. 2*D*). Rectoscopy showed significant mucosal inflammation extending from the stapling line up to 7 cm above the anal verge

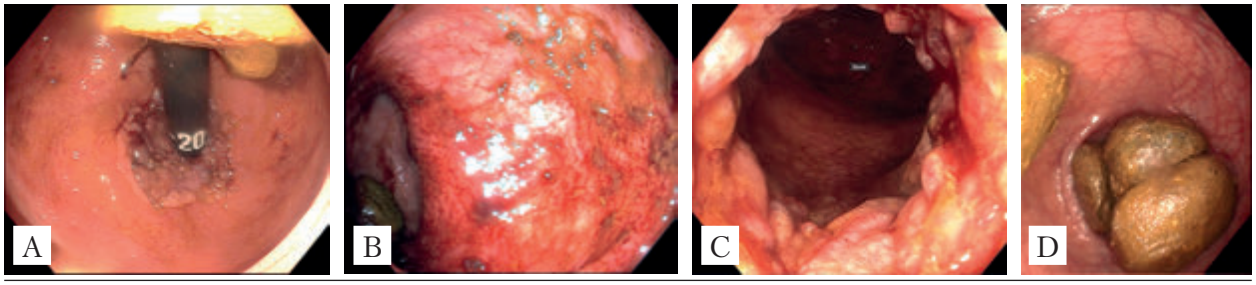

Figure 2. **Endoscopic imaging: rectoscopic evaluation revealed a circular anal stricture located approximately 1 cm from the anal verge (A); significant mucosal inflammation was observed, extending from the stapling line up to 7 cm above the anal verge (B); the staple line was covered with fibrin but showed no signs of dehiscence (C); fecal impaction in the rectal ampulla required manual evacuation (D)**

(Fig. 2*B*). Beyond this point, the rectal mucosa appeared healthy and pink, with additional fecal stones present. The staple line was covered with fibrin but showed no signs of dehiscence (Fig. 2*C*). Anal manometry confirmed impaired sphincter function. MRI of the rectum with contrast revealed significantly thinned musculature at the 7—8 o'clock position in the lithotomy position, approximately 4.5 cm from the anus, resulting in luminal bulging.

Management and outcomes

The patient was diagnosed with postoperative anal stenosis, fecal incontinence, and severe pain syndrome. Initial conservative management with biofeedback therapy was unsuccessful. Consequently, a laparoscopic loop sigmoidostomy was performed to alleviate symptoms and allow for rectal healing. Multiple sessions of anal dilation were conducted to address the stenosis.

Follow-up

Three months later, when the anastomosis maintained satisfactory passage following regular dilation, the patient underwent a sigmoidostomy reversal. Nine months after the initial creation of the stoma, she reported significant improvement in bowel function, with regular, pain-free defecation. Although she occasionally experienced a foreign body sensation in the anal region, this did not affect her daily activities. She resumed physical exercise and reported an almost complete return to her preoperative quality of life.

Discussion

The two case reports presented underscore the complexities and risks associated with SH as a treatment for high-grade hemorrhoidal disease. Both cases highlight rare but severe complications, namely perirectal hematoma and anal stenosis, which require careful management and a multidisciplinary approach.

The first case report focuses on a 41-year-old male patient who experienced intra-abdominal bleeding after SH involving a rupture of the mesentery and serosa at the rectosigmoid junction. According to the literature, postoperative bleeding following SH is rare, with an incidence of 0—10 % (Table 1). PHs are even less common; in a study of 3058 patients who underwent stapling procedures, only 14 cases (0.5 %) of large PHs were documented [13]. Although infrequent, these complications are among the most severe and concerning outcomes of SH [1, 2, 9, 16].

The possible pathomechanism of perirectal hematoma after SH is that it likely originates from damage to the blood vessels in the perirectal fat, which were partially transected by the stapling device [9]. A case of significant intra-abdominal bleeding following SH triggered by the intra-abdominal placement of the stapler due to an enterocele was described [2].

Key risk factors for acute bleeding following SH include patient comorbidities, such as the use of anticoagulants or pre-existing coagulopathies (like in our case report), inadequate hemostasis, surgical site disruption, or technical difficulties encountered during the procedure [13, 15]. A systematic review of 16 studies involving 37 patients with perirectal (12 cases) and intra-abdominal (6 cases) bleeding after SH and STARR stapled transanal rectal resection identified abdominal pain (43 %), pelvic discomfort without rectal bleeding (36 %), and external rectal bleeding (21 %) as the main symptoms, with a median onset of 1 day [15]. Notably, 57 % of patients with large PHs did not have rectal bleeding [13]. In our case, intraoperative proctoscopy confirmed the integrity of the staple line, suggesting that the bleeding originated from submucosal tissues, a phenomenon observed in rare cases of SH complications. The absence of rectal bleeding and chronic anemia complicated the diagnosis, highlighting the need to assess both intraluminal and intra-abdominal bleeding sources.

Table 1. **Bleeding complications, including perirectal hematoma, following stapled hemorrhoidopexy as reported in selected publications**

Patient cohort, n	Overall bleeding rate	PH	Treatment Approach	Re-operation rate	Year of publication	Country	Reference
1	N.ap.	1	Laparotomy	N.ap.	2024	Germany	Prokopchuk et al. (our case report)
3058	N.av.	14 (0.5 %)	Conservatively, embolization	0	2023	Italy	Mascagni et al. [13]
59	3 (5.1 %)	1 (1.7 %)	Conservatively	0 for PH 1 (1.7 %) for overall bleeding	2023	Italy, Jordan, Chile	Sturiale et al. [17]
646	64 (9.9 %)	N.av.	19 pts: band ligation 45 (7 %) pts conservatively	0	2023	Italy	Eminoğlu [8]
37 (16 studies)	N.ap.	12 pts: PH 6 pts: intra-abdominal bleeding	14 (38 %) non-operatively	23 (62 %)	2020	Different	Systematic review Popivanov et al . [15]
1	N.ap.	1	Laparotomy (Hartmann's operation)	N.ap.	2009	Croatia	Augustin et al. [1]
186	0	0	N.ap.	0	1999	Italy	Longo et al. [11, 12]

Note. N.av.: not available; N.ap.: not applicable; LA: local anesthesia, pts: patients; PH: perirectal hematoma.

Hemodynamic instability occurred in 19 %, and CT scans were used in 77 % of cases [15]. Treatment varied: 38 % were managed non-operatively with arteriography and embolization, while 62 % required surgery, including transabdominal procedures, transanal surgery, perineal access, and CT-guided paracoccygeal drainage [15]. Interestingly, a report from large-volume centers involving 3058 patients found that only 14 (0.5 %) developed PH, none of whom required abdominal surgery. Twelve were managed conservatively with antibiotics and monitored through CT scans and laboratory tests, while two patients with progressive PH underwent embolization [13], emphasizing that not all bleeding complications require invasive interventions. To reduce bleeding risk, extended compression time has been recommended. Specifically, a compression duration of 2 minutes, compared to the typical 30 seconds, was associated with a lower incidence of postoperative bleeding [20].

Our management approach for perirectal and intra-abdominal bleeding after SH is guided by hemodynamic stability and imaging findings (Fig. 3). Immediate surgical intervention is crucial for unstable patients, as illustrated by our case. For hemodynamically stable patients, conservative strategies like selective arteriography and embolization should be considered to avoid unnecessary surgery.

The second case highlights a 49-year-old female patient who developed severe anal stenosis, pain, and fecal incontinence following SH. Despite initial management attempts, including biofeedback and dilatation therapy, the patient's symptoms persisted, leading to the decision for surgical intervention. A laparoscopic loop sigmoidostomy was performed to relieve symptoms and allow for rectal healing. Additionally, multiple sessions of anal dilation were undertaken to address the stenosis. This treatment approach, though invasive, ultimately provided relief and allowed for recovery.

Anal stenosis is a rare complication of SH with an incidence of less than 0.5—7.0 % (Table 2). Strictures after SH are generally classified as high anal stenosis but are often considered rectal stenoses due to the resection of rectal mucosa [14]. Stenosis definitions vary, with Burke describing rectal stenosis as the inability to pass a 19 mm sigmoidoscope through an anastomosis, while others base it on digital examination difficulty [4, 14].

One primary cause of stenosis is the improper placement of the circular stapler, which can result in excessive resection or incorrect tissue capture [14]. Residual purse-string sutures that are not fully released postoperatively may also contribute to

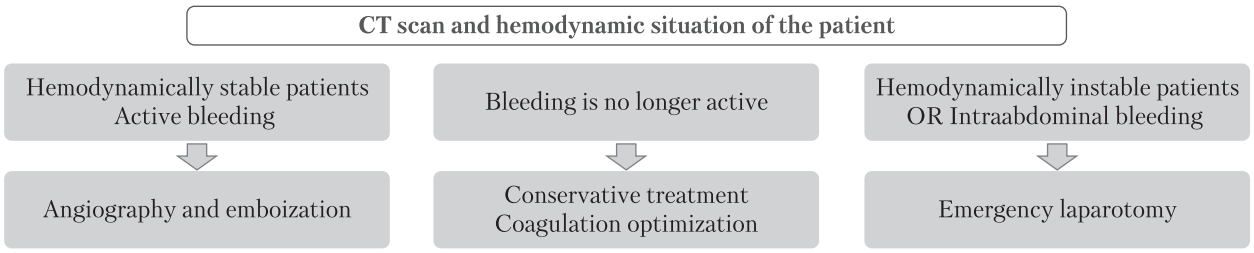

Figure 3. **Proposed algorithm for management of perirectal hematomas and intra-abdominal bleeding (modified after [3] and [15]).** The decision is made based on the contrast-enhanced CT scan and the patient's hemodynamic situation, similar to the algorithm used in pelvic trauma: in hemodynamically stable patients with active bleeding, angiography and embolization are performed; if the bleeding is no longer active, a conservative treatment with coagulation optimization is implemented. In cases of hemodynamically unstable patients or intra-abdominal bleeding, an emergency laparotomy is indicated

luminal narrowing, causing obstruction [5]. Studies highlight that inadequate dilatation before firing the stapler and excessive traction on the purse-string can increase the risk of strictures. Literature reports suggest that using a Hegar dilator during the procedure can help ensure proper lumen size, reducing the likelihood of stenosis. Additionally, it is crucial to avoid overlapping staple lines and to ensure that no residual tissue is entrapped. A modified stapled hemorrhoidopexy, which involves selectively removing staples at the 3-o'clock and 9-o'clock positions and placing a hemostatic suture to control bleeding, has been proposed to reduce lower postoperative stenosis [10] and may be validated in future studies.

These two cases, while distinct in their complications, underscore the importance of a proactive and individualized management approach following stapled hemorrhoidopexy. Both rectal hematoma and anal stenosis, though rare, can have serious implications and require prompt intervention. The key considerations for managing such complications include early recognition of symptoms, a structured evaluation of anal and rectal function, and a multidisciplinary treatment approach involving both surgical and non-surgical therapies. Both cases also highlight the need for thorough preoperative screening to identify potential risk factors, such as coagulation disorders in the case of bleeding complications. In both instances, a combination of conservative management and more invasive surgical procedures was required to achieve a favourable outcome. The importance of patient education cannot be overstated, as setting realistic expectations

Table 2. **Incidence of anal stenosis following stapled hemorrhoidopexy as reported in selected publications**

Patient cohort, n	Stenosis rate	Treatment approach	Re-operation rate	Year of publication	Country	Reference
1	N.ap.	Surgery (colostomy) and progressive dilatation therapy	N.ap.	2024	Germany	Prokopchuk et al (our case report)
313	21 (6.7 %)	Transanal stricture release surgery; dilatation by finger; Pratt speculum-based dilation	9 (42.9 %)	2024	China	Liu et al. [10]
59	1 (1.7 %)	Dilatation and redo surgery	100 %	2023	Italy, Jordan, Chile	Sturiale et al. [17]
646	3 (0.5 %)	N.av.	N.av.	2023	Italy	Eminoğlu [8]
289	9 (3.1 %)	Dilatation (n = 8); surgery for transanal strictureplasty with electrocautery (n = 1)	11.1 % %	2004	Germany	Petersen et al. [14]
1	N.ap.	Surgery: insertion of a Hegar dilator and release of the purse-string entrapped by the staples	N.ap.	2002	Italy	Cipriani et al. [5]

Note. N.av.: not available; N.ap.: not applicable; LA: local anesthesia, pts: patients.

about potential complications and recovery timelines can help mitigate patient anxiety and improve adherence to treatment plans.

Conclusions

These case reports demonstrate the complexity of managing severe complications after stapled hemorrhoidopexy. Although SH remains an effective treatment for high-grade hemorrhoidal disease, complications such as perirectal hematoma and anal stenosis must be carefully managed to optimize patient outcomes. A multidisciplinary approach, including prompt surgical intervention, structured diagnostic evaluation, and tailored therapies, was crucial in achieving favourable results for both patients. This report serves as a reminder of the need for vigilance, early intervention, and individualized care in colorectal surgery, particularly when rare but severe complications arise.

Declaration of interests

The authors declare that they have no conflicts of interest.

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Ethics approval and written informed consent statements

The written informed consent to participate in the study was obtained. The first case report was presented at the 141st German Surgery Congress on April 16, 2024 (DCK Digital 2024—141. Deutscher Chirurgenkongress).

Authors contributions

O. Prokopchuk: acquisition of data, analysis and interpretation of data, drafting of the manuscript; F. Fuchs: acquisition of data, critical revision of the manuscript; D. Nedic: critical revision of the manuscript; D. Quaiser: analysis and interpretation of imaging; critical revision of the manuscript; H. F. G. Novotny: critical revision of the manuscript; H. Friess: critical revision of the manuscript; J. Bachmann: analysis and interpretation of data, design of the study, critical revision of the manuscript; F. Spelsberg: design of the study, analysis and interpretation of data, critical revision of the manuscript.

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26 років досвіду застосування степлерної гемороїдопексії — підходи до ведення тяжких ускладнень. Два клінічні випадки та огляд літератури

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Степлерну гемороїдопексію, уперше запропоновану Лонго в 1998 р., широко застосовують для хірургічного лікування гемороїдальної хвороби. Ця інноваційна процедура стала популярною завдяки менш виразному післяопераційному болю, скороченню періоду госпіталізації та швидшому відновленню. Водночас вона не позбавлена ризику та пов'язана з рідкісними, але серйозними ускладненнями, які можуть суттєво впливати на здоров'я пацієнта. Описано два показові клінічні випадки таких ускладнень. У першому випадку в 41-річного чоловіка виникла перириктальна гематома, яка супроводжувалася гострою абдомінальною кровотечею через розрив мезентеріальних судин у зоні ректосигмоїдного з'єднання. Пацієнту була проведена невідкладна хірургічна операція та інтенсивна післяопераційна терапія. У другому випадку в 49-річної жінки мав місце анальний стеноз із фекальною інконтиненцією, що потребувало хірургічної корекції та тривалої реабілітації для відновлення функції кишечника й поліпшення якості життя. Ці клінічні випадки свідчать про важливість своєчасної діагностики й ефективного менеджменту ускладнень, які, хоча і трапляються рідко, можуть мати серйозні наслідки, а також про необхідність використання мультидисциплінарного підходу із залученням колопроктолога, загального хірурга та гастроентеролога для оптимізації лікування.

Аналіз літератури виявив основні чинники ризику, зокрема супутні захворювання, технічні особливості виконання операції та ретельний відбір кандидатів для процедури. Обговорюються найкращі практики, спрямовані на зниження ризику ускладнень, зокрема вдосконалення хірургічних технік, ретельне доопераційне обстеження та навчання персоналу. Наведена інформація покликана допомогти хірургам у зниженні ризиків та підвищенні безпеки пацієнтів при збереженні переваг інноваційного підходу.

Ключові слова: степлерна гемороїдопексія, операція за Лонго, перириктальна гематома, анальний стеноз, ректальний стеноз, менеджмент ускладнень.

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A case of metachronous ascending colon cancer and synchronous primary rectal and duodenal cancer in a patient with Lynch syndrome

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Multiple primary malignant tumours (MPMTs) are defined as the simultaneous or sequential occurrence of two or more primary malignant tumours in a single patient, which may originate from the same organ, paired organs, different parts of the same system, or different organs. Synchronous MPMTs develop within 6 months of the primary tumour, while metachronous ones occur more than 6 months later. The available sources have no information on metachronous or synchronous colorectal and duodenal cancer.

Objective — to present treatment outcomes of a rare case of metachronous ascending colon cancer and synchronous primary rectal and duodenal cancer in a patient with Lynch syndrome.

A male patient, born in 1963, underwent a right-sided hemicolectomy for ascending colon mucinous adenocarcinoma — stage III ($pT_{4p}N_1M_0$) — in 2002. In the summer of 2022, he complained of pain in the right hypochondrium, nausea, general weakness, and blood in the stool. The examination revealed the presence of synchronous primary cancer in the rectosigmoid section and duodenal cancer. The decision to proceed with a two-stage surgical intervention was based on the partial colonic obstruction. The first stage (September 08, 2022) included the anterior resection of the rectum with sigmo-recto anastomosis ($pT_{4c}N_{2b}M_0$, stage III, R-0). The second stage (December 08, 2022) included the resection of a portion of the descending and lower horizontal parts of the duodenum with duodeno-duodenoanastomosis, followed by Roux-en-Y gastrojejunostomy. The procedure entailed stitching the stomach in the prepyloric section, performing a cholecystectomy, and draining the abdominal cavity (duodenal adenocarcinoma with free margins: R-0). The patient was diagnosed with Lynch syndrome based on immunohistochemistry screening results and genetic studies. After the first and second stages, the patient categorically refused to undergo a course of traditional adjuvant therapy. At the control CT scan 1.9 months after the last operation, there were no signs of prolongatio morbi. A rare case of synchronous rectal and duodenal cancer, demonstrating favourable treatment outcomes after two-stage surgery without standard adjuvant therapy, is described. Patient follow-up is ongoing; therefore, the results may change in the future.

Keywords
metachronous cancer, synchronous primary rectal and duodenal cancer, surgical treatment, Lynch syndrome.

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Multiple primary malignant tumours (MPMTs) are described as two or more primary malignant tumours that develop simultaneously or sequentially in the same patient. They may originate from the same organ, paired organs, different parts of the same system, or different organs of different systems [20]. The diagnostic criteria for MPMTs require each tumour to exhibit clear malignant histopathological changes, have an independent morpho-embryogenetic pathological type, and not be an invasion or metastasis of a second tumour type. MPMTs are classified as metachronous and synchronous tumours. Synchronous MPMTs are defined as the second primary tumour occurring within 6 months after the first primary tumour, and metachronous MPMTs are defined as the second primary tumour occurring later than 6 months after the diagnosis of the first tumour [13]. MPMTs

were first described by Billroth in 1889, and the first report was published by Warren and Gates in 1932 [20]. A literature review of 1,104,269 cancer patients showed that the incidence of MPMTs ranges from 0.73 % to 11.7 % [8].

Double MPMTs are most commonly diagnosed [10, 25], but three to five MPMTs are also found [4, 17, 22, 24]. The combinations of the locations of the first and second primary cancers can manifest in a variety of ways. Excluding breast and genital cancers in women, the most common primary cancers are thyroid, lung, colon, renal cell, bladder, rectal, and stomach cancers. The most common second primary cancers are lung, thyroid, rectal, bladder, colon, liver, and renal cell cancers [21]. According to X. B. Yang et al. [21], out of the total number of MPMT cases, 1,678 (88.2 %) were metachronous, and 224 (11.8 %) were synchronous [19]. In men, among synchronous cancers, the incidence of colon cancer was the highest among first primary cancers (15.1 %), and the incidence of rectal cancer was the highest among second primary cancers (21.0 %) [19].

After analysing the clinicopathological data from 15,321 patients with malignant neoplasms, S. Zhai et al. [23] discovered that the most prevalent MPMTs were malignant neoplasms in the digestive system. MPMTs were more commonly found in the large intestine (colon and rectum), rather than the stomach [7]. Zhu CL and L. Z. Peng [26] reported the highest frequency of MPMTs in the colon (38.37 %), rectum (33.14 %), and stomach (26.16 %). According to T. Kato et al. [14], MPMTs occur in 10.5 % of cases of colorectal cancer, with gastric cancer being the most frequent neoplasm (44.4 %).

We found no case reports of metachronous or synchronous colorectal and duodenal cancer in the available sources.

Objective — to present treatment outcomes of a rare case of metachronous ascending colon cancer and synchronous primary rectal and duodenal cancer in a patient with Lynch syndrome.

Patient I., a male born in 1963, received two-stage surgical treatment for synchronous primary rectal and duodenal cancer at the Municipal Nonprofit Enterprise «Kyiv City Clinical Hospital of Emergency Medical Care».

In the anamnesis (July 23, 2002), he underwent a right-sided hemicolectomy for ascending colon cancer. Final diagnosis: Colon cancer of stage III, clinical group II ($pT_{4p}N_1M_0$). Pathohistological conclusion: 1. Lymph node — undifferentiated cancer. 2. Colon area — mucinous adenocarcinoma; involvement of all intestinal membranes.

During the postoperative period, he underwent 6 courses of chemotherapy that included 5-fluorouracil and folic acid. According to the patient, he tolerated chemotherapy poorly, with hepatotoxic and emetogenic manifestations.

In the summer of 2022, the patient complained of moderate pain in the right hypochondrium, hypogastric region, nausea, belching, general weakness, sometimes fresh blood in the stool, occasional difficulty defecating, and abdominal bloating. The diagnosis was established based on the examination data (fibrocolonoscopy and fibrogastroduodenoscopy dated June 4, 2022 and computed tomography (CT) dated August 6, 2022): Synchronous primary cancer of the rectosigmoid colon, complicated by mild bleeding (Fig. 1, 2) and retrobulbar duodenal cancer (Fig. 3, 4).

The biopsy results dated August 4, 2022 indicate a low-grade adenocarcinoma of the colon (G1–G2) according to the previous grading system (ICD-O code: 8140/3) and low-grade adenocarcinoma of the small intestine (G1-G2) according to the previous grading system (ICD-O code: 8140/3).

The decision to proceed with a two-stage surgical intervention was based on the partial colonic obstruction.

In the first stage (September 8, 2022), the patient underwent anterior resection of the rectum with «end-to-end» sigmo-recto anastomosis, debridement, and drainage of the abdominal cavity.

During the surgical procedure, we discovered a circular tumour in the upper ampullary region of the rectum, which had spread to the pararectal tissue. The pararectal, bifurcation and para-aortic lymph nodes were enlarged to 0.5—1.0 cm.

Macroscopic specimen after surgery: The rectum with mesorectal tissue and para-aortic lymph nodes. In the intestine, a circular tumour with disintegration and bleeding, which occludes the lumen by 2/3 and grows into the pararectal tissue.

Clinical diagnosis: Cancer of the upper ampullary part of the rectum ($pT_{4c}N_{2b}M_0$, stage III, R-0), clinical group 2. Mild bleeding from a tumour. Partial colonic obstruction. Duodenal cancer.

Pathohistological conclusion (September 16, 2022): Adenocarcinoma of the rectum with invasion of the muscle layer. Tumour growth is not detected at the edges of the resection. Tumour growth is not detected in the mesenteric lymph nodes and para-aortic lymph nodes.

Due to pre-existing complaints, the patient underwent an outpatient examination following the first stage of surgery.

Fibrogastroduodenoscopy (FGDS) dated October 17, 2022: The esophagus has no abnormalities. There is a moderate amount of secretion in the stomach; the gastric mucosa is focally hyperemic.

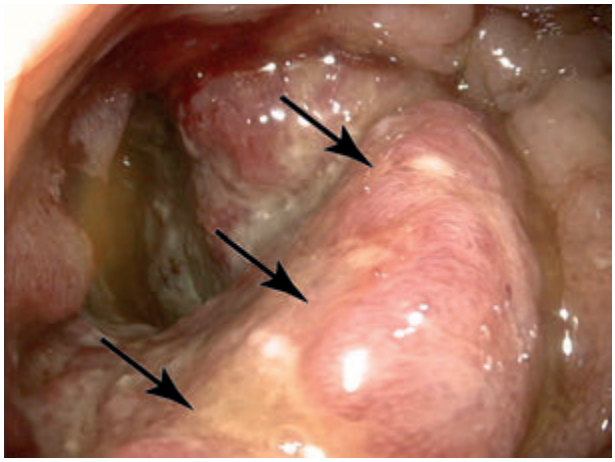

Figure 1. **A circular infiltrative tumour of cartilaginous density is determined at 20 cm, occupying half of the intestinal lumen. The tissues here are amorphous, cyanotic, rigid, nodular, and bleed on contact (arrows)**

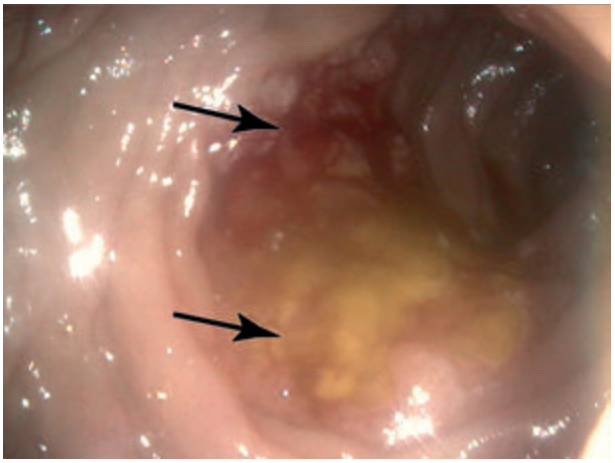

Figure 3. **In the area below the major duodenal papilla, a subcircular ulcer-like defect of the duodenum of infiltrative nature with cartilaginous density is visualized, it bleeds on contact, covered with food (the area does not peristaltize). The duodenal patency is observed during endoscopy (arrows)**

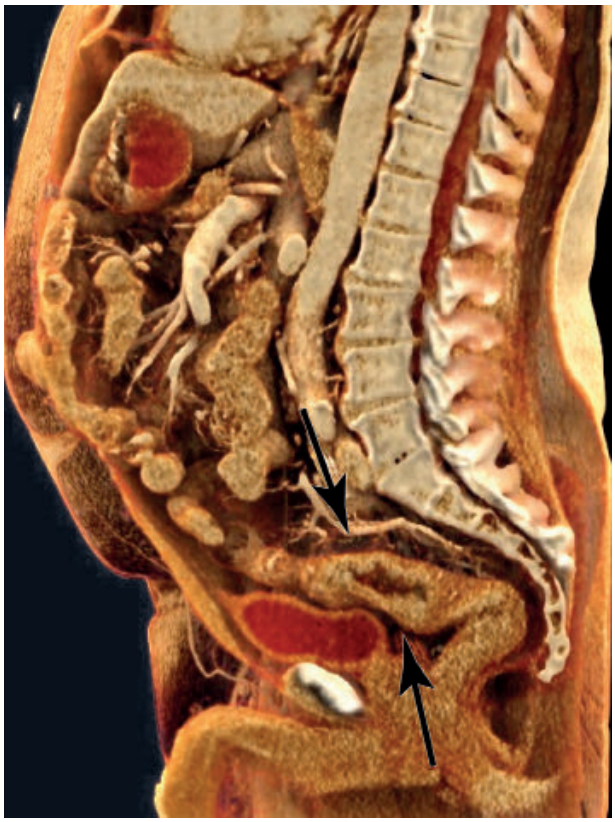

Figure 2. **Preoperative CT reconstruction, 3D visualization. Circular thickening of the rectosigmoid colon wall up to 15 mm. The affected wall has an indistinct, uneven outer contour; the differentiation of the layers is disturbed, and the wall has active contrast enhancement. The surrounding fatty tissue is dense and compacted (arrows)**

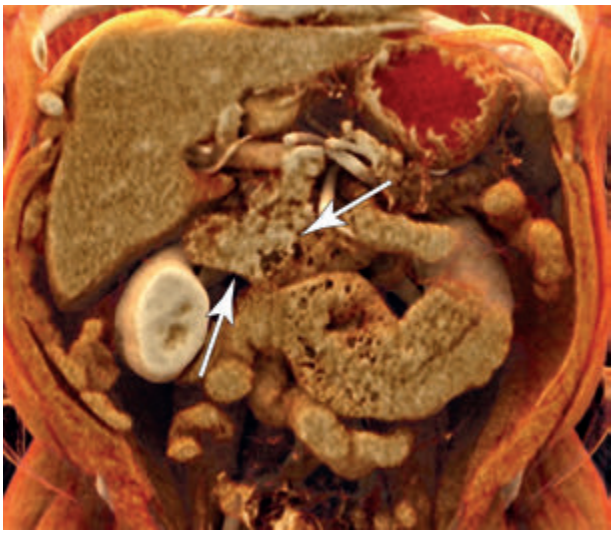

Figure 4. **Preoperative CT reconstruction, 3D visualization. Circular thickening of the wall of the descending and lower horizontal parts of the duodenum up to 10 mm; the lumen of the intestine at this level is unevenly narrowed (arrows)**

In the descending part of the duodenum, there is a neoplasia of approximately 4 cm on the lateral wall; the tissues here are cyanotic, amorphous and bleeding, and the edges are nodular. Biopsy (performed previously).

Conclusion: Duodenal neoplasia; FIIC.

After the operation, the patient was prescribed adjuvant chemotherapy. However, due to the potential severe toxic effects the patient had previously experienced from chemotherapy after the first operation, he flatly refused the proposed therapy. Instead, he independently underwent a course of outpatient treatment using the Greater Celandine extract *(Amitozyn)* [1—3, 12].

The patient reported taking *Amitozyn* for a month (from October 24, 2022 to November 28, 2022), administering 50 mg intravenously in 200 ml of saline every third day, for a total dose of 500 mg. During the first four administrations, hyperthermia was observed to be 37.5—38.5°C, which subsided within 12 hours without the administration of antipyretics. No other reactions to the drug were noted.

An FGDS was conducted on November 28, 2022, in response to the patient's further complaints, subsequent to the first stage of the operation. The esophagus has no abnormalities. A gastric secretion is observed. The duodenal defect in the descending and horizontal sections along the lateral wall has marginally reduced in volume since October 17, 2022; however, its dimensions remain about 4—5 cm. The lumen is unobstructed for the endoscope. The defect measures around 5—7 cm from the pylorus to its proximal margin.

Conclusion: Duodenal neoplasia; FIIC; positive dynamics.

Regarding the duodenal tumour, the patient was offered surgical intervention in the scope of pancreatoduodenal resection (PDR), which he categorically refused but agreed to tumour excision due to the threat of bleeding.

The second stage of the operation (December 08, 2022) was performed: Resection of part of the descending and lower horizontal section of the duodenum with duodeno-duodenoanastomosis, Roux-en Y gastrojejunostomy, through-the-stomach stitching in the prepyloric section, cholecystectomy, and drainage of the abdominal cavity. The operation was without complications.

During the revision in the abdominal cavity, the adhesion process was detected, especially pronounced in the right hypochondrium and subhepatic space; small concrements were found in the gallbladder; and an irregularly shaped, dense tumour measuring 4 × 5 × 3 cm was palpated along the lateral edge in the lower horizontal part of the duodenum. Duodenotomy — the tumour has a glandular structure, easily disintegrates, and bleeds. Regional lymph nodes are not enlarged.

Histopathology report dated December 22, 2022, No. 11436-39: Duodenal adenocarcinoma with free margins (R-0), atrophic cholecystitis, and gallbladder adenosis.

Since the disease exhibited the characteristics typical of Lynch syndrome, additional studies were carried out to confirm it. Initially, immunochemistry (IHC) was used to assess the status of proteins within the mismatch repair (MMR) system. The screening revealed a deficiency (dMMR/MSI-H) characterized by the loss of MSH2 and MSH6, which is typically associated with Lynch syndrome due to an inherited mutation in the MSH2 gene. Genetic tests confirmed the presence of an inherited MSH2 mutation (c.2042C > T (p.Ala681Val)), thereby validating the diagnosis of Lynch syndrome in the patient.

During the postoperative period, suppuration of the retroperitoneal tissue hematoma was noted, which was managed with antibiotic treatment and hematoma drainage.

After surgery, the patient once more declined the recommended adjuvant chemotherapy. The patient reported undergoing outpatient therapy from April 4, 2023, until May 19, 2023 taking *Amitozyn* 50 mg intravenously in 200 ml of saline every third day, for a total dose of 500 mg.

The patient underwent a similar treatment course in January 2024 [1—3, 12]. The total dose was 1500 mg.

Five months after surgical treatment, the patient complained of moderate pain in the epigastric region and heartburn. A gastroscopy was performed (May 16, 2023), during which a superficial peptic ulcer up to 1.5 cm in diameter was detected immediately behind the gastroentero-anastomosis from the side of the small intestine, Fores III. The antrum ends blindly. The afferent loop ends blindly and there are single ligatures. The efferent loop has no abnormalities. The patient underwent an antiulcer therapy course. Control gastroscopy dated June 26, 2023: The ulcer healed. Fifteen months later (September 23, 2024),a during FGDS, erosions of the gastrojejunoanastomosis zone from the side of the small intestine measuring 3—7 mm were detected. The antrum ends blindly and the afferent loop on a segment 15 cm long is unchanged.

After 1.9 months (September 29, 2024), a CT scan of the chest and abdominal cavity, retroperitoneal space, and pelvis was performed with contrast «Tomohexol 350» (120 ml). Interintestinal anastomoses are patent without wall thickening. The

remainder of the colon does not exhibit gross wall thickening. The stomach stump is of sufficient size without wall thickening and the gastrojejunal anastomosis is patent. The afferent loop and duodenal stump are not dilated, without additional pathological formations and wall thickenings.

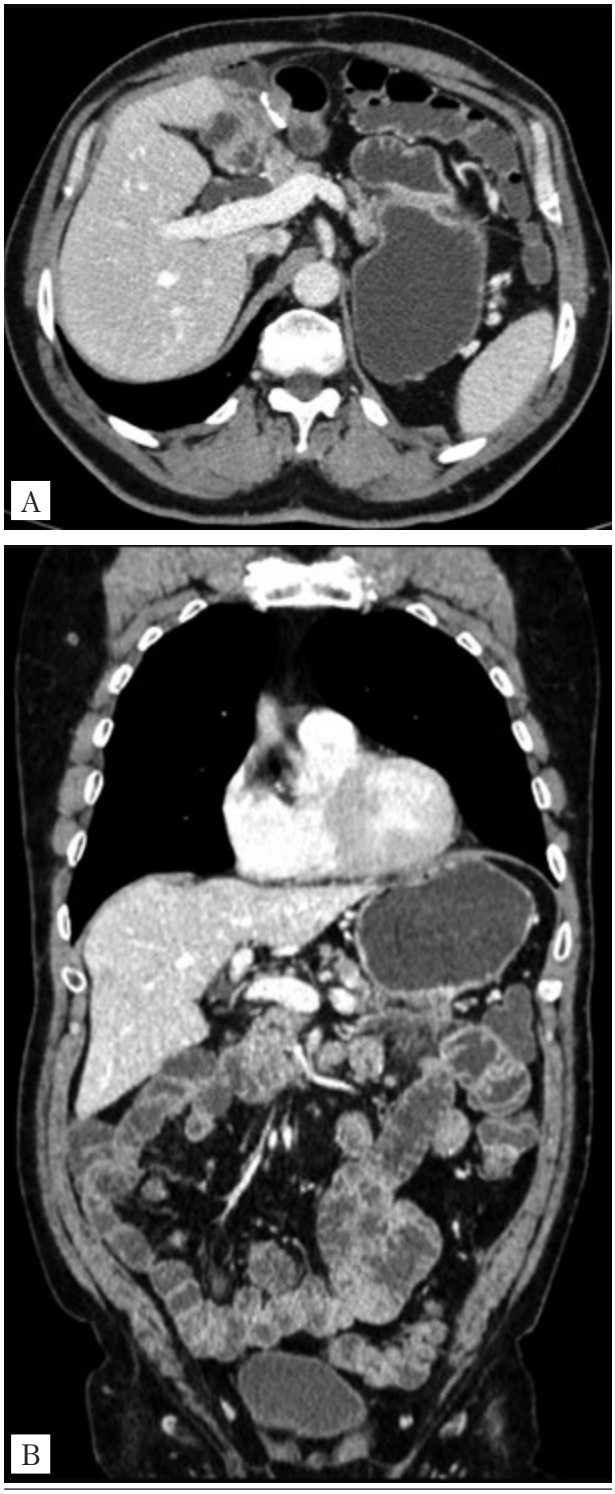

Figure 5. **CT scan of the abdominal cavity with contrast, as of October 10, 2024: axial (A) and frontal (B) projection. There are no signs of prolongatio morbi**

There are no pathologically enlarged retroperitoneal, mesenteric, pelvic, or inguinal lymph nodes. There is no ascites or pneumoperitoneum. There are no peritoneal implants.

The liver has even contours and normal dimensions. No pathological alterations are noted in the internal structure of the organ.

Bone destructive changes are not determined.

Conclusion: Condition after right-sided hemicolectomy and rectal resection. Condition after duodenal resection for cancer. No CT signs of prolongatio morbi (Fig. 5).

According to the SF-36 Score questionnaire, the patient's quality of life indicators one year and nine months after the last operation correspond to the population norm (table).

The indicators of tumour markers of the gastrointestinal tract CA-242 and pancreas CA 19-9 (as of September 12, 2024) are within normal limits (< 0.5 U/ml and < 1.2 U/ml, respectively).

Discussion

The occurrence of metachronous cancer, first of the colon and then of the rectum, among gastrointestinal MPMTs is a common phenomenon [7, 26]. Such a chronological sequence of malignant tumours was also observed in our patient. However, he was diagnosed with duodenal adenocarcinoma simultaneously with rectal cancer, which is rare (< 0.5 % of all gastrointestinal cancers) [6, 15]. Therefore, the adenocarcinoma was synchronous with respect to rectal cancer and metachronous with respect to colon cancer. Such variants of combinations of multiple carcinomas are not given in the literature.

Table. **Patient quality of life indicators 1 year and 9 months after the last surgery according to SF-36 Score**

Item	Percentage
Physical functioning	80
Role limitations due to physical health	100
Role limitations due to emotional problems	100
Energy/fatigue	65
Emotional well-being	80
Social functioning	100
Pain	100
General health	70
Health change	75

In the surgical treatment of synchronous cancer, we chose a two-stage strategy. Initially, we removed the rectal tumour due to the presence of partial colonic obstruction and uncertainty about the scope of the operation for duodenal adenocarcinoma.

The second stage (surgery for duodenal cancer) was planned after standard adjuvant chemotherapy. However, the patient refused the prescribed treatment and independently underwent an outpatient treatment course using the Greater Celandine extract *(Amitozyn)* [1—3, 12].

The lack of studies and limited evidence on the effects of *Amitozyn* use make it difficult to draw conclusions about its potential effectiveness.

After three months, the second stage of operation was performed. Pancreatoduodenal resection was planned. The patient flatly refused the specified volume of surgical intervention, but due to intestinal bleeding, he agreed to resection of the part of the duodenum affected by the tumour. Thus, we performed resection of part of the descending and lower horizontal section of the duodenum with duodeno-duodenoanastomosis, Roux-en-Y gastrojejunostomy, through-the-stomach stitching in the prepyloric section, cholecystectomy, and drainage of the abdominal cavity.

Protective gastric suturing and Roux-en-Y gastroenteroanastomosis were performed to prevent food transit through the duodeno-duodenoanastomosis zone, which made it possible to prevent failure of its sutures.

Roux-en-Y gastroenterostomy presents a higher incidence of anastomotic peptic ulcers. In bariatric surgery, Roux-en-Y anastomotic ulcers are particularly common, accounting for 16 % of cases [18]. This is due to a number of causes, including the action of acid on the mucosa of the small intestine. The Roux-en-Y gastrojejunostomy area is more vulnerable to acid because the alkaline duodenal contents do not neutralize it, unlike other gastrojejunostomies. In our situation, a superficial ulcer up to 1.5 cm in diameter appeared directly below the anastomosis on the small intestine side, five months following surgery. Since the Roux-en-Y anastomosis was performed on the entire stomach, it was probably advisable to reinforce the procedure with a selective proximal vagotomy or selective vagotomy to avoid peptic ulcers. However, the peptic ulcer in this case responds well to standard conservative treatment.

Since the disease exhibited the characteristics typical of Lynch syndrome, namely the occurrence of a tumour at a young age (in our patient at the age of 39 years), most often in the right half of the colon, a high risk of synchronous or metachronous (recurrent) cancer, (as in this case) [9, 16], we conducted additional studies to confirm it after the second stage of the operation. Immunochemistry (IHC) was used to assess the status of proteins within the mismatch repair (MMR) system. The screening revealed a deficiency (dMMR/MSI-H) characterized by the loss of MSH2 and MSH6, which is typically associated with Lynch syndrome due to an inherited mutation in the MSH2 gene. Genetic tests also confirmed the presence of an inherited MSH2 mutation (c.2042C > T, (p.Ala681Val)), which allowed us to diagnose Lynch syndrome in the patient.

Very few studies have identified variants of Lynch syndrome that result in damage to the colon and duodenum. A recent study by N. Hammoudi et al. [11] reported a specific risk of duodenal cancer in Lynch syndrome. The authors identified 154 patients with Lynch syndrome, including 85 patients with MSH2 mutations and 41 patients with MLH1 mutations. Seven of the 154 (4.5 %) had at least one duodenal lesion. Of these 7 patients, three had synchronous colorectal adenocarcinomas. The median age at diagnosis was 58 years (range: 49—73). Twelve lesion locations were: descending duodenum (n = 7), lower part (n = 2), duodenal bulb (n = 1), ampulla (n = 1), and fourth duodenum (n = 1). Three lesions were invasive adenocarcinomas. The incidence of duodenal involvement in patients with pathogenic MSH2 or MLH1 variants was 7.1 % (6 of 85) and 2.4 % (1 of 41), respectively. This suggests that patients with MSH2 mutations tend to have a higher risk of duodenal involvement (RR: 5.17; 95 % CI (0.8—60.07), p = 0.1307.

A.I. Amjad et al. [5] reported the diagnosis of squamous cell cancer in the duodenum of a 58-year-old man with Lynch syndrome. Previous malignancies included two metachronous colorectal adenocarcinomas.

In our case, the histological analysis revealed that the synchronous duodenal and rectal tumours were adenocarcinomas, while the metachronous tumour of the right colon was a mucinous adenocarcinoma. We did not find similar variants of Lynch syndrome in the available literature.

After the second stage, the patient underwent two independent courses of outpatient treatment using the Greater Celandine extract *(Amitozyn)*. The patient's condition is satisfactory 1.9 months later. The quality-of-life indicators, as measured by the SF-36 questionnaire, align with the population norm, and the tumour markers of the gastrointestinal tract (CA-242) and pancreas (CA 19-9) are within normal limits. There are no signs of prolongatio morbi.

The radicality of the surgical intervention can absolutely explain the positive effect of treatment for synchronous rectal and duodenal cancer.

Conclusions

A rare case of Lynch syndrome with synchronous primary rectal and duodenal cancer, which exhibited positive treatment outcomes after two-stage surgery without the use of conventional neoadjuvant and adjuvant therapies, is described. Patient follow-up is ongoing; therefore, the results may change in the future.

Declaration of interests

The authors declare that they have no conflicts of interest.

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Authors contributions

Work concept and design, writing the manuscript — Y.M. Susak; data collection and analysis — I.M. Leschyshyn, O.M. Lobanova; critical review — Y.M. Susak, I.M. Leschyshyn.

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Випадок метахронного раку висхідної кишки та синхронного первинного раку прямої і дванадцятипалої кишки у хворого із синдромом Лінча

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Множинні первинні злоякісні пухлини (МПЗП) — це дві або більше первинні злоякісні пухлини, які одночасно або послідовно виникли в одного пацієнта. Можуть походити з одного органа, парних органів, різних частин тієї самої системи або з різних органів. Синхронні МПЗП виникають протягом 6 міс після першої пухлини, метахронні — пізніше 6 міс. Відомостей про метахронний або синхронний колоректальний рак і рак дванадцятипалої кишки (ДПК) у доступних джерелах не знайдено.

Мета — представити результати лікування рідкісного випадку метахронного раку висхідної кишки й синхронного первинного раку прямої та дванадцятипалої кишки у хворого із синдромом Лінча.

Описано рідкісний випадок синхронного раку прямої та ДПК з позитивними результатами лікування після двоетапного хірургічного втручання без традиційної ад'ювантної терапії. Пацієнт, чоловік, 1963 року народження, у 2002 р. переніс правобічну геміколектомію з приводу муцинозної аденокарциноми висхідного відділу товстої кишки III стадії ($pT_{4p}N_1M_0$). Улітку 2022 р. у нього з'явилися скарги на біль у правому підребер'ї, нудоту, загальну слабкість і домішки крові в калі. Обстеження виявило синхронний первинний рак ректосигмоїдного відділу та рак ДПК. Через часткову низьку кишкову непрохідність ухвалено рішення про двоетапне оперативне втручання. Перший етап (08.09.2022): передня резекція прямої кишки з накладанням сигморектоанастомозу ($pT_{4c}N_{2b}M_0$, III стадія, R-0). За результатами імуногістохімічного скринінгу та генетичних досліджень у пацієнта діагностовано синдром Лінча. Другий етап (08.12.2022): резекція частини нисхідного та нижньо-горизонтального відділу ДПК із дуодено-дуоденоанастомозом, гастроєюностомія за методом Ру, наскрізне прошивання шлунка в препілоричному відділі, холецистектомія, дренування черевної порожнини (аденокарцинома ДПК, краї вільні: R-0). Під час контрольної комп'ютерної томографії через 1,9 міс після останньої операції ознак prolongatio morbi немає. Спостереження за пацієнтом триває.

Ключові слова: метахронний рак, синхронний первинний рак прямої та дванадцятипалої кишки, хірургічне лікування, синдром Лінча.

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