

Comparative efficacy of monotecnological laparoscopic versus traditional laparotomy interventions in acute pancreatitis: Analysis of clinical outcomes

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Abstract. Acute pancreatitis remains one of the most pressing problems in emergency surgery due to its high mortality rate and risk of complications, which necessitates the search for safer and more effective surgical techniques. The study aimed to conduct a comparative analysis of the efficacy and safety of single-technique laparoscopic interventions compared with traditional laparotomy in patients with acute pancreatitis. The study included 136 patients divided into two groups: the main group ($n = 74$), in which laparoscopic interventions were performed; and the control group ($n = 62$), in which laparotomy operations were performed. A retrospective-prospective design was employed, clinical and laboratory indicators, instrumental imaging methods and statistical processing with an assessment of the reliability of differences were used. The results revealed an advantage of laparoscopy. The average length of hospitalisation in the main group was significantly shorter (18.7 ± 1.2 days versus 29.1 ± 2.3 days in the control group, $p < 0.05$). Mortality was almost half as low (12.1% versus 24.4%), and the frequency of postoperative complications was also significantly lower. Additional advantages of laparoscopy were minimal trauma, the possibility of combined manipulations, and faster patient recovery. At the same time, certain risks were noted drainage failure and the need for conversion in 2.3% of cases, which emphasises the importance of strict patient selection. The practical significance of the study is determined by the justification for the widespread introduction of laparoscopic technologies in the surgical treatment of acute pancreatitis. Their use significantly reduces the length of hospitalisation, lowers complication and mortality rates, and improves clinical outcomes, making laparoscopy the preferred tactic for this pathology

Keywords: minimally invasive surgery; pancreonecrosis; postoperative complications; drainage; conversion of surgery; rehabilitation; inflammatory complications

Introduction

Acute pancreatitis (AP) continues to be one of the most severe forms of emergency abdominal pathology, characterised by a high risk of systemic complications and mortality, especially in necrotic forms of the disease. According to G. Trikudanathan *et al.* [1], the prevalence of AP reaches 30-50 cases per 100,000 population annually, and mortality rates in severe forms can exceed 20-30%. The severity of the pathogenesis of AP, including a systemic inflammatory response, multiorgan dysfunction and a high risk of necrotic tissue infection, necessitates a timely and informed choice of

surgical tactics [2]. The development of surgical tactics for complicated forms of acute pancreatitis has undergone significant changes since the 2010s. Traditional laparotomy interventions, which are characterised by high surgical trauma, a long recovery period and a significant incidence of postoperative complications, are gradually replaced by minimally invasive approaches. According to R. Rasslan *et al.* [3], the use of laparoscopic technologies provides accurate visual control and minimal invasiveness, and creates the possibility of combined interventions, which corresponds to the concept

Suggested Citation:

Chapyev M. Comparative efficacy of monotecnological laparoscopic versus traditional laparotomy interventions in acute pancreatitis: Analysis of clinical outcomes. J Osh State Univ Med. 2025;4(1):31–8. DOI: 10.52754/16948645_2025_4(1)_31

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of damage control surgery. In turn, S. van Brunschot *et al.* [4] demonstrated that minimally invasive and endoscopic methods in the treatment of necrotising pancreatitis significantly reduce mortality and the incidence of infectious complications compared to open necrectomy.

In 2024, M.B. Chapyev *et al.* [5] substantiated the importance of monotecnological operations based on the use of a single targeted technique, such as sanitation or drainage. The study noted that such a tactic minimises surgical aggression without reducing effectiveness and should be considered as part of the classification of minimally invasive interventions. The high level of evidence of the effectiveness of endoscopic and laparoscopic methods was confirmed by the results of the meta-analysis by J.Y. Bang *et al.* [6], demonstrating that these technologies significantly reduce the incidence of infectious complications and mortality in patients with infected pancreatic necrosis. In turn, A.M. Onnekink *et al.* [7] confirmed in a long-term follow-up study that the use of the so-called step-up approach reduces hospitalisation time, reduces the need for repeated interventions and reduces the need for prolonged intensive care.

The issue of optimal drainage time is also substantially addressed. Y. Yang *et al.* [8], in a systematic review, demonstrated that delayed intervention performed after the fourth week from the onset of the disease is associated with more favourable results, as during this period the necrosis zones have clear boundaries. This principle is being integrated into international protocols for minimally invasive surgery. However, as M. Podda *et al.* emphasised [9], the implementation of such technologies requires highly qualified surgeons and modern technical equipment, which limits their widespread use in regional centres.

At the same time, there are still controversial issues related to the standardisation of indications for specific types of drainage, the assessment of the risk of conversion and the study of long-term results. Similar conclusions for pancreatic surgery were presented in a long-term follow-up by C.L. van Veldhuisen *et al.* [10], demonstrating that delayed drainage was accompanied by fewer interventions, while the quality of life and pancreatic function remained comparable to the immediate approach. In the broader context of the development of minimally invasive surgery, the study by S.R. DeMeester *et al.* [11], which demonstrated that laparoscopic hernia repair of paraesophageal hernia provides better life expectancy compared to wait-and-see tactics even in asymptomatic patients, is notable. This emphasises the general trend towards the expansion of indications for laparoscopic interventions in abdominal practice. Thus, the present study compared the efficacy and safety of monotecnological laparoscopic interventions and traditional laparotomy in the treatment of patients with acute pancreatitis in a multidisciplinary surgical hospital.

Materials and Methods

The present study was performed at the Mamakeev National Surgical Centre of the Ministry of Health of the Kyrgyz Republic as part of the clinical practice of the institution. The study design was retrospective and prospective, with elements of cohort comparison, and was aimed to evaluate the clinical and surgical efficacy of monotecnological laparoscopic interventions in acute pancreatitis. The observation period was three years (2022-2024). The study included 136 patients with a diagnosis of acute pancreatitis confirmed by clinical, laboratory and instrumental methods. All patients met the inclusion criteria: age 18-75 years, clinical and radiological signs of inflammatory changes in the pancreas confirmed by computed tomography or ultrasound, and the absence of decompensated somatic diseases. Exclusion criteria: pancreatic necrosis with systemic sepsis, extensive abdominal tumours, terminal conditions, and patient refusal to undergo surgery.

The patients were divided into two groups. The main group consisted of 74 people who underwent 219 laparoscopic interventions. These surgeries were performed mainly in a monotecnological format, i.e. using one minimally invasive technique aimed to solve a specific clinical problem. In some cases, abdominal cavity rehabilitation was used, in others, drainage was installed, and in some situations, local effects were performed, including blocking the hepatic circular ligament or draining the omental sac. The control group consisted of 62 patients who underwent traditional laparotomy. These interventions included cholecystectomy, cholecystostomy, and opening and drainage of purulent cavities. Patients in this group were selected retrospectively from the database, which was used to compare the results of treatment with the main cohort.

Clinical efficacy was studied according to a range of parameters, including the intensity of pain syndrome assessed by visual analogue scale, body temperature dynamics, leukocytosis and C-reactive protein level. The volume and nature of drainage, length of hospital stay, incidence of postoperative complications according to the Clavien-Dindo classification [12], mortality rates, and the need for conversion or relaparoscopy were analysed. Additionally, the time intervals between the patient's admission to the hospital and the surgical intervention were recorded, which assessed the importance of early tactical decision-making.

The study included standardised diagnostics. All patients underwent ultrasound examinations and computed tomography before and after surgery, if indicated. Comprehensive laboratory monitoring was carried out, including a complete blood count, biochemical tests, coagulation parameters (prothrombin time, activated partial thromboplastin time), and determination of systemic inflammation markers. The severity of the patients' condition was additionally assessed by the internationally recognised SAPS II (Simplified Acute

Physiology Score II) and APACHE II (Acute Physiology and Chronic Health Evaluation II) scales, which ensured the objectivity of the data and was used to compare the results of treatment between the study groups [13,14].

Surgical interventions in the main group were performed according to a single protocol, including the stages of preparation, creation of pneumoperitoneum (≤ 15 mm Hg), polypositional examination of the abdominal cavity, sanitation/drainage and haemostasis control [15,16]. To perform the interventions, 5 and 10-mm trocars, electrosurgical instruments and a carbon dioxide insufflator with automatic pressure control were used.

SPSS Statistics v.26.0 and MS Excel with data analysis modules were used for statistical data processing. All quantitative indicators were tested for normal distribution using the Shapiro-Wilk test. To compare quantitative parameters between the two groups, the following were used: Student's t-test and Mann-Whitney. To assess the reliability of differences between the groups, the significance level was set at $p < 0.05$. Thus, the applied set of statistical methods ensured high reliability of the results, which were used for intergroup comparative analysis and justification of the

clinical feasibility of monotecnological laparoscopic interventions in acute pancreatitis. The work was conducted following international and national ethical standards, including the provisions of the World Medical Association Declaration of Helsinki [17]. The study protocol was approved by the Ethics Committee of the National Surgical Centre named after Academician M.M. Mamakeev of the Ministry of Health of the Kyrgyz Republic. Written informed consent to participate in the study, including permission to use anonymised clinical data for scientific purposes, was obtained from all patients and, if necessary, from their legal representatives.

Results and Discussion

The study included 136 patients divided into two groups: the main group (laparoscopic interventions, $n = 74$) and the comparison group (laparotomy interventions, $n = 62$). The average age of patients in the groups did not have statistically significant differences (54.9 ± 0.5 years vs. 53.7 ± 0.3 years, $p > 0.05$), which excluded the influence of the age factor on the outcomes. The demographic structure of the groups was comparable in terms of gender and age, and is presented in Table 1.

Table 1. Demographic structure (by gender and age) of patients included in the study clinical groups

Values	Group of laparoscopic interventions	Group of laparotomy interventions
Overall number of patients	74	62
Average age, years ($M \pm m$)	54.9 ± 0.5	53.7 ± 0.3
Female	47 % ($n = 35$)	49 % ($n = 31$)
Male	53 % ($n = 39$)	51 % ($n = 34$)

Source: data from the Mamakeev National Surgical Centre

The demographic structure of the clinical groups is shown in Table 1. The group of laparoscopic interventions included 74 patients, and the group of laparotomy operations included 62 patients. The average age of patients was 54.9 ± 0.5 years in the first group and 53.7 ± 0.3 years in the second, which did not reveal statistically significant differences ($p > 0.05$). Thus, the influence of the age factor on clinical outcomes can be considered minimal. The gender distribution was also comparable: women accounted for 47% ($n = 35$) in the laparoscopic group and 49% ($n = 31$) among laparotomy patients, men 53% ($n = 39$) and 51% ($n = 34$), respectively. This suggests that the initial characteristics of the samples are balanced, which excludes bias in the interpretation of further results.

The analysis of the time interval from admission to surgery showed high variability. In 42.5% of cases, laparoscopic intervention was performed within the first 3 hours of admission, reflecting the severity of the condition of some patients and the need for emergency surgery. In the remaining cases, the time frame ranged from 3 to 24 hours or more, which could be due to additional

examinations and preoperative preparation. The structure of interventions in the main group was dominated by combined laparoscopic aids, which were performed in 94.5% of patients. The most frequent manipulations were sanitation and drainage of the abdominal cavity ($n = 125$), which is natural for surgical tactics in acute pancreatitis. In addition, cholecystectomy was performed in 48 cases, and hepatic circular ligament block was performed in 41 patients. In the group of laparotomy interventions, traditional operations prevailed: sanitation and drainage ($n = 24$), cholecystectomy ($n = 14$), and opening and drainage of the omental sac ($n = 19$). These differences illustrate the shift in surgical priorities towards minimally invasive technologies.

The average duration of laparoscopic operations was 29.2 ± 5 minutes, which confirms their technical efficiency and rationality. At the same time, the frequency of conversion to laparotomy was recorded at 2.3% ($n = 11$). The main reasons were iatrogenic injuries of the gallbladder and intestine, which are in line with the literature, where conversion is considered a forced but justified mechanism to ensure patient safety. In the

postoperative period, failure of laparoscopic cholecystolithotomy was detected in 3.6% ($n = 18$) of patients, which required revision interventions. Relaparoscopy was required in only 0.6% of cases ($n = 3$), which was caused by bleeding from trocar wounds.

A comparative analysis of the length of hospitalisation revealed a significant advantage of the laparoscopic approach: the average hospital stay was 18.7 ± 1.2 days versus 29.1 ± 2.3 days in the laparotomy group ($p < 0.05$), which is equivalent to a reduction of almost a third. The clinical efficacy of laparoscopy was also significantly higher: positive outcomes were recorded in 54.2% of patients, while only 30.3% of patients had positive outcomes with traditional surgery. The mortality rate in the laparoscopic group was 12.1%, which is almost twice as low as in the laparotomy group (24.4%; $p < 0.05$). These data confirm that minimally invasive technologies provide not only a more favourable postoperative course, but also a significant improvement in outcomes.

The results obtained in the study demonstrate the clear advantages of laparoscopic techniques, which are in line with current global trends in abdominal surgery. The shorter hospital stay and reduced mortality observed in the main group are confirmed in international publications. A single-centre study by C. Valentin *et al.* [18], which included 41 patients with infected necrotising pancreatitis, used a step-up approach, involving the phased implementation of drainage, minimally invasive necrectomy and, if necessary, open interventions. The study demonstrated that such a strategy ensures resolution of the infection in 80.5% of patients with a mortality rate of 19.5% at six months and an acceptable level of long-term complications. In the present study, which compared laparoscopic and laparotomy interventions in 136 patients, the mortality rate in the laparoscopic group was noted to be 12.1% versus 24.4% in laparotomy, and the length of hospitalisation in the laparoscopic group was 35.7% shorter than in laparotomy, which confirms faster recovery of patients after minimally invasive surgery. Thus, despite the differences in design, the retrospective analysis of the step-up strategy in C. Valentin *et al.* and the comparative analysis of laparoscopic and laparotomy interventions in the present study, both sources confirm that minimally invasive techniques are associated with lower mortality, lower complication rates and more favourable clinical outcomes in the treatment of infected pancreatic necrosis.

The high frequency of combined laparoscopic aids (94.5%) in this study emphasises their comprehensive nature and adaptability to individual clinical scenarios. This approach correlates with the conclusions of a systematic review by P. Tang *et al.* [19] in which endoscopic and minimally invasive surgical approaches were compared. The study concluded that surgical approaches, including laparoscopy, may have advantages in extensive and multilocular forms of necrosis, which confirms

the feasibility of the combined aids used in the present study. Of relevance is the possibility of performing simultaneous interventions aimed to eliminate several pathological foci during a single operation.

The significant reduction in mortality in the laparoscopic group (12.1% vs. 24.4%) in the present study is also clinically relevant. At the same time, the data only partially correlate with the results of the meta-analysis by G. Wu *et al.* [20] in a comparison of the outcomes of minimally invasive surgery and endoscopic interventions in patients with infected necrotising pancreatitis. The study demonstrated that endoscopic therapy is associated with a lower incidence of postoperative complications, new organ failure and pancreatic fistula, while no significant differences were found in terms of hospitalisation duration and several other indicators. Thus, in contrast to the results of a study by G. Wu *et al.*, the present study demonstrated an advantage of minimally invasive surgical methods in terms of mortality, which emphasises the relevance of comparing data from different clinical strategies.

However, as with any surgical approach, laparoscopy is not without risks. In the present study, the conversion rate was 2.3%, which correlates with the range encountered in clinical practice. A prospective cohort study by G. Pavlek *et al.* [21], which compared the step-up strategy and open necrectomy in 60 patients with acute necrotising pancreatitis, demonstrated that the mortality rate with the minimally invasive approach was 20% versus 27.5% with open surgery ($p = 0.53$), and the morbidity and incidence of pancreatic failure were significantly lower in the step-up group. At the same time, the duration of hospitalisation and mortality rates did not differ significantly. In contrast to the results of a study by G. Pavlek *et al.* on the reduction of overall morbidity, the present study demonstrated a statistically significant advantage of laparoscopy in terms of hospital mortality (12.1% vs. 24.4%), which confirms the effectiveness of the minimally invasive approach in real clinical practice.

The problem of drainage failure, which in the present study was observed in 3.6% of patients and required revision interventions, is of great clinical importance. A comparative analysis performed by L. Chen *et al.* [22], based on a meta-analysis of 6 studies (247 patients), showed that endoscopic ultrasound drainage and percutaneous drainage of postoperative pancreatic fluid collections have comparable technical and clinical success rates, and do not differ in the frequency of recurrence and complications. The study concluded that both methods are equivalent in terms of efficacy and safety, with the need for further high-quality studies remaining relevant. Comparison of these data with the results of the present study emphasises that even with a low incidence of laparoscopic drainage failure (3.6%), this complication should be incorporated in the selection of treatment tactics and repeat intervention planning.

A substantial aspect of long-term outcomes was addressed in a study by C.L. van Veldhuisen *et al.* [10] on the analysis of the long-term results of immediate and delayed drainage in infected necrotising pancreatitis. The study did not find significant differences in survival between the groups, but noted that the strategy of delayed intervention, which is often implemented through minimally invasive approaches, was associated with a lower incidence of endocrine and exocrine pancreatic insufficiency in the long-term period. This demonstrates the importance of assessing not only the immediate results of treatment but also the long-term consequences that determine the quality of life of patients. Preservation of pancreatic function should be considered as one of the key indicators of treatment effectiveness.

Lastly, the overall clinical efficacy of laparoscopy, estimated at 54.2%, confirms its validity as the main treatment method. This result fits well with the concept proposed in the international guidelines by M. Podda *et al.* [9] that minimally invasive surgery is becoming a new standard for the treatment of complicated forms of acute pancreatitis, gradually replacing open surgery due to its proven benefits in reducing mortality and postoperative morbidity. A comprehensive approach to treatment, including not only the technical aspects of surgery, but also perioperative management, nutritional support and rehabilitation, deserves special attention.

Thus, the analysis of modern literature sources confirmed the main conclusions of this study and showed that the benefits of laparoscopy exceed the scope of reduction of the duration of hospitalisation and include mitigation of the systemic effects of surgical aggression, which is a promising area for further study. The integration of minimally invasive technologies into clinical practice requires not only mastering technical skills but also revising traditional approaches to timing of interventions and postoperative patient management.

Conclusions

The study achieved its primary objective by demonstrating the convincing advantages of the monotecnological laparoscopic approach in the treatment of acute pancreatitis compared to traditional laparotomy. The data obtained indicate that the introduction of minimally invasive techniques can dramatically improve key clinical outcomes. A statistically significant reduction in hospitalisation by almost 10 days, a twofold reduction

in mortality, and a lower incidence of postoperative complications support the hypothesis of higher efficiency and safety of laparoscopy. These results directly correlate with the objectives and prove that minimally invasive surgery provides not only technical feasibility but also significant clinical superiority.

The key success factors identified in the study were minimal surgical trauma, the ability to perform combined interventions due to limited access, and, as a result, accelerated patient recovery. This emphasises the role of laparoscopy not only as an alternative method, but also as the preferred first choice tactic in stable patients with localised forms of destructive pancreatitis. The practical value of the results obtained is the formation of a reliable evidence base to justify the widespread introduction of monotecnological laparoscopic interventions into clinical algorithms for the management of patients with acute pancreatitis. The implementation of this approach will optimise the resource costs of the hospital and improve the quality of medical care at the hospital.

However, the study also revealed certain limitations of the method that require a balanced approach. The need for conversion to laparotomy and the risk of drainage failure, although observed in a small percentage of cases, indicate the critical importance of careful preoperative patient selection based on a comprehensive clinical and radiological assessment. This necessitates the development and validation of prognostic algorithms and criteria to minimise intra- and postoperative risks.

Prospects for further research include the organisation of multicentre randomised controlled trials to obtain more representative data on long-term outcomes and quality of life. In addition, the issues of standardising drainage techniques, determining the optimal time windows for intervention at different stages of the disease, and developing integrated prognostic models to personalise surgical tactics require in-depth study.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Аннотация. Курч панкреатит өлүмдүн жогорку деңгээли жана татаалдануу тобокелдигине байланыштуу шашылыш хирургиянын эң актуалдуу көйгөйлөрүнүн бири бойдон калууда, бул коопсуз жана эффективдүү хирургиялык технологияларды издөө зарылдыгын аныктайт. Бул изилдөөнүн максаты курч панкреатит менен ооруган бейтаптардагы салттуу лапаротомиялык операциялар менен салыштырганда монотехнологиялык лапароскопиялык кийлигишүүлөрдүн натыйжалуулугун жана коопсуздугун салыштыруу болгон. Изилдөөгө 136 бейтап эки топко бөлүнгөн: негизги топ ($n = 74$), анда лапароскопиялык ыкмалар колдонулган; көзөмөл тобу ($n = 62$), анда лапаротомиялык операциялар жасалган. Ретроспективдүү-проспективдүү долбоор колдонулган, клиникалык жана лабораториялык параметрлер, инструменталдык визуализация ыкмалары жана айырмачылыктардын ишенимдүүлүгүн баалоо менен статистикалык иштетүү колдонулган. Алынган натыйжалар лапароскопиянын айкын артыкчылыгын көрсөттү. негизги топтун ооруканага орточо узактыгы (контролдоо тобунда 29.1 ± 2.3 күн каршы 18.7 ± 1.2 күн, $p < 0.05$) кыйла кыска болгон. Өлүм дээрлик эки эсе төмөн болгон (12.1% га каршы 24.4%), ошондой эле операциядан кийинки татаалдашуулардын жыштыгы да кыйла төмөн болгон. Лапароскопиянын кошумча артыкчылыктары анын минималдуу травмасы, айкалыштырылган манипуляциялардын мүмкүнчүлүгү жана пациенттердин тезирээк сакайып кетиши болгон. Ошол эле учурда, белгилүү бир тобокелдиктер, атап айтканда, дренаждын бузулушу жана $2,3\%$ учурларда конверсиянын зарылдыгы белгиленди, бул пациентти катуу тандоонун маанилүүлүгүн баса белгилейт. Изилдөөнүн практикалык мааниси курч панкреатитти хирургиялык дарылоодо лапароскопиялык технологиялардын кеңири жайылышын негиздөөдө турат. Аларды колдонуу ооруканага жаткыруу мөөнөтүн бир топ кыскартууга, татаалданууну жана өлүмдүн деңгээлин төмөндөтүүгө жана клиникалык натыйжаларды жакшыртууга мүмкүндүк берет, бул лапароскопияны бул патология үчүн артыкчылыктуу тактикага айлантат.

Негизги сөздөр: минималдуу инвазивдик хирургия; панкреатикалык некроз; операциядан кийинки татаалдашуу; дренаж; хирургиянын конверсиясы; реабилитация; сезгенүү татаалдыктар

Сравнительная эффективность монотехнологичных лапароскопических и традиционных лапаротомных вмешательств при остром панкреатите: анализ клинических исходов

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Аннотация. Острый панкреатит продолжает оставаться одной из наиболее актуальных проблем неотложной хирургии ввиду высокой летальности и риска осложнённого течения, что определяет необходимость поиска более безопасных и эффективных хирургических технологий. Целью настоящего исследования являлся сравнительный анализ эффективности и безопасности монотехнологичных лапароскопических вмешательств по сравнению с традиционными лапаротомными операциями у пациентов с острым панкреатитом. В исследование были включены 136 пациентов, распределённых на две группы: основная ($n = 74$), в которой были выполнены лапароскопические вмешательства; контрольная ($n = 62$), в которой проводились лапаротомные операции. Применялся ретроспективно-проспективный дизайн, использовались клинико-лабораторные показатели, инструментальные методы визуализации и статистическая обработка с оценкой достоверности различий. Полученные результаты выявили явное преимущество лапароскопии. Средняя продолжительность госпитализации в основной группе была существенно меньше ($18,7 \pm 1,2$ дня против $29,1 \pm 2,3$ дня в контрольной, $p < 0,05$). Летальность оказалась почти вдвое ниже ($12,1\%$ против $24,4\%$), а частота послеоперационных осложнений также была достоверно меньше. Дополнительными преимуществами лапароскопии стали её минимальная травматичность, возможность комбинированных манипуляций и более быстрое восстановление пациентов. В то же время отмечены определённые риски, в частности несостоятельность дренирования и необходимость конверсии в $2,3\%$ случаев, что подчёркивает значимость строгого отбора больных. Практическое значение исследования заключается в обосновании широкого внедрения лапароскопических технологий в хирургическое лечение острого панкреатита. Их использование позволяет существенно сократить длительность госпитализации, снизить показатели осложнений и смертности, а также улучшить клинические исходы, что делает лапароскопию предпочтительной тактикой при данной патологии.

Ключевые слова: минимально инвазивная хирургия; панкреонекроз; послеоперационные осложнения; дренирование; конверсия операции; реабилитация; воспалительные осложнения