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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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