

ECONOMIC AND CLINICAL BENEFITS OF DELAYED AND MINIMALLY INVASIVE SURGERY IN NECROTIZING ACUTE PANCREATITIS

Akhmedov Shukhrat Khayrullo ugli
Department of Surgical Diseases No. 2
Samarkand State Medical University

Abstract. Analysis was performed on the cost-effectiveness of introducing minimally invasive interventions for acute severe non-biliary pancreatitis. The cost of a completed case for patients treated with laparoscopy, bursoomentoscopy, and retroperitoneoscopy with placement of an originally designed drainage was compared to similar costs for patients who underwent traditional open surgeries. It was found that the adoption of minimally invasive techniques leads to a reduction in the cost of surgery from 62.8 thousand rubles to 44.3 thousand rubles, the cost of hospital stay from 151.3 thousand rubles to 104.2 thousand rubles, the cost of drug therapy from 129.5 thousand rubles to 79.6 thousand rubles (largely due to a significant decrease in the need for expensive reserve antibiotics), the cost of laboratory and instrumental diagnostics from 46.5 thousand rubles to 33.6 thousand rubles, as well as a reduction in rehabilitation costs from 19.4 thousand rubles to 15.5 thousand rubles.

Keywords: minimally invasive techniques; acute severe pancreatitis treatment; cost of treatment; cost-effectiveness analysis

ЭКОНОМИЧЕСКАЯ И КЛИНИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ОТСРОЧЕННЫХ И МАЛОИНВАЗИВНЫХ ХИРУРГИЧЕСКИХ ВМЕШАТЕЛЬСТВ ПРИ ОСТРОМ ДЕСТРУКТИВНОМ ПАНКРЕАТИТЕ

Ахмедов Шухрат Хайрулло угли
Кафедра хирургических болезней №2
Самаркандский государственный медицинский университет

Аннотация. Проведён анализ экономической эффективности внедрения малоинвазивных вмешательств при лечении острого тяжёлого небилиарного панкреатита. Стоимость законченного случая у пациентов, которым проводились лапароскопия, бурсооментоскопия и ретроперитонеоскопия с установкой оригинального дренажного устройства, была сопоставлена со стоимостью лечения пациентов, перенёвших традиционные открытые операции. Установлено, что внедрение малоинвазивных технологий позволяет

снизить стоимость оперативного вмешательства с 62,8 тыс. руб. до 44,3 тыс. руб., стоимость пребывания в стационаре — со 151,3 тыс. руб. до 104,2 тыс. руб., стоимость медикаментозной терапии — со 129,5 тыс. руб. до 79,6 тыс. руб. (в основном за счёт существенного уменьшения потребности в дорогостоящих антибиотиках резерва), стоимость лабораторно-инструментальной диагностики — с 46,5 тыс. руб. до 33,6 тыс. руб., а также снизить затраты на реабилитацию с 19,4 тыс. руб. до 15,5 тыс. руб.

Ключевые слова: малоинвазивные технологии; лечение тяжёлого панкреатита; стоимость лечения; анализ экономической эффективности

Relevance. Acute pancreatitis (AP) is one of the most common emergency pathologies of the gastrointestinal tract [5, 7]. Recent studies under the auspices of the WHO note a continuous increase in the annual incidence of acute pancreatitis worldwide, ranging from 4.9 to 73.4 cases per 100,000 population [6, 8]. The costs of treating patients with acute severe pancreatitis are very high. For example, in the United States in 2007, 2.6 billion dollars were spent on the diagnosis and treatment of acute pancreatitis [5]. In our country, according to Yu.I. Ivanov, the average cost of treating one patient with a confirmed diagnosis of pancreonecrosis in a hospital setting is 1.2–1.5 million rubles, and “for a patient with severe pancreonecrosis in the ICU for one month, no less than 2 million rubles is expended” [1]. Thus, the costs of treating patients with infected pancreonecrosis in its clinical manifestations (retroperitoneal phlegmon, purulent peritonitis, etc.) remain high and urgently demand new, effective, and low-cost treatment methods.

The aim of the study was to examine the cost-effectiveness of introducing minimally invasive interventions in acute severe non-biliary pancreatitis.

Materials and Methods. To assess the economic impact of implementing minimally invasive procedures, we analyzed the average treatment costs for ten patients hospitalized at the Zlatoust Railway Hospital (Russian Railways) with acute severe pancreatitis complicated by pancreonecrosis and retroperitoneal necrosis (research group). These patients were treated using laparoscopic lavage of the abdominal cavity, bursoomentoscopy, and retroperitoneoscopy with our proposed retroperitoneoscopy device and an originally designed drainage system [2, 3, 4]. We compared their treatment costs with the average costs of treating nine patients with comparably severe acute pancreatitis and complications (comparison group) who were managed with traditional open surgical interventions.

For classification of medications, we utilized the international Anatomical Therapeutic Chemical (ATC) system. For certain groups of drugs, we calculated the Defined Daily Dose per 100 bed-days. The Defined Daily Dose (DDD) is the standard daily dosage of a drug used for its main indication as maintenance therapy.

Results and Discussion. The average duration of the initial surgery in the comparison group (open surgery) was 2.11 hours, whereas in the research group the average duration of the initial laparoscopic sanitation was 1.8 hours. Subsequently, the mean duration of each repeat relaparotomy in the comparison group was 1.5

hours, while the repeat laparoscopic re-lavages in the research group lasted on average 1 hour each. (In two patients of the research group, conversion to open laparotomy and relaparotomy was required.) The average cost of the initial operation plus any subsequent surgical interventions in the minimally invasive group was 18,968 rubles and 25,408 rubles, respectively, compared to 30,360 rubles and 32,449 rubles for patients treated by traditional open surgeries. The overall economic benefit for surgical treatment cost in the minimally invasive group amounted to 18,433 rubles saved per patient. The cost of a stay in the surgical department of the Zlatoust hospital is 1,539 rubles per bed-day, and the cost of a stay in the intensive care unit is 4,458 rubles per bed-day. The average length of stay for patients treated with minimally invasive methods was 16.0 ± 3.4 days in ICU and 21.4 ± 1.7 days in the regular surgical ward. In the patients who underwent traditional open operations, these durations were 22.2 ± 3.6 bed-days in ICU and 33.9 ± 3.4 bed-days in the ward, i.e. almost 1.5 times longer than in the research group. As a result of the reduced length of hospital stay, the introduction of minimally invasive techniques led to a decrease in the total cost of hospitalization per case from 151,296 rubles to 104,213 rubles, yielding a savings of about 47,000 rubles per patient.

When analyzing the structure of expenditures on various aspects of drug therapy, we found that the overall consumption of antibiotics in the research group was 119 DDD/100 bed-days, which is almost the same as in the comparison group (117 DDD/100 bed-days). However, the average cost of a daily dose of an antibacterial drug in the comparison group was 602 rubles per day, which is nearly three times higher than in the research group (209 rubles per day). In **Figure 1**, we illustrate the average consumption of different classes of antibiotics in both groups, ordered by increasing cost of a daily dose. As shown, the majority of antibiotic needs are covered by the use of 3rd-generation cephalosporins (cefotaxime), 4th-generation cephalosporins (cefepime), and imidazole derivatives (metronidazole). The consumption of these drugs is 16.4, 19.8 and 27.8 DDD/100 bed-days, respectively, with a daily dose cost of 46–411 rubles. However, in patients operated on with the traditional open approach, there often arises a need to use expensive reserve antibiotics such as carbapenems, fluoroquinolones, monobactams, and fosfomycin, costing 2,245–5,248 rubles per daily dose, due to the development of resistant flora. This is caused by the presence of a large open wound in the abdominal wall for a long time and the frequent development of postoperative complications. The need for these high-cost antibiotics in the open surgery group leads to a sharp increase in the cost of antibiotic therapy from 24,873 rubles per patient in the minimally invasive group to 70,524 rubles in the open surgery group.

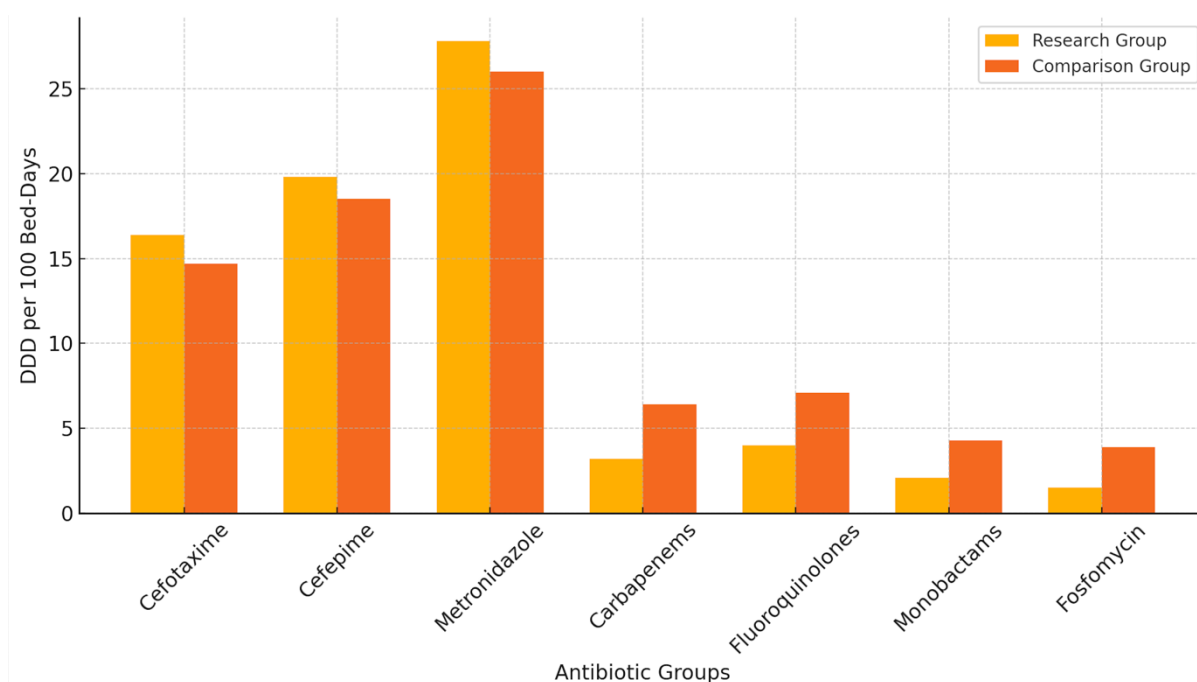


Figure 1. Average consumption of different groups of antibiotics (in DDD per 100 bed-days) in the research and comparison groups, ordered by increasing cost of a daily dose of the drug.

Expenditures on pain management after the introduction of minimally invasive methods were reduced by 664 rubles per patient. In particular, the total cost of anesthetic agents was reduced from 558.7 ± 172.3 rubles to 300.5 ± 80.5 rubles per patient. The number of doses of narcotic analgesics from various chemical classes required per patient decreased from 18.5 ± 4.8 doses (comparison group) to 9.6 ± 1.7 doses (research group). Correspondingly, the costs for analgesics fell from 279.2 ± 93.98 rubles to 162.5 ± 34.9 rubles per patient. The total volume of infusion therapy administered was 38.6 liters per patient in the minimally invasive group versus 49.7 liters per patient in the comparison group. The volume of amino acid solutions and fat emulsions given was 6.1 liters per patient in the research group and 8.9 liters per patient in the comparison group. The costs of infusion therapy amounted to 4,546 rubles in the research group and 5,742 rubles in the comparison group, while the costs of parenteral nutrition were 3,631 rubles and 5,261 rubles, respectively. This resulted in a combined savings of 2,826 rubles per patient in the minimally invasive group. The expenses for blood products and blood components were similar in both groups (16,555 rubles vs 16,222 rubles, research vs comparison). Notably, the need for red blood cell transfusions in the research group was almost 1.5 times less than in the comparison group. The above figures, as well as expenditures for other areas of drug therapy, consumable materials, and wound care supplies, are summarized in Figure 2. In summary of the above data, it should be noted that the largest share of drug therapy costs comes from antibacterial drugs, which is exactly where the most significant savings are observed when switching to minimally invasive methods of treatment (see Figure 2). One reason for this is the absence of a large anterior abdominal wall incision that must be left open with moist-

to-dry gauze dressings. Such an open wound, on one hand, contributes to contamination of the air with micro-particles of dried exudate containing large numbers of microorganisms, and on the other hand, serves as an entry point for infection by resistant and nosocomial strains of microbes.

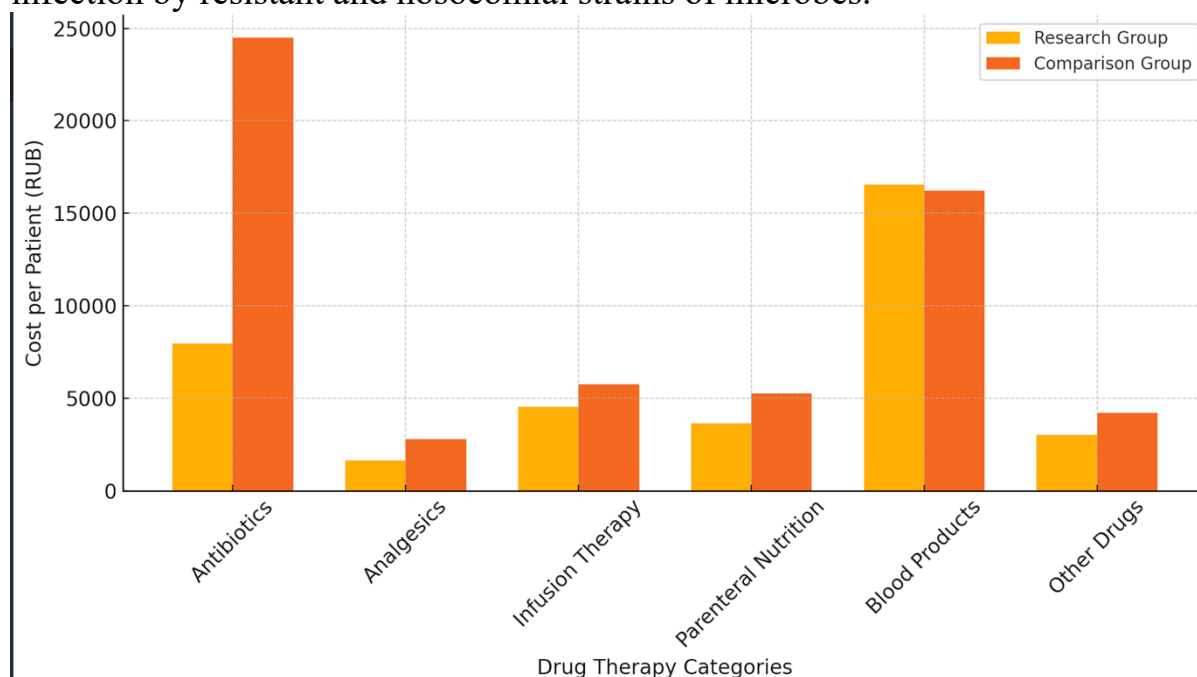


Figure 2. Breakdown of drug therapy costs per patient in the research and comparison groups

Analyzing the costs of laboratory and instrumental diagnostics revealed that patients in the comparison group, having a significantly higher rate of postoperative complications after open surgeries, incurred additional expenses for laboratory and imaging studies during hospitalization (46,570 rubles in the comparison group versus 33,626 rubles in the research group). Moreover, in the research group, some follow-up studies (repeat MRI, CT scans) were performed after hospital discharge during outpatient follow-up, which reduced the financial burden on the hospital. The total savings in funds spent on diagnostic methods due to the implementation of minimally invasive techniques was 12,945 rubles per patient.

The cost of a single rehabilitation course after acute severe pancreatitis is 9,473.64 rubles. In the comparison group, all patients underwent two rehabilitation courses (3–12 months post-illness). In the research group, some patients did not require a second rehabilitation course; the average number of rehabilitation courses was 1.6 per patient. The average cost of rehabilitation in the research group was 15,480.02 rubles, which is 4,004.26 rubles less than in the comparison group, where the average rehabilitation cost was 19,484.28 rubles.

Thus, the introduction of minimally invasive treatment methods yields a pronounced economic benefit. The average total cost of treatment per patient with minimally invasive interventions was 277,353 rubles, whereas the average cost with open surgical interventions was 409,679 rubles, i.e. 132,326 rubles higher than in the minimally invasive group (Figure 3).

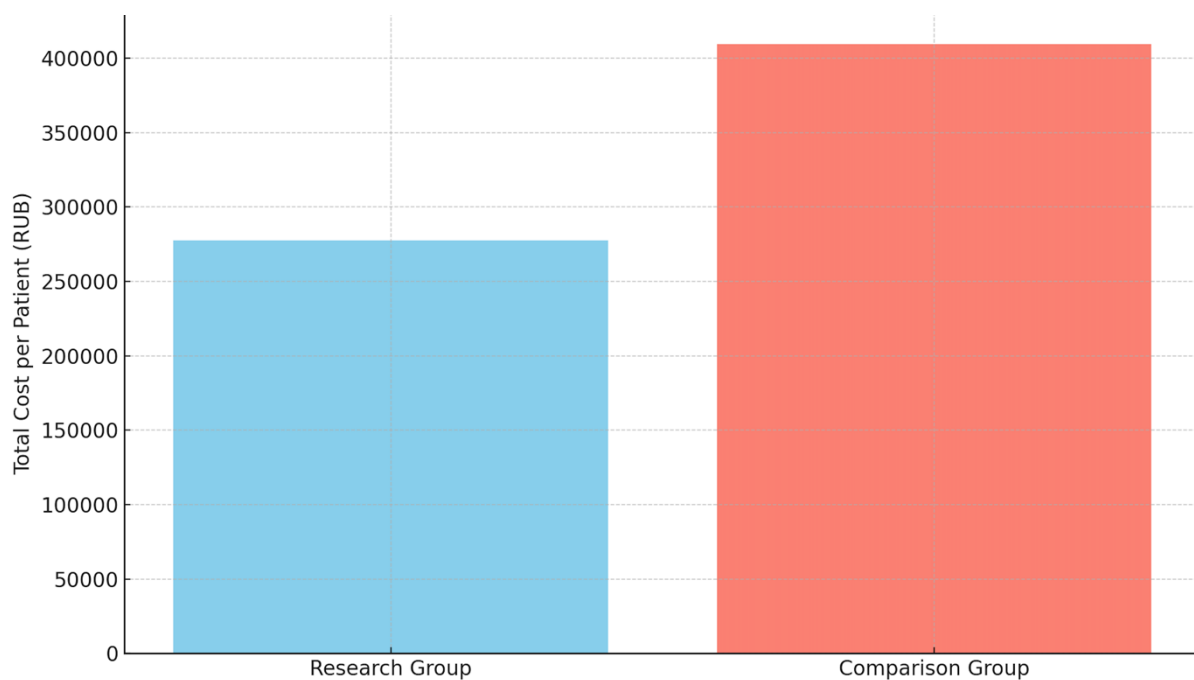


Figure 3. Total cost of treating one patient in the research and comparison groups

Conclusions

1. The use of minimally invasive techniques in comparison with traditional surgery leads to a reduction of hospital expenses from 409 thousand rubles to 277 thousand rubles for one completed case.
2. The most notable economic effect is achieved by reducing the costs of patient hospital stay (saving 47,083 rubles per patient) and reducing the costs of drug therapy (saving 49,860 rubles per patient).
3. The savings in funds spent on drug therapy are largely achieved by reducing the need to prescribe expensive reserve antibiotics (carbapenems, fluoroquinolones, monobactams, and fosfomycin) costing 2,245–5,248 rubles per daily dose. As a result, the average cost of a daily dose of antibiotics in the research group (209 rubles/day) is almost three times lower than in the comparison group (602 rubles/day), and the economic savings on antibacterial therapy amount to approximately 45,650 rubles per patient.

References

1. Ivanov, Y.I. How to Break the Vicious Circle? Available at: <http://pancreonecrosis.ru/kak-viyti-iz-zamknutogo-kruga/> (accessed October 11, 2014).
2. Bukhvalov, A.G., Shakirov, R.F., Bordunovskiy, V.N. Device for Retroperitoneoscopy – Utility Model Patent RUS 86085, issued January 12, 2009.
3. Bukhvalov, A.G., Bordunovskiy, V.N. Method for Surgical Treatment of Complicated Forms of Pancreonecrosis – Invention Patent RUS 2392020, issued January 19, 2009.

4. Bukhvalov, A.G., Shakirov, R.F., Bordunovskiy, V.N. Device for Treatment of Acute Destructive Pancreatitis – Utility Model Patent RUS 85340, issued January 12, 2009.
5. Fagenholz P.J. Increasing United States hospital admissions for acute pancreatitis, 1988–2003. *Ann. Epidemiol.* 2007; 17: 491–497.
6. Fagenholz P.J. Direct medical costs of acute pancreatitis hospitalizations in the United States. *Pancreas* 2007; 35: 302–307.
7. Peery A.E. Burden of gastrointestinal diseases in the United States: 2012 update. *Gastroenterology* 2012; 143: 1179–1187.
8. Yadav D., Lowenfels A.B. Trends in the epidemiology of the first attack of acute pancreatitis: a systematic review. *Pancreas* 2006; 33: 323–330.