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Features of diagnosis and surgical treatment of post–traumatic pancreatitis in gunshot wound of the pancreas at the stage of highly specialized medical care

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Abstracts

Objective. To analyze the peculiarities of diagnosis and treatment of posttraumatic pancreatitis at the stage of highly specialized surgical care in order to improve the results of treatment of gunshot wounds of the pancreas

Materials and Methods. The results of diagnosis and treatment of gunshot wounds of the abdominal cavity with pancreatic damage in 23 patients were analyzed. All patients were men of military age, their average age was (35.7± 12.8) years, and they sustained gunshot wounds of the abdominal cavity during military operations.

Results. At the stage of providing highly specialized medical care, all patients underwent surgical intervention for gunshot pancreatic injury. In 18 (78.3%) wounded, the course of post–traumatic pancreatitis was complicated by the development of destructive pancreatitis. All of these wounded underwent relaparotomy.

Conclusions. Gunshot trauma to the pancreas always results in post–traumatic pancreatitis, which has a latent course against the background of damage to other organs and is difficult diagnose and treat.

Keywords: gunshot wound of the pancreas; post–traumatic pancreatitis; highly specialized medical care.

In the overall structure of gunshot wounds to the abdominal cavity in wartime, the proportion of pancreatic injuries ranges from 3 to 8%. In isolated pancreatic injuries, the mortality rate is 3–9%, and in the presence of combined injuries it increases to 30–40%. Gunshot wounds to the pancreas are among the most severe abdominal injuries. This is explained, firstly, by the much greater traumatic force required to damage the pancreas, which is located in the retroperitoneal space, and secondly, by the complexity of the anatomical structure of the pancreas and the presence of large trunk vessels that can be easily injured and lead to active internal bleeding with the development of hemorrhagic shock [1–3].

The most serious complication of pancreatic injury is post–traumatic pancreatitis. According to scientific sources, this complication occurs in 80 to 100% of patients with gunshot wounds to the pancreas and has various morphological forms, from aseptic inflammation to infected pancreatic necrosis. Mortality in the case of this complication ranges from 17 to 32%. In wounds to the head of the pancreas, mortality is 2 times higher than in wounds to its body and tail [4]

The development of posttraumatic pancreatitis in gunshot wounds of the pancreas has its own peculiarities. Damage to the pancreas is accompanied by primary traumatic necrosis of its parenchyma with the development of a destructive inflammatory process as the main pathogenetic link in posttraumatic pancreatitis. The effect of a traumatic agent on the pancreas always causes a disruption of its blood supply, which leads to secondary destruction of the glandular parenchyma vessels. In most patients, the pancreatic duct system is damaged, which creates conditions for active enzymatic tissue destruction [5].

In the diagnosis of gunshot wounds of the pancreas, examination and revision of the wounds, as well as ultrasound examination (US), are prioritized to determine the penetrating nature of the injury. If the medical and tactical situation allows, diagnostic laparoscopy is preferred [6].

In wartime, the purpose of diagnosing pancreatic injury is to categorize the wounded according to the extent and type of surgical interventions required to provide emergency surgical care. This reduces the number of tactical errors. To choose a method of surgical intervention for pancreatic injury, it is necessary to first take into account its severity, not just the mechanism of its occurrence. However, most diagnostic classifications use the type of injury to stratify patients with gunshot wounds of the pancreas [7].

Victims with gunshot wounds to the pancreas usually have to be treated in a difficult medical and tactical situation, when the surgeon's main task is to save their lives. At the same time, the extremely serious condition of the patient, the complexity of intraoperative assessment of the severity of pancreatic injury and prediction of post–traumatic pancreatitis, a large number of different options for combining

injury to this organ with injuries to other organs make it difficult to choose the most rational method of surgical intervention. In view of the above, the problem of optimal surgical tactics in gunshot wounds of the pancreas forces surgeons to look for the most effective ways to solve it [8–10].

Thus, the increase in the number of gunshot wounds to the pancreas, high mortality rates and the lack of standardization of diagnosis and treatment of post–traumatic pancreatitis remain urgent problems of abdominal surgery.

The aim of the study is to analyze the features of diagnosis and treatment of post–traumatic pancreatitis at the stage of highly specialized surgical care in order to improve the results of treatment of gunshot wounds of the pancreas.

Materials and methods

The article analyzes the results of diagnosis and treatment of gunshot wounds of the abdominal cavity with pancreatic damage in 23 patients. All the victims were servicemen of the Armed Forces of Ukraine who were treated in the Vinnytsia Regional Clinical Hospital named after M. I. Pirogov and Military Medical Clinical Center of the Central Region in the period from 02/24/2022 to 09/01/2024.

Patient inclusion criteria: gunshot penetrating abdominal wound with peritoneal integrity violation by any type of firearm; appearance of a characteristic clinical picture of acute pancreatitis later than 1 day after the injury; visual signs of pancreatic injury during diagnostic laparotomy. Patients with decompensated comorbidities were not included in the study.

All the wounded were men of military age between 23 and 45 years old. The average age of the patients was (35.7± 12.8) years. All of them sustained gunshot wounds to the abdomen during hostilities.

Clinical examination and diagnosis of victims with gunshot wounds of the abdomen with pancreatic damage was carried out in accordance with the general principles of management of such patients, using laboratory tests, imaging, monitoring of the clinical picture and vital signs.

We chose the optimal surgical tactics and determined the scope of surgical intervention for each patient individually, taking into account the medical and tactical situation. The severity of the pancreatic injury and the mechanism of its occurrence were taken into account for surgical intervention.

Methods of parametric and non–parametric analysis were used for statistical data processing, Microsoft Office Excel 2021 was used to collect and process the results, and BioStat was used for statistical analysis.

The nominal data were described as absolute values and percentages and compared using Pearson's χ^2 test of consistency.

Results

Gunshot wound of the pancreas in mine–blast wounds was present in 19 (82.6%) patients; in shrapnel wounds – in 3 (13.0%), and in bullet wounds – in 1 (4.3%).

In 12 (52.2%) patients there were multiple abdominal injuries, in 10 (43.5%) – combined. In 7 (30.4%) patients, the abdominal trauma was combined with chest trauma, in 2 (8.7%) – with musculoskeletal trauma, and in 1 (4.3%) – with craniocerebral trauma. An isolated trauma was noted only in 1 (4.3%) patient with a gunshot wound

One abdominal organ was injured in 1 (4.3%), two organs in 7 (30.4%), three organs in 9 (39.1%), four organs in 5 (21.8%), and five organs in 1 (4.3%).

The most commonly damaged parts of the abdominal cavity in multiple gunshot wounds with pancreatic injury were the intestinal mesentery (47.8%), stomach (34.8%), and duodenum (30.4%) (*Table 1*).

All the wounded were taken to the hospital with signs of traumatic shock. 8 (34.8%) patients were diagnosed with traumatic shock of the first degree, 12 (52.2%) with the second degree, and 3 (13.0%) with third degree

The American Association for the Surgery of Trauma (AAST) organ damage scale was used to assess the severity of pancreatic injury. Patients were divided according to the

Table 1. **Frequency of damage to other organs in case of multiple gunshot trauma with damage to the peritoneum**

Damaged organ	Number of patients	
	abs.	%
SOFTWARE.	23	100
Mesentery of the intestine (including mesenteric vessels)	11	47,8
Stomach	8	34,8
Duodenum	7	30,4
Liver	5	21,7
Colon	3	13,0

Table 2. **Distribution of wounded by the severity of the software damage according to the AAST scale**

Severity of software damage	Number of patients	
	abs.	%
I	9	39,1
II	7	30,4
III	4	17,4
IV	2	8,7
V	1	4,3
In total ...	23	100

Table 3. **Frequency of complaints and in patients with gunshot wounds of the abdominal cavity with damage to the pancreas**

Complaints and symptoms	Number of patients	
	abs.	%
Pain in the abdomen	23	100
General weakness	21	91,3
Dizziness	17	73,9
Nausea	13	56,5
Vomiting.	10	43,5
Difficulty in breathing	6	26,1

severity of pancreatic injury (*Table 2*). The vast majority – 16 (69.6%) – were wounded with I and II degrees of severity of pancreatic injury. In 1 (4.3%) patient with pancreatic injury of V severity, there was a massive destruction of its head.

The localization of pancreatic injuries was also analyzed. In 4 (17.4%) patients, the head of the pancreas was damaged, in 1 (4.3%) – the neck, in 14 (60.9%) – the body, and in 4 (17.4%) – the tail. Most often, the body and head of the pancreas were damaged – in 18 (78.3%) patients

No specific complaints and symptoms were noted in victims with gunshot wounds to the pancreas at the time of hospitalization. Complaints of generalized weakness, dizziness, nausea, and pain throughout the abdomen and in the upper abdomen prevailed *(Table 3)*

In addition to the mandatory laboratory parameters, the level of α–amylase in the blood of all wounded was studied. The baseline level of α–amylase was elevated in 5 (21.7%) wounded. In the postoperative period, an increase in the level of α–amylase in the blood was noted in 19 (82.6%) wounded.

Ultrasound was performed to detect injuries to the abdominal organs. direct pathological changes in the structure of the pancreas were detected. An indirect sign of damage to internal organs, such as the presence of free fluid around the pancreas, was diagnosed in 11 (47.8%) of the wounded. In another 9 (39.1%) victims, ultrasound revealed a hematoma in the parapancreatic tissue. In 6 (26.1%) patients, non–tension hematomas of medium size (up to 40 ml) were diagnosed, and in 3 (13.0%) – large tension hematomas (over 40 ml)

The sensitivity of ultrasound in gunshot wounds of the pancreas was 59.1%. It was impossible to determine the specificity of ultrasound in this study because the sample consisted exclusively of patients with gunshot wounds of the pancreas.

Multislice computed tomography (MSCT) of the abdominal cavity was performed in 17 (73.9%) patients at the stage of highly specialized medical care. The sensitivity of MSCT in gunshot wounds of the pancreas was 83.6%. The direct signs of pancreatic injury were intense bleeding, hematoma (*Fig. 1*) or tear (*Fig. 2*), and indirect signs were fluid accumulation in the retroperitoneal space and parapancreatic edema.

Primary surgical treatment within 3 hours of injury was performed on 9 (39.1%) wounded; from 3 to 6 hours – on 7 (30.4%), from 6 to 12 hours – on 5 (21.7%), from 12 to 24 hours – on 1 (4.3%), and over 24 hours – on 1 (4.3%).

Laparotomy was performed on urgent grounds in 6 (26.1%) wounded with signs of penetrating abdominal wounds and unstable hemodynamics, as well as in 3 (13.1%) wounded with severe signs of peritonitis and entering abdominal organs. In other patients, a minimal range of diagnostics was performed for evacuation to a highly specialized surgical center.

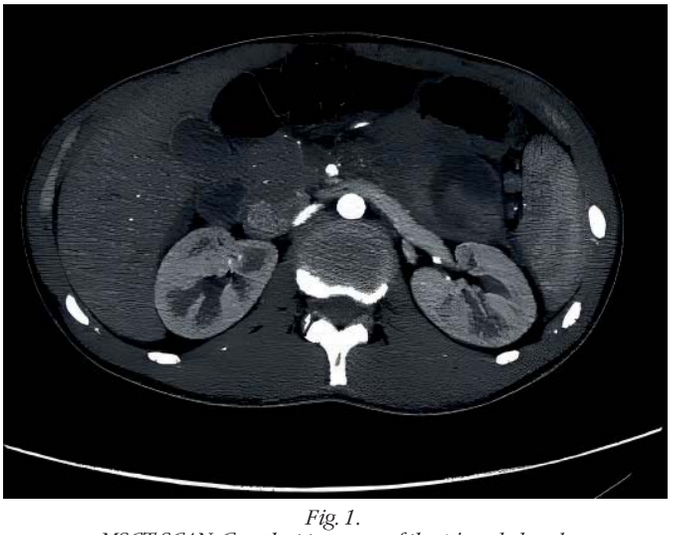

Fig. 1.
MSCT SCAN. Gunshot trauma of the pineal gland. Increased head size and fluid accumulation in the parapancreatic tissue (during surgical hematoma in the area of the head and neck of the pancreas was detected during surgery).

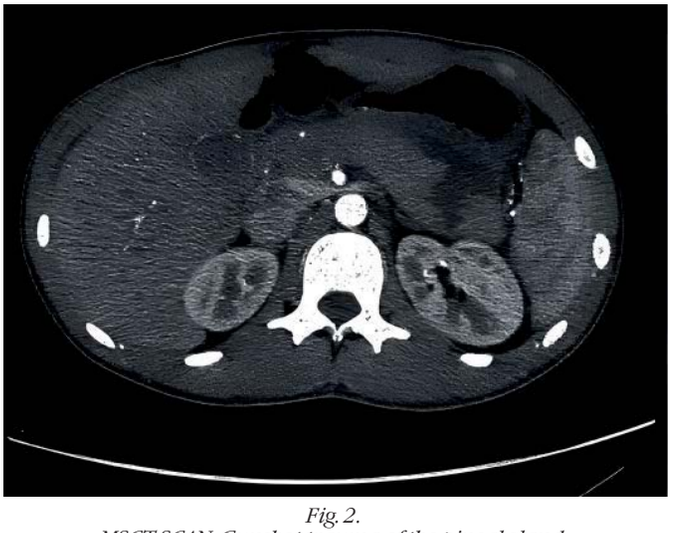

Fig. 2.
MSCT SCAN. Gunshot trauma of the pineal gland. Distal parenchymal rupture with ductal damage.

Given that the initial surgical intervention was performed at the stage of qualified medical care, the main task at the stage of highly specialized surgical care was to eliminate life–threatening consequences of the wound and prevent the development of purulent and septic complications. At this stage, all patients underwent surgical intervention for gunshot wounds of the abdominal cavity with damage to the pancreas. After the revision of the omental sac, 19 (82.6%) of the wounded underwent surgical intervention on the pancreas: suturing of the pancreatic capsule in 9 (39.1%) of the wounded, distal resection of the pancreas in 7 (30.4%), hemostatic suturing in 2 (8.7%), and pancreaticoduodenal resection in 1 (4.3%).

At the stage of highly specialized surgical care, 17 (73.9%) patients were diagnosed with hemoperitoneum without bleeding. They additionally underwent hemostasis of superficial pancreatic wounds by electrocoagulation, blood aspiration, and drainage of the abdominal cavity for dynamic observation. The volume of hemoperitoneum was (278.1± 48.8) ml. Another 3 (13.0%) patients were diagnosed with unstable hemostasis. Combined hemostatic methods were used to stop the bleeding completely.

In 18 (78.3%) of the wounded, the course of post–traumatic pancreatitis was complicated by the development of destructive pancreatitis. All of them underwent relaparotomy. Abdominoplasty with drainage of the omental sac and necrosectomy was performed in 18 (78.3%) wounded, drainage of omental abscesses with removal of drains in the left lumbar region – in 4 (17.4%), drainage of parapancreatic abscesses – in 3 (13.0%). The need for a sanitation programmed relaparotomy arose in 6 (26.1%) of the wounded.

In the postoperative period, active infusion and antibacterial therapy was performed. Sanitation of the omental sac and drains was performed 2 times a day until clean flush water was obtained. The drains were removed after 3 to 5 days if there was no discharge from them.

No intraoperative complications were observed in patients. In the postoperative period, the most common wound complications of an inflammatory nature were the formation of seromas, infiltrates and hematomas.

Among all patients with post–traumatic pancreatitis, 1 (4.3%) died, the cause of death was very severe combined trauma.

Discussion

Gunshot wounds to the pancreas sustained during hostilities are complicated by the development of post–traumatic pancreatitis. The incidence of gunshot wounds the pancreas during hostilities does not tend to decrease and is about 5%; more common is pancreatic injury in combination with damage to other organs [11]. According to our data, the incidence of isolated gunshot wounds of the pancreas was 4.3%

The most significant result of this study is that all patients who underwent staged surgical treatment of post–traumatic pancreatitis at the stage of highly specialized medical care had improved long–term outcomes after laparotomy. Thus, a staged surgical approach reduces mortality in patients with gunshot wounds of the abdominal cavity in polytrauma. This is consistent with published data showing that the recovery rate increased in the case of staged laparotomy in patients with severe gunshot traumatic injuries of the pancreas [12].

Only a small number of studies have examined the impact of highly specialized surgical care on long–term outcomes. Most authors focus on indicators such as the frequency of readmission or the ability to resume professional work and daily activities.

Today, one of the key factors in reducing mortality is the search for and use of methods to reduce the incidence of complications (including post–traumatic pancreatitis) and thus improve the overall results of treatment.

Conclusions

1. Gunshot trauma to the pancreas is always complicated by the development of post–traumatic pancreatitis with a latent course against the background of damage to other organs, has no specific clinical signs and is difficult diagnose

2. In a patient with a gunshot wound of the pancreas delivered in the first days after the injury, during the instrumental examination, attention should be paid to heterogeneous inclusions in the organ parenchyma, which may indicate a hematoma or rupture

3. In case of a penetrating gunshot wound of the abdomen, a thorough revision with a wide opening of the omental sac is necessary to exclude damage to the pancreas

4. At the stage of providing qualified medical care, surgical tactics depend on the severity of the pancreatic injury. At I–III degrees, organ–preserving treatment of the pancreas with hemostasis by stitching bleeding vessels is indicated, at IV degree – distal resection of the pancreas

5. At the stage of highly specialized surgical care in case of purulent–destructive complications of post–traumatic pancreatitis, necrosequestrectomy with subsequent adequate drainage of the omental sac and abdominal cavity is optimal.

Ethical aspects. All procedures performed in the study involving patients complied with ethical standards for clinical practice and the 1964 Declaration of Helsinki, as amended.

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ysis of the results; Martsynkovsky IP – literature review, writing the text; Romanchuk VD – collection of material; Verba MA – literature review, analysis of the results, preparation of the text, design of illustrations.

Conflict of interest. The authors who contributed to this study have declared that they have no conflicts of interest in relation to this article.

Consent for publication. All authors have read and approved the final version of the article and agreed to its publication

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