



# Attainment Experience with Damage Control Surgery for Severe Pancreatic Trauma: 2 Case Reports

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## Abstract

**Background:** Pancreatic injury is relatively uncommon in abdominal trauma, and severe pancreatic injury is even rarer. Previous management strategies have changed on the basis of various factors, such as the precise site of injury, the degree of injury to the main pancreatic duct, and the time interval between diagnosis and intervention. We report two cases of successful simple one-stage repair and drainage. Even though the main pancreatic duct was transected, the pancreas was preserved without special treatment such as stent placement.

**Case Report:** In one case, a 46-year-old woman was injured by an iron mold while working in a factory. She was conscious and had marked epigastric tenderness and was referred to our hospital 3 h later. The other patient was a 27-year-old young man who was rushed to our hospital because of a car accident. He was already delirious, and his vital signs were unstable.

**Conclusion:** Therefore, early diagnosis and assessment of the integrity of the main pancreatic duct are necessary, and damage control surgery is undoubtedly the best choice for such severe pancreatic injuries. Based on our experience in the treatment of two patients with severe pancreatic injury, this paper intends to consider and analyze the significance of damage control surgery for severe pancreatic injury. And explore its advantages and disadvantages in the diagnosis and treatment of severe pancreatic injury, with a view to improving the level of surgical treatment for pancreatic injury.

**Keywords:** Severe pancreatic trauma; Damage control surgery; AAST-OIS

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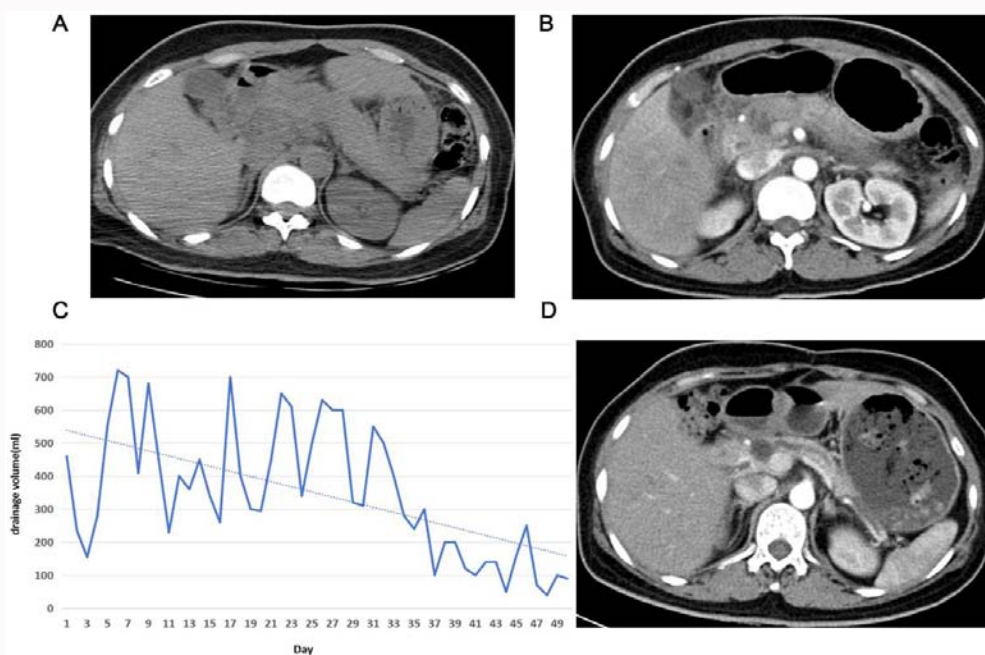
## Introduction

Pancreatic injury is a rare but potentially fatal severe organ injury, accounting for about 1% to 2% of clinical abdominal organ injuries [1]. Due to the small number of cases, low incidence, as well as its special anatomical structure and physiological function, it is not easy to diagnose the disease before surgery, easy to miss the diagnosis during surgery, and many postoperative complications, which inevitably leads to the continuous increase of mortality. Especially for severe pancreatic injury above AAST-OIS grade III [2], the mortality rate can be greatly increased to 30% due to the involvement of the main pancreatic duct injury [3].

Damage Control Surgery (DCS) has been developed for the rapid control of massive bleeding and contamination caused by severe physiological injuries [4]. With the continuous improvement of the concept of damage control, more and more scholars have questioned whether damage control surgery can be more widely used in various diseases and various stages of the disease [5]. Experts have made practice for this, and it has proved that there is still a lot of space for the application of damage control surgery [6].

## Case Presentation

A 46-year-old female, who was admitted to the hospital due to abdominal pain in the upper and middle abdomen caused by trauma for more than three hours. CT scan at 5 h after injury (Figure 1A) showed pancreatic contusion with blurred fat space around, and conservative treatment was given. Forty-four hours after injury, the abdominal pain worsened. Blood amylase 1191 U/L $\uparrow$ , blood lipase 647 U/L $\uparrow$ . Re-examination of abdominal enhanced CT (Figure 1B) showed contusion and laceration of the neck of the pancreas, possibly incomplete disconnection, and massive intra-abdominal fluid collection. Emergency laparotomy was performed, and during the operation: The amount of light bloody exudate in the abdominal cavity was about 1000 ml, and the abdominal

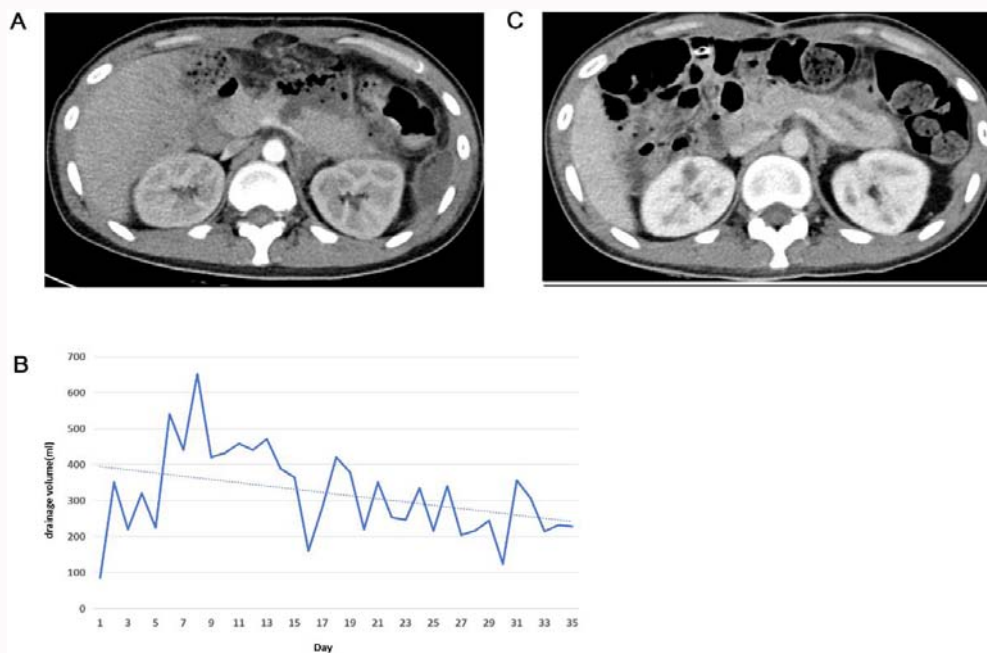


**Figure 1:** The pancreas was swollen and the peripancreatic fat space was blurred (A). The neck of the pancreas was contusion and laceration, and there may be incomplete separation (B). The change of drainage volume of peri-pancreatic drainage tube with time and its trend line after surgery (C). Pseudocyst formation in the head of the pancreas and dilatation of the distal pancreatic duct (D).

tissue was extensively edema, which was the most serious around the duodenum, around the hepatic flexure of the colon and behind the peritoneum, and "saponification spots" were seen in the peritoneum. The posterior half of the junction of the pancreatic head and neck was separated, and the surrounding tissue was seriously contusion, and the tissue was edema, crisping, and pancreatic juice leakage was seen. Double tubes and negative pressure balloon irrigation and drainage were placed in the pancreatic fracture during the operation. On the fourth day after the operation, blood amylase 131 U/L, blood lipase 124 U/L, and amylase 29796 U/L in the drainage tube of the lower edge of the pancreas were reexamined. Incomplete rupture of the pancreas and pancreatic juice leakage was considered. Irrigation and drainage were continued, and necrotic tissue was cleaned through the irrigation tube (Figure 1C). The leakage volume was gradually reduced, and the patient was discharged with a tube. Five months after operation, contrast-enhanced CT (Figure 1D) showed the formation of pseudocyst in the head of the pancreas and the dilatation of the pancreatic duct. During the postoperative follow-up, the patient had no abdominal pain or cyst enlargement, and the catheter was removed 2 months later.

A male, 27 years old, was admitted to the hospital due to 11 h of unconsciousness caused by trauma. After tracheal intubation, blood transfusion, and fluid replacement, the patient underwent surgical treatment through the green channel, including splenectomy, mesenteric suture for hemostasis, and repair of the transverse colon seromuscular layer tear. During the operation, about 3000 ml of dark red non-clotting blood was found in the abdominal cavity. There was a massive blood clot in the splenic fossa, a 10-cm tear in the mesentery of the hepatic flexure of the colon, and local active bleeding. There was a 5 cm long tear in the lower spleen, and local active bleeding was observed. Two tears of the seromuscular layer were found in the transverse colon, about 5 cm and 2 cm in length, respectively. A few saponification spots on the surface of the pancreas were explored without obvious laceration, and double-cannula irrigation

and drainage were performed. On the second day after operation, the peripancreatic drainage tube amylase was 5469 U/L $\uparrow$ . After conservative treatment such as inhibition of pancreatic secretion, the peripancreatic drainage tube amylase was reexamined at 490 U/L $\uparrow$ . On the 11<sup>th</sup> day after the operation, she became agitated and unconscious, and removed double sets of drainage tubes around the pancreas by herself, followed by fever and abdominal pain, and dark brown cloudy fluid flowed out of the drainage tube. Conservative treatment was not effective. Re-examination of enhanced CT (Figure 1A) showed contusion of the left lateral lobe of the liver and the body of the pancreas, contusion of the mesentery, and incomplete transection of the left edge of the superior mesenteric vein near the body of the pancreas. The peritoneal encapsulated effusion increased compared with before. Pancreatectomy and abdominal infection were considered, and emergency surgery was performed again, including abdominal irrigation and drainage, repair of delayed gastric rupture, and jejunostomy. The abdominal incision was partially dehiscence with dense adhesion below the incision. An encapsulated effusion was found at the lower edge of the pancreas, about 7 cm  $\times$  6 cm  $\times$  5 cm in size, with a large amount of black necrotic tissue inside. The junction of the pancreatic body and tail was not completely severed, and pancreatic fluid exudation was seen, indicating grade III pancreatic injury. Posterior to the body of the stomach was a pus cavity measuring about 3 cm  $\times$  3 cm  $\times$  4 cm adjacent to a rupture opening measuring about 7 cm  $\times$  3 cm. During the operation, irrigation and drainage tubes were placed around the pancreatic and gastric tear respectively, and continuous irrigation and drainage were performed after the operation. The highest amylase level in the drainage fluid around the pancreas was 33243 U/L. The change of drainage volume is shown in Figure 2B. On the 100<sup>th</sup> day of hospitalization, the patient was discharged with a peripancreatic drainage tube and jejunal nutrition tube. Contrast-enhanced CT was reexamined 2 weeks after discharge (Figure 2C). Three months later, the patient was returned to the hospital for extubation, and there was no discomfort such as



**Figure 2:** The pancreas was fractured and there was accumulation of necrotic material around the pancreas (A). This patient was treated with double-tube irrigation and drainage after surgery, so this chart shows the daily drainage volume and its trend line at the pancreatic broken end since the patient was replaced by negative pressure suction (B). The pancreatic injury was significantly improved, and the distal pancreatic duct was dilated (C).

abdominal pain during the follow-up.

## Discussion

Since the pancreas is in the protected retroperitoneal position, excessive blunt or penetrating trauma is required to damage the pancreas. Therefore, among all abdominal injuries, pancreatic injury is very rare, with an incidence of only about 3%. However, under the influence of many factors such as the frequent occurrence of traffic accidents, the incidence of pancreatic injury is obviously on the rise [7,8]. Moreover, due to the small number of cases, the lack of high-grade and high-quality evidence-based medical evidence in diagnosis and treatment, and the high number of complications of pancreatic trauma and other factors, studies have shown that the fatality rate can be as high as 21.2%, or even higher [9]. In particular, patients with severe pancreatic injury, that is, patients with AAST-OIS classification in the III-V level, often have hemodynamic disorder. If hemodynamic instability occurs, it can lead to internal environment disorder, which further leads to the triad of hypothermia, metabolic acidosis, and fatal coagulation disorder. If not corrected in time, the body is prone to multiple organ dysfunction syndrome, which eventually leads to death. Therefore, early diagnosis and treatment are particularly important. CT is usually used as an early diagnosis method for pancreatic injury, which is mainly manifested as loss of continuity of the pancreas, parenchymal edema of the pancreas and active bleeding, among which peripancreatic effusion is an important indication of the injury of the main pancreatic duct. Magnetic Resonance Cholangiopancreatography (MRCP) and Endoscopic Retrograde Cholangiopancreatography (ERCP) can be used for the definitive diagnosis of pancreatic duct injury. The sensitivity of MRCP to the injury of the main pancreatic duct is as high as 91%, and MRCP can even show the active leakage of the ruptured main pancreatic duct. ERCP has more advantages than MRCP, but due to its injury, it is more commonly used in patients with stable conditions that cannot be diagnosed by CT and MRCP [10]. Although MRCP

and ERCP were not examined in the two cases included in this paper, CT examination showed pancreatic rupture, significant dilation of distal pancreatic duct in the later stage, and huge pancreatic fluid leakage during treatment, so severe pancreatic injury above grade III was diagnosed.

The previous view was that severe pancreatic trauma involving the main pancreatic duct should be treated actively by surgery. Distal pancreatectomy or spleen-preserving distal pancreatectomy was often used for grade III pancreatic trauma. IV Proximal pancreatic stump closure, distal Roux-Y jejunostomy or double Roux-Y jejunostomy of proximal and distal pancreatic stump are often used [11]. However, the above surgical methods have obvious shortcomings. (1) The surgical trauma was too great, and the patient was in poor general condition and could not tolerate it. (2) The pancreas has two broken ends, so the incidence of pancreatic leakage after digestive tract reconstruction is high, so the incidence of local infection and massive bleeding will also increase. (3) Early diagnosis of pancreatic trauma, especially main pancreatic duct injury, is difficult, and the local tissue congestion and edema are serious during operation, which is not conducive to digestive tract reconstruction; (4) When more pancreatic tissue is removed, the risk of postoperative pancreatic exocrine insufficiency increases. (5) Removal of the spleen, affecting the body's immune function, etc. The two reports attached to this article show that the patient's body is still in the extreme state and the tolerance is poor, and it is extremely dangerous and inappropriate to perform more complex operations such as pancreatic resection or digestive tract reconstruction. According to the concept of damage control, a staged surgical strategy can be adopted for different degrees of pancreatic injury. DCS is used to control the disease first, and definitive surgery, such as digestive tract reconstruction, can be performed selectively after the vital signs are stable [12,13]. Therefore, we gave up the traditional mainstream surgical methods and adopted damage control surgery with full drainage and jejunostomy. In the process of treatment, its advantages were gradually reflected. (1) The

surgical trauma was small and simple, which was in line with the concept of damage control and avoided the death of patients due to the excessive surgical impact beyond the physiological limit of the patient. (2) Without digestive tract reconstruction, simple pancreatic leakage has a low risk of massive bleeding because pancreatic enzymes are not activated. Even if gastrointestinal bleeding occurs, it can be improved by conservative treatment. (3) The functions of pancreas and spleen were preserved to the greatest extent. (4) The fistula can be closed in some patients after damage control surgery such as irrigation and drainage. Even if the pancreatic fistula cannot be closed after drainage, the risk will be significantly reduced when the patient's general condition improves, and local tissue inflammation and edema subside before definitive surgery. However, the use of damage control surgery can lead to an increase in the probability of pancreatic leakage, a prolonged hospital stays, and an increase in the corresponding treatment cost. Therefore, our research team believes that on the one hand, patients can be treated with inhibition of pancreatic enzymes, anti-infection, intravenous nutrition, on the other hand, double sets of drainage tubes can be used to flush drainage with large amounts of normal saline to promote the formation of stable pancreatic fistula. After the pancreatic leakage was stable, the patient was changed to closed drainage, discharged with a tube, and enteral nutrition was performed at home, so as to reduce the risk and improve the quality of life of patients.

## Conclusion

In a Nutshell, for patients with severe pancreatic injury who cannot undergo complex and definitive surgery at the first time, damage control surgery is undoubtedly the best choice. As the most critical part of holistic treatment, damage control surgery can minimize mortality, obtain the best curative effect with minimal damage, and thus extend the survival period of patients and improve the long-term quality of life. However, how to correctly apply pancreatic damage control surgery and avoid blindly expanding or shrinking the indications of damage control surgery remain to be further explored. We believe that due to the rarity of pancreatic injury, the relevant exploration of pancreatic injury control surgery is insufficient. However, with the continuous update and iteration of medical technology, the concept of damage control will be further extended and expanded, and deeply integrated into surgical treatment strategies to provide patients with more suitable programs, so as to improve the efficacy and quality of life of patients.

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