

Trauma to the Pancreas

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Summary

Pancreatic trauma is most often due to impact of the seat belt or steering wheel in automobile accidents. It generally occurs as one of multiple injuries, and therefore, rarely observed isolated. Thus, clinical signs and severity are variable, depending not only on the injury to the pancreas itself but also on the extent of other injuries. The diagnosis is reached by integrating the findings of procedures such as physical examination, chest X-rays, blood tests, abdominal ultrasound, abdominal computerized tomography (CT), endoscopic retrograde cholangiopancreatography (ERCP), magnetic resonance imaging (MRI), and magnetic resonance cholangiopancreatography (MRCP). The presence of other injuries can necessitate a laparotomy, and therefore, the extent of pancreatic injury must very often be determined during the operation. Treatment involves conservative observation to follow the state of pancreatic edema. The treatment of pancreatic contusion may also be conservative if the pancreatic ducts are not overtly injured. Drainage would be the basic approach if the pancreatic branch ducts are clearly injured or a crush injury is apparent. If the main pancreatic duct is ruptured in the body or tail region, the pancreatic tail is resected. In the pancreatic head region, a highly invasive pancreaticoduodenectomy should be avoided in favor of drainage designed to accommodate the possibility of a second-stage operation. (Kimura W, Watanabe T, Yano M, and Fuse A in *Geka* (Nankodo.Co) 67: 1063-1068, 2005)

Key words : resection of the pancreatic tail, peripancreatic drainage, Complicating Injuries, modified Letton–Wilson procedure

Introduction

Advances in diagnostic imaging have led to remarkable improvements in the diagnosis and treatment of pancreatic disorders. However, the diagnosis and treatment of pancreatic injury remains perplexing. Since the pancreas is a retroperitoneal organ that is narrow and elongated mediolaterally, diagnosing only the presence or absence of injury, let alone its location and extent, is difficult. In addition, the indication and decision on type of surgery is challenging.

I. Concepts and Mechanisms of Pancreatic Injury

Pancreatic trauma can be classified into sharp trauma and blunt trauma. In Japan, blunt trauma accounts for approximately 90 percent or a greater proportion of such injuries, most of them due to the impact of a seat belt or steering wheel in automobile accidents,^{1,2)} in which the pancreas is crushed between the seat belt or steering wheel and the spine. Usually the pancreatic head and jejunum are injured by pressure from the right side of the spine, the part

of the pancreas near the superior mesenteric artery by pressure from the front of the spine, and the pancreatic tail and spleen by pressure from the left side of the spine. Thus, knowing the direction of impact is very important when diagnosing pancreatic trauma. With regards to the relation between the spine and the pancreas, the more serious injuries, such as rupture of the main pancreatic duct, are usually sustained in the pancreatic body.

The impact of a steering wheel usually results in serious pancreatic injury, whereas that of a seat belt tends to give rise to a milder pancreatic lesion. Thus, considering only the risk of pancreatic injury, fastening the seat belt during driving should be considered a must.

II. Injury to Other Organs Accompanying Pancreatic Injury (Complicating Injuries)

In cases of trauma, the pancreas is usually not subject to isolated injury, but rather sustains injury along with other organs, and hence, is associated with complications. More than 70 percent of the cases reported in Japan were associated with complications, although the incidence among children was lower.¹⁾

Approximately 70 percent of the complications are injuries to abdominal organs, especially those close to the pancreas, with 28% to the liver, 19% to the jejunum, 28% to the larger abdominal blood vessels, and 10% to the spleen.¹⁾ The clinical signs and the degree of severity vary greatly, depending on the extent of the complications as well as on the pancreatic injury itself. Treatment of pancreatic trauma should be fitted along with treatment of the other types of injuries.

III. Classification of Severity

Lucas' classification³⁾ is usually followed in the western world, whereas the classification of pancreatic injury of the Japanese Association for the Surgery of Trauma⁴⁾ is generally used in Japan. In general, types I and II in Lucas' classification and types I (contusion) and II (laceration) in the Japanese classification are considered relatively mild, whereas types III and IV in Lucas' classification and type III (ductal injury) in the Japanese classification are considered as being more severe.

IV. Diagnosis

1. Physical Findings

Given the fact that the pancreas is retroperitoneally situated, even when it is injured, symptoms of peritoneal irritation are not quick to appear. Moreover, the physical findings of coincident injury frequently blur the evidence of injury arising from the pancreatic trauma itself.

Pain from pancreatic trauma, whether spontaneous pain or tenderness, often subsides within an hour or two only to return more intensely within six hours.³⁾ Abdominal pain from blunt pancreatic trauma is primarily located to the epigastric region; however, it is subject to modification by other injuries, making diagnosis difficult by physical findings only.

2. Simple Abdominal Roentgenography

Free air in the retroperitoneal space may suggest rupture of the jejunum, but in most cases, findings specific to pancreatic trauma are limited.

3. Blood Tests

The most useful test is measurement of serum amylase, which increases more in cases of blunt pancreatic trauma than in cases of sharp trauma. In a series of 270 cases, only 16% of those with sharp pancreatic trauma had hyperamylasemia, whereas 61% of the blunt trauma cases tested positive; even in cases of complete rupture of the pancreas, only 65% exhibited hyperamylasemia.⁵⁾ Measuring serum amylase over time is important because its values within the first three hours after trauma fail to relate closely to the extent of the trauma, whereas values measured three and forty-eight hours following the trauma are more useful for diagnosing pancreatic trauma.⁶⁾ Hence, the possibility of false negatives/false positive results of serum amylase values should be considered, and therefore, data should be collected over time rather than at a single point.

4. Abdominal Ultrasonography

The pancreas is an intrinsically difficult organ to visualize using ultrasound. Paralytic ileus can occur at the time of the trauma, further impairing the ability to visualize the pancreas. Edema, rupture, or an enveloping hematoma of the pancreas can occasionally make it easier to detect. Ultrasound is nevertheless always necessary, to aid in the diagnosis of injury to the liver, spleen, or kidneys, or of

intraperitoneal bleeding.

5. Abdominal Computerized Tomography (CT)

Compared with ultrasound, CT is better suited to diagnosing pancreatic trauma. Unfortunately, CT shortly after injury does not necessarily provide significant information in the face of clear pancreatic trauma, with 40% of pancreatic injuries appearing normal on CT.⁷⁾ Thus, pancreatic injury cannot be ruled out even if CT fails to reveal any abnormalities. However, CT unquestionably remains powerful in the diagnosis of pancreatic injury, although CT scans must be repeated over time if its full diagnostic potential is to be realized.

6. Endoscopic Retrograde Cholangiopancreatography (ERCP)

The most important piece of information in determining the direction of treatment for pancreatic trauma is whether or not any pancreatic ducts have been injured. Apart from cases in which complications necessitate immediate laparotomy, many reports claim that a stable patient in whom pancreatic trauma is suspected should undergo contrast radiography of the pancreatic ducts.⁸⁾ However, this is not always possible, as swelling of the papillary region may make intubation impractical, or a rupture of the stomach would make the entire ERCP procedure impossible.¹²⁾ Ways can still be found to perform preoperative endoscopy or to do pancreatic duct contrast radiography in the midst of a laparotomy.

7. Magnetic Resonance Imaging (MRI) and Magnetic Resonance Cholangiopancreatography (MRCP)

Some patients with pancreatic injury arrive at the hospital in relatively stable condition and without any severe symptoms, and therefore, their diagnoses can be pursued over time. For such cases, MRI and MRCP are relevant. As mentioned above, not every patient can undergo ERCP and this type of examination is quite invasive, therefore, MRCP may have a future of more frequent use with regards to obtaining information on, for example, rupture of the main pancreatic duct, spreading of pancreatic juice, or hemorrhage.

V. Treatment

1. Indications for Laparotomy

Treatment of pancreatic trauma varies, depending on whether the patient is a child or an adult, whether the trauma was blunt or sharp, which part of the pancreas is affected and to what extent, and whether or not other injuries are present as well. Most children suffer blunt but mild trauma, requiring observation only, without surgery. In a series by Keller et al.,⁹⁾ only 42 of 154 children (27%) required surgery, and in Japan, the incidence has been reported to be only 13%.¹⁾ On the other hand, in adults, sharp trauma is predominant in the United States, with almost all of those cases undergoing laparotomy, whereas blunt trauma occurs more often in Japan, with 78% of these cases being operated on.¹⁾

The indication for laparotomy depends on the severity of the trauma. For swelling of the pancreas, conservative treatment and the observation of progress suffice. Even with contusion of the pancreas, if the injury to the pancreatic duct is not pronounced, conservative treatment is a possibility.¹⁰⁾ If injury to the pancreatic duct branches or a strong crush injury is clearly evident, the basic treatment would be to do a laparotomy and install a drain. However, in all probability, a laparotomy would already be required due to other injuries, and the extent of pancreatic trauma would then often require evaluation during the operation.

2. Diagnosing Pancreatic Injury during Surgery

To assess the degree of pancreatic trauma during operation, it is recommended to (1) open the gastrocolic ligament and lesser omentum to inspect the anterior aspect of the pancreas; (2) mobilize the duodenum at the pancreatic head and push the colon inferiorly out of the way to obtain a full view of the whole duodenum and of the pancreas from its head to its uncinate region; and (3) adequately observe the tail region of the pancreas, dislodge the pancreas from the retroperitoneum if the spleen has been injured, and otherwise divide the retroperitoneum along the inferior border of the pancreas. Since the main pancreatic duct may sustain subcapsular injury, this possibility should be kept in mind, even if the pancreatic capsule itself appears normal.

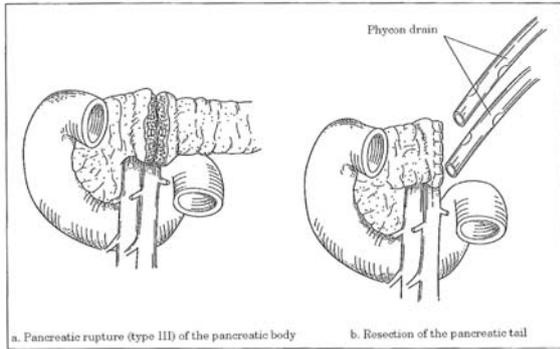


Figure 1. Surgery for pancreatic duct injury (from references 11 and 12)

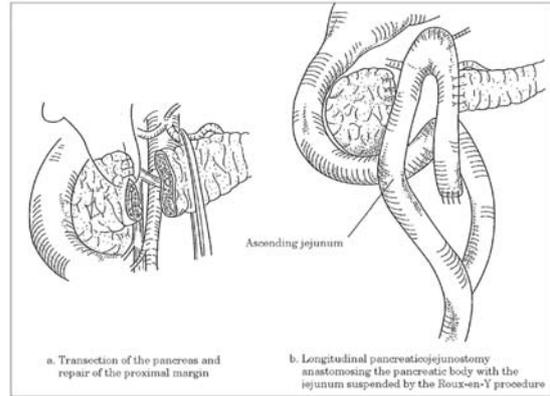


Figure 2. Surgery (modified Letton-Wilson procedure) for injury to the main pancreatic duct in the body of the pancreas. (from references 11 and 12)

3. Operative Procedures

A review¹¹⁾ of past reports on pancreatic trauma indicates that among 870 surviving surgical patients, 58% underwent drainage alone, and 22% had resection of the pancreatic tail (Figure 1), thereby accounting for 80% of the operations. Other surgeries included pancreatic suture with drainage (7.6%), pyloric exclusion (3%), and less than 3% each of pancreaticojejunostomy (including the modified Letton-Wilson method, Figure 2), pancreaticoduodenectomy, and duodenal diverticulation. Patients who undergo surgery for pancreatic trauma usually have serious complications due to additional injury, and therefore, complicated surgical procedures or methods requiring a hazardous anastomosis tend to be eschewed in favor of relatively non-invasive and simple operations.¹²⁾ For pancreatic trauma of milder severity—types I and II—reports on which surgical procedures to use are largely in consensus. Meanwhile, generally acknowledged guidelines regarding the management of more serious cases remain to be established.

a) Type I Injury (Contusion)

For type I injury, conservative treatment is certainly an option. For surgical intervention, setting up an external drain from the region near the pancreas should suffice. Drainage should use the closed suction type to prevent retrograde infection.

b) Type II Injury (Laceration)

The principal options for type II injury, depending on the extent of the laceration, include installing a

drain only, suturing the pancreas along with putting in a drain, pyloric exclusion, and resection of the pancreatic tail. Some experts consider suturing hazardous and unnecessary, and others claim that drainage alone yields excellent results; therefore, opinions differ to some extent.¹²⁾ If suturing is performed, care should be taken not to go in too deeply or puncture the main duct, as that may give rise to pancreatitis or a pancreatic fistula. Pyloric exclusion¹²⁾ is considered to be the most appropriate surgical procedure in cases where both the pancreas and duodenum have been injured. Resecting the pancreatic tail should be unnecessary if the pancreatic ducts are intact, but may be indicated if ductal damage is suspected. Including splenectomy with pancreatic tail resection is not desirable in the case of a child, and in adults it should be limited to patients who are overall medically stable with no complications, including no spleen damage, since a prolonged surgical time is necessary to preserve the spleen.

c) Type III Injury (Ductal Injury), a: Pancreatic Body and Tail, b: Pancreatic Head

If the injury is in the pancreatic body or tail, resection of the pancreatic tail is the safest procedure and the procedure most often performed. Pancreatic duct reconstruction (the Martin procedure¹³⁾) and pancreaticojejunostomy (the modified Letton-Wilson procedure, Figure 2) are ideal for preserving the pancreas; however, they are technically complex and if a complication were to arise, this procedure could

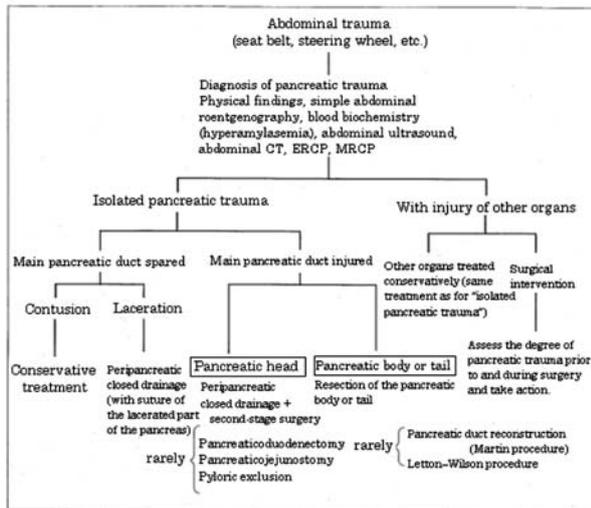


Figure 3. Algorithm for diagnosis and treatment of pancreatic trauma.

have fatal consequences. If the main pancreatic duct is injured in the pancreatic head and repair appears unachievable, pancreaticoduodenectomy might be considered; however, postoperative mortality stands at 30%–40%.¹⁴⁾ Thus, indications for surgery should be considered with great care.

Therefore, even if the main pancreatic duct has clearly been lacerated, a sensible approach would be to simply install a drain in the region of the pancreas and to observe whether a pancreatic fistula forms postoperatively, and then perform a second-stage operation, if necessary. In that approach, 400–500 mL of pancreatic juice a day would be drained from the pancreatic body and tail. Later, after the patient has sufficiently recovered and become stable, the lesion can be diagnosed with the aid of various methods.

If second-stage surgery is indicated, anastomosis of the pancreatic fistula and digestive tract or pancreatico-digestive anastomosis might be considered; however, depending on the pathology, a sufficient amount of time should be allocated to allow for making the right choice. Anastomosis of the pancreatic fistula and digestive tract would generally involve a long postoperative period before the fistula is stenosed, and drainage from the body and tail of the pancreas could deteriorate in the meantime, resulting in chronic obstructive pancreatitis. Thus, pancreatico-digestive anastomosis would be preferable.

4. Complications

The incidence of directly related complications following treatment of pancreatic trauma is high, approximately 25%–35%^{9),12)}, with the rate increasing if non-pancreatic complications are included. The principal complications related to the pancreas itself include intraabdominal abscess, pancreatic fistula, pancreatic pseudocyst, and pancreatitis. Octreotide acetate (Sandostatin) is reportedly effective in preventing complications.¹⁵⁾

The mortality of pancreatic trauma is high, reaching a rate of 9%–21%.^{1),5),12)} However, mortality directly attributable to pancreatic injury is only 0%–3%,^{5),12)} revealing the strong influence of accompanying injuries. This underscores the importance of thoroughly considering the severity of coincident injuries when considering treatment of injury to the pancreas.

VI. Algorithm for Diagnosis and Treatment of Pancreatic Injury

Taking all of the above into consideration, an algorithm for diagnosis and treatment of pancreatic trauma is presented in Figure 3. Looking forward, guidelines for diagnosis and treatment in which the highly invasive ERCP procedure is replaced by active usage of MRI and MRCP is likely in the pipeline.

In Closing

I am hoping that the algorithm presented here for the diagnosis and treatment of pancreatic injury will be useful in emergency medicine.

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