

## 단일 기관에서 치료한 췌 십이지장 손상에 대한 임상경험 보고

가톨릭대학교 의과대학 부천성모병원 외과

조진범, 이준현, 이도상

### - Abstract -

## Experiences with Pancreaticoduodenal Injuries at a Single Institute

Jin-Beom Cho, M.D., Jun-Hyun Lee, M.D., Do-Sang Lee, M.D.

*Department of Surgery, Bucheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea*

**Purpose:** Although the duodenum and the pancreas are protected by surrounding organs and have a low probability of injury during trauma, the mortality and the morbidity due to complications is high. This report includes the pancreaticoduodenal injuries we observed that were treated at a single institute.

**Methods:** The medical records of patients admitted to our institute between 2001 and 2012 for pancreaticoduodenal injury were retrospectively reviewed.

**Results:** In our hospital, between 2001 and 2012, 15 patients were admitted for a pancreaticoduodenal injury. All patients experienced blunt trauma, 6 of whom were involved in traffic accidents and 9 of whom received injuries from physical assault. Most of the patients were men(13 of 15 patients, 86%) with a mean age of 23 years (range, 5-39 years). All patients were admitted to the emergency center and managed by the surgeons on duty. The mean value of the injury severity score was 22. The mortality rate was 6%(1 of 15 patients). Seven of the fourteen surviving patients(50%) had duodenal injury, 6 patients(42%) had a pancreatic injury, and 1 patient(7%) had a combined pancreaticoduodenal injury. The surgical procedures were targeted at damage control.

**Conclusion:** In conclusion, we believe that damage control surgery is the optimal management for a pancreaticoduodenal injury.

**Key Words:** Pancreas injury, Duodenal injury, Pancreaticoduodenal injuries, Blunt pancreaticoduodenal injuries

### I. Introduction

The duodenum and the pancreas are protected by surrounding organs and have a low probability of

damage during trauma. Most injuries to these organs result from penetrating trauma, and blunt injuries are rarely reported. According to the National Trauma Data Bank, duodenal injury was

\* Address for Correspondence : **Do-Sang Lee, M.D.**

Department of Surgery, Bucheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Sosa-dong, Wonmi-gu, Bucheon-si, Gyeonggi-do 420-717, Korea

Tel : 82-32-340-7023, Fax : 82-32-340-2668, E-mail : dosangs@catholic.ac.kr

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seen in 0.1% of blunt trauma patients, and 0.09% of blunt and penetrating trauma patients had pancreatic injury.(1) Furthermore, the close proximity of these 2 organs increases the risk of concurrent damage, and mortality is high even with the low incidence of injury. The mortality rate is 11.4%~14.8% in blunt duodenal injuries and 23.4%~30.2% in blunt and penetrating pancreatic injuries.(1) Our hospital is a city-based medical school-affiliated hospital. We do not have a trauma team and general surgeons treat trauma patients according to the principle of damage control. The purpose of this study is to present the epidemiology, surgical procedures, outcomes, and complications of blunt traumatic injuries to the duodenum and the pancreas that we observed at our institution. Our report also may be helpful to general surgeons who treat trauma patients in regional facilities without access to large trauma centers.

## II. Methods

The medical records of patients admitted to our institute during 2001~2012 for pancreaticoduodenal injury were retrospectively reviewed. Data on the

epidemiology, injury mechanism, organ injury scale, injury severity score, associated injury, surgical procedures, mortality, morbidity, and time to oral feeding were collected and analyzed. Organ injuries were classified using the organ injury scale established in 1990 by the Organ Injury Scaling Committee of the American Association for the Surgery of Trauma (AAST).(2) The injury severity score was calculated according to the method proposed by Baker et al.(3) in 1974. This study was approved by ethical review board of our institution and therefore performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

## III. Results

Between 2001 and 2012, 15 patients were treated at our institution for blunt pancreaticoduodenal injuries. All injured patients were admitted to the department of surgery through the emergency department, and the surgical staff on duty was in charge of preoperative evaluation, surgery, intensive care, and postoperative management. Table 1 lists the demographic and clinical characteristics of

**Table 1.** Demographics and Clinical characteristics of the injured patients

	Number of patients	Percentage (%)
Age	5-39 (mean 23)	
Gender		
Male	13	86
Female	2	14
Injury Severity Score	16-50 (mean 22)	
Injury mechanism		
Blunt	15	100
Traffic accident	6	40
Other blunt trauma	9	60
Penetrating	0	0
Shock at first admission	3	21
CPCR at first admission	1	7
Mortality	1	7
Injured organ		
Pancreatic injury	6	40
Duodenal injury	7	46
Combined injury	2	14
Associated injury		
Transverse colon	3	21
Liver	1	7

the patients. Six patients(40%) had duodenal injury, 7 patients(46%) had pancreatic injury, and 2 patients (14%) had combined pancreaticoduodenal injury. In 4 patients(26%), associated intra-abdominal injury was also observed: transverse colon injury in 3 patients and liver injury in 1 patient.

Duodenal injury was observed in 9 patients, and 2 had an associated pancreatic injury. Most patients sustained injuries to >1 portion of the duodenum, and a total of 12 portions of the duodenum were injured. Injury to the duodenal second portion was the most frequently observed.(50%)(Table 2).

**Table 2.** Location of duodenal injury<sup>a)</sup> related to the AAST injury severity grade

	Grade I (n=1)*	Grade II (n=3)	Grade III (n=4)	Grade IV (n=1) <sup>†</sup>	Total (n=9)
First portion	0	0	0	0	0
Second portion	1	3	1	1	6
Third portion	0	2	3	0	5
Forth portion	0	1	0	0	1

\* Most patients had duodenal injuries of more than one portion

<sup>†</sup> These patients had combined pancreatic injuries

**Table 3.** Location of pancreatic injury related to the AAST injury severity grade

	Grade II (n=2)	Grade III (n=1)	Grade IV (n=4)*	Grade V (n=1)*	Total (n=8)
Head	1 <sup>†</sup>	0	2	1 <sup>†</sup>	4
Body	1	1	2	0	4
Tail	0	0	0	0	0

\* These patients had pancreatic ductal injury

<sup>†</sup> These patients had combined duodenal injuries

**Table 4.** Surgical procedures performed for injured duodenum and outcomes

	AAST grade II (n=3)	AAST grade III (n=4)	Total (n=7)
Gastrojejunostomy with pyloric exclusion	1	3	4
Gastrojejunostomy without pyloric exclusion	1	0	1
Roux en Y	1	0	1
Duodenojejunostomy*			
Primary closure	0	1 <sup>†</sup>	1
Shock at admission	0	0	0
Unstable hemodynamics during operation	0	0	0
Mortality	0	0	0
Post operative complications			
Post operative ileus	0	1	1
Wound infection	0	1	1
Days to oral feeding <sup>‡</sup> (post operative days)	6	11	8

\*An anastomosis between injured site of the duodenum and Jejunal Rouex-limb

<sup>†</sup> This patient was 6 years old

<sup>‡</sup> Mean value

Pancreatic injury was observed in 8 patients, and 2 patients showed an associated duodenal injury. An equal number of patients sustained pancreatic head injuries(4 patients, 50%) and pancreatic body injuries(4 patients, 50%) (Table 3). In patients with combined pancreaticoduodenal injury, 1 patient had grade V pancreatic head injury and grade I duodenal second portion injury, and the other patient had grade II pancreatic head injury and grade IV duodenal second portion injury.

Of the 7 patients who showed duodenal injury without pancreatic injury, 4 patients had grade III injury. Of these, 3 underwent pyloric exclusion and gastrojejunostomy, and in the single pediatric patient (Age, 6 years), primary closure alone was performed without pyloric exclusion. The 3 patients with grade II injury underwent distinct procedures for repair: 1 patient underwent pyloric exclusion and gastrojejunostomy, 1 patient underwent gastrojejunostomy without pyloric exclusion, and 1 underwent duodenojejunostomy without pyloric exclusion (Table 4). In patients with AAST injury grade II injuries, no specific postoperative complications were observed, and on average, oral feeding commenced 6 days after surgery. In patients with AAST grade III injury, postoperative ileus was observed in 1 patient and wound infection was presented by 1 patient. The average time to oral feeding was 11 days after surgery in these patients.

Of the 6 patients with pancreatic injury, 4 had ductal injury, of which 3 received pancreatic resection. In the other patient, surgery began under hypovolemic shock. Therefore, debridement with drainage was first performed followed by a second look operation. In the 2 patients without pancreatic ductal injury, pancreatic resection was performed in the patient with a grade III injury because of severe parenchymal injury, whereas only drainage was performed in the patient with a grade II injury (Table 5). In all cases of pancreatic resection, splenectomy was also performed. In the 2 patients without pancreatic ductal injury, no postoperative complication was observed, and oral feeding began on postoperative days 5 and 8. In the 3 patients who underwent pancreatic resection because of pancreatic ductal injury, 1 presented with postoperative ileus, and the patient in whom external drainage was performed, developed a pancreatic fistula. The average time to oral feeding was 11 days. Because the pancreatic fistula did not heal during conservative treatment, pancreaticoduodenectomy was performed on 25 days after the first surgery, and the patient was released 10 days after the second surgery without specific findings.

In the 2 patients with combined pancreaticoduodenal injury, drainage was performed in 1 patient with hemodynamic instability and pancreaticoduodenectomy was performed in 1 patient without

**Table 5.** Surgical procedures performed for injured pancreas and outcomes

	Ductal injury: AAST grade IV (n=4)	No ductal injury: AAST grade II, III (n=2)	Total (n=6)
Pancreas resection* (distal or subtotal)	3	1	4
Drainage	1	1	2
Shock at admission	1	0	1
Unstable Hemodynamics during operations	0	0	0
Mortality	0	0	0
Post operative complications			
Pancreatic fistula	1	0	1
Post operative ileus	1	0	1
Days to oral feeding <sup>†</sup> ( post operative days)	11	6	10

\* Splenectomy was also performed

<sup>†</sup> Mean value

hemodynamic instability. The patient who underwent Whipple's operation developed a pancreatic fistula, which was cured by conservative treatment, and was released on postoperative day 26. The other patient died of hypovolemic shock and multiorgan failure 2 days after surgery. The cause of death was right hemothorax which had not been previously observed.

#### IV. Discussion

Treatment of traumatic pancreaticoduodenal injury is difficult because of the low incidence, diagnostic difficulty, decision between surgical and non-surgical treatments, difficulties in selecting surgical procedures, possibility of injury in other organs, and associated lethal injuries.(4) As in other severe traumatic injuries, patient survival can only be improved by an integrated effort including optimal initial management, rapid diagnosis, appropriate surgery, intensive care, and nutritional therapy. The purpose of this study was not to suggest a management guideline for pancreaticoduodenal injuries, but to report the successful treatment of rare gunshot injuries and penetrating injuries by constant adherence to principles, even if different surgical teams provide the treatment.

There is still controversy among trauma surgeons about the surgical treatment for traumatic duodenal injury. Successful surgery must reduce complications such as duodenal fistula. To protect the suture line to minimize complications, surgical methods to divert the digestive enzymes and enteric contents have been devised. In 1966, Stone et al.(5) introduced the triple tube osotomy approach, and in 1977, Vaughan et al.(6) introduced pyloric exclusion. The principles of these surgeries are to first perform primary repair in patients with duodenal laceration and transection without involving the ampulla of Vater, and to protect the surgical site from enteric contents and digestive enzymes if necessary. To achieve this, gastrojejunostomy or tube duodenostomy can be performed. If the patient is in critical condition, the duodenum can be resected and a temporary discontinuity can be formed in the gastrointestinal tract. The literature includes numerous

opinions on the diversion of the gastrointestinal tract course after primary repair; however, a consensus has not been established. According to recent reports, in most cases of penetrating duodenal injury, pyloric exclusion can lead to increased complications; therefore, performing primary repair alone may be a superior option.(7) However, in cases of AAST grade III or higher duodenal injury, primary repair alone could result in an increase in complications such as duodenal fistula; hence, the repair site must be protected from enteric contents.(8) Primary repair is reportedly feasible in children.(9) In our study, of the 7 patients with duodenal injury without pancreatic injury, 6 underwent surgery to protect the suture line from enteric contents, and the pediatric patient alone received only primary repair. The decision was made based on the hemodynamic status, intra-abdominal contamination, and injury severity. Of the patients with AAST grade III or higher injuries, with the exception of 1 pediatric patient, all 3 underwent pyloric exclusion with gastrojejunostomy. For AAST grade II cases, pyloric exclusion with gastrojejunostomy was performed in 1 patient and only bypass surgery was performed in the remaining 2 patients. For bypass surgery, 1 patient underwent gastrojejunostomy, and the other underwent duodenojejunostomy. In the case of duodenojejunostomy, the jejunal Roux limb was raised and anastomosis with the injured site of the duodenum was performed in an end-to-side manner and jejuno-jejunal anastomosis was formed approximately 15 cm inferior. A limitation of our study is that these decisions were made after laparotomy by several different surgical teams. However, the consistent principle was to perform damage control surgery. Based on this, the surgery that the surgical staff was most comfortable with at the time of surgery, according to the experience of the operating surgeon, was selected. In all 7 cases, no duodenum-related morbidities such as duodenal fistula or mortality were observed.

If the traumatic pancreatic injury is minor, non-operative management is recommended, and if pancreatic ductal injury is suspected, surgical exploration must be performed. In cases of pancreatic ductal injury, if pancreas ductal injury is to the left

of the superior mesenteric vessels, distal pancreatectomy is commonly performed, and for injuries to the right, damage control surgery is commonly performed, including external drainage.(10) As the pancreas is in the retroperitoneum, it is difficult to diagnose an injury. According to recent reports, intravenous contrast-enhanced computed tomography scan can provide limited assistance in diagnosis (11); however, diagnosis is difficult based on a single imaging study. The injury mechanism, symptoms, and laboratory findings of the patient also need to be integrated for the diagnosis. In our case, we performed distal pancreatectomy for all cases of pancreatic injury to the left of the superior mesenteric vessels. In the case of injury to the right of the superior mesenteric vessels, in 1 case, subtotal pancreatectomy was performed as devitalized tissue was widely observed, parenchymal disruption was severe, and the hemodynamic status of the patient was stable. In the other case, pancreatic head injury was observed but only external drainage was performed because of the unstable hemodynamic status. In the 2 patients without pancreatic ductal injury, we were unable to clearly determine the presence of pancreatic ductal injury from preoperative evaluations, and we conducted a surgical exploration. In the patient with AAST grade II injury, external drainage was performed. In the patient with AAST grade III injury with severe parenchymal disruption, distal pancreatectomy was performed. With the exception of 1 case of pancreatic fistula, no pancreas-related morbidities were observed in the patients.

For combined pancreaticoduodenal injury, the decision to perform pancreaticoduodenectomy is difficult. In principle, damage control surgery should be performed, and external drainage should be done if possible. Whipple's operation is selected as a last resort if there is widespread disruption throughout the common bile duct, duodenum, and pancreas. Some authors argued that resection and reconstruction is better performed separately in a 2-stage surgery.(12) In our case, we treated 2 patients with combined pancreaticoduodenal injury. One patient was hemodynamically stable, and since the surgeon had a vast pancreatic surgical experience, 1-stage

pancreaticoduodenectomy was performed. In the other patient, AAST grade II injury was seen in the pancreatic head and grade IV injury was seen in the duodenum second portion. As the patient was hemodynamically unstable, external drainage was performed. This patient did not recover from the hemorrhagic shock and multiorgan failure, and died on postoperative day 2.

## V. Conclusion

The limitations of this study are that, first, the number of cases was small, and second, the pancreaticoduodenal injuries were managed by the surgical team on duty rather than by a trauma team. Therefore, management can differ depending on personal experience, skill, and specialization of the team leader. However, the surgeons adhered to the basic surgical principles, and the consistent principles applied were fast decision-making and damage control surgery. In the future, a clear management strategy must be established from a collection and analysis of more data.

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