

## **Pancreaticoduodenectomy For Complex Pancreaticoduodenal Trauma: A Case Series**

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Pancreaticoduodenectomy (Whipple's) procedure is indicated for complex pancreatic injuries, with immediate reconstruction for stable patients and delayed reconstruction for unstable patients. This study aimed to review the authors' experience with trauma-related Whipple's procedure at the East Avenue Medical Center (EAMC).

**Methods:** This study reviews cases where Whipple's procedure was performed from 2011 to 2015 at EAMC. Data collected included age, gender, mechanism of injury, presentation, patient Injury Severity Score (ISS), time interval between injury to presentation, associated injury, surgical procedure, time and type of surgical reconstruction after resection complications and 30-day mortality.

**Results:** During the 5 year period, 4 patients underwent Whipple's. All patients were male, mean age of 33.25 (range 29-48). Penetrating gunshot trauma was the predominant mechanism of injury (75% of cases) whereas peritonitis was the most common presentation (75% of cases). Mean ISS score is 29.5 (range 25-37). Among them, 2 underwent initial resection with delayed reconstruction and the other 2 underwent immediate reconstruction. Pancreaticojejunostomy was done for all pancreatic reconstruction. Cholecystojejunostomy (75%) and Choledochojejunostomy (25%) for biliary enteric conduit. Complications included pancreatic leak (50%), sepsis (25%) and pneumonia (25%). Overall, 30-day mortality rate was 25%. Pancreatic leak was noted on all patients without stent placed on the pancreatic anastomosis.

**Conclusion:** Use of stents in pancreatic anastomosis in Whipple's for trauma may lessen the pancreatic leak rates, further studies are needed to prove this. Cholecystojejunostomy can be an option for biliary enteric continuity, but further studies are needed to identify long term patency rates.

**Key words:** Pancreaticoduodenectomy, pancreatic leak, pancreatic injury

Traumatic pancreaticoduodenal injury still remains a challenge for the surgeon. Operative management is determined according to the location and grade of pancreatic injury. However, there is a lack of standardized treatment of pancreatic injuries, especially for complex pancreatic lesions or combined pancreaticoduodenal injuries.<sup>1</sup> Historically, the first step in the management of patients with pancreatic injury involves making the diagnosis. In patients with significant pancreatic head injury with ductal disruption and associated duodenal injury, pancreaticoduodenectomy (Whipple's) is recommended.<sup>2</sup> Pancreaticoduodenectomy is also indicated for patients who have devascularized pancreatic head, ampulla disruption and uncontrollable bleeding to the pancreaticoduodenal complex. However, pancreaticoduodenectomy for combined pancreaticoduodenal injuries is rarely resorted to in the trauma setting owing to severe concomitant injuries.<sup>3</sup> Pancreaticoduodenal injuries are frequently complicated by intra- or retroperitoneal hemorrhage and concomitant hollow viscous injuries may lead to gross contamination of the abdominal cavity. Major damage to this area carries significant hospital care burdens as complications abound with these injuries. Morbidity and mortality have been reported to be in the range of 31-50%.<sup>4</sup>

The choice of surgical procedures for complex pancreaticoduodenal injuries depends on the severity

and hemodynamic stability of the patient. In hemodynamically stable patients, Whipple's procedure with immediate reconstruction can be done. Whereas, in unstable patients, delayed reconstruction can be warranted after pancreaticoduodenectomy.<sup>5</sup> The purpose of this study was to review our experience with trauma-related Whipple procedures at the East Avenue Medical Center.

## Methods

This is a case series of patients seen by the Department of Surgery, East Avenue Medical Center. The operative files and medical charts of patients who underwent Whipple's procedure for injury to the pancreaticoduodenal complex over the last 5 years, from 2011 to 2015 were reviewed. There were 4 patients who underwent Whipple's procedure for trauma for 5 years at EAMC.

Data collected were patient age, gender, mechanism of injury, presentation at the emergency room patient, Injury Severity Score (ISS), time interval between injury to presentation, associated injury, surgical procedure, time of reconstruction, type of surgical reconstruction after resection, complications and 30-day mortality. Patients were then categorized in two groups after pancreaticoduodenectomy: either 1) damage control surgery with delayed reconstruction after resection and 2) immediate reconstruction after resection.

Individual patient ISS is taken by assigning an Abbreviated Injury Scale (AIS) allocated to one of six body regions (Head, Face, Chest, Abdomen, Extremities, External). AIS was scored by the clinician who saw the patient at presentation and during surgery. It is ranked on a scale of 1 to 6 on each organ system, with 1 being minor and to a spectrum of 5 being severe, and 6 a non-survivable injury. Only the highest AIS score in each body region is used to get the ISS. The 3 most severely injured body regions have their score squared and added together to produce the ISS score. The ISS score takes values from 0 to 75. If an injury is assigned an AIS of 6 (non-survivable injury), an ISS score of 75 is automatically assigned.

Age, gender, mechanism of injury, presentation at the emergency room, interval between injury and presentation, associated injury and ISS were gathered

from medical record, emergency room notes, patient's clinical history and nurse's notes. Surgical technique, reconstruction and complications were gathered from the operative files of the individual patients. Complications and mortality outcome were gathered from medical charts during the postoperative period and Out-patient records after discharge.

Categorical data are presented as tables. Ordinal data are presented as mean and range.

## Results

During the 5 year period from January 1, 2011 to December 31, 2015, there were 4 patients who underwent Whipple' procedure for trauma, (Table 1). All patients were males with a mean age of 33.25 (range 29-48). Penetrating gunshot trauma was the predominant mechanism of injury occurring in 3 out 4 cases (75%). All patients came in to the emergency room within 1 hour of injury. Peritonitis was the most common presentation occurring in 3 out 4 cases (75%). These patients were severely injured with a mean ISS score of 29.5 (range 25-37). Among the patients, 2 underwent initial Damage Control Surgery with delayed reconstruction and the other 2 underwent immediate reconstruction.

The initial Damage Control for the 2 patients was due to massive blood loss arising from the severed pancreatic head. In the delayed reconstruction group, resection was done, with the pancreatic duct cannulated with a Fr 5 feeding tube and exteriorized to allow drainage of the pancreatic juices. Bile diversion in this group was performed by placing a cholecystostomy tube to preserve as much of the Common Bile Duct (CBD) as possible to be used in the delayed reconstruction. Reconstruction was done 1 week after the initial pancreaticoduodenectomy. Patient was then scheduled for reconstruction after resuscitation was done and laboratory parameters were within normal range. In the delayed reconstruction group, biliary enteric continuity was done by doing a cholecystojejunostomy because of questionable viability of the distal CBD. Pancreatic continuity was accomplished by using an end to end pancreaticojejunostomy. Antecolic gastrojejunostomy was used to establish enteric continuity.

**Table 1.** Clinical Profile of patients who underwent pancreaticoduodenectomy for trauma at East Avenue Medical Center from January 1, 2011 to December 31, 2015.

Parameters	Case 1	Case 2	Case 3	Case 4
Age	43	23	19	48
Gender	Male	Male	Male	Male
Mechanism of injury	Penetrating (Gunshot)	Penetrating (Gunshot)	Blunt	Penetrating (Gunshot)
Presentation	Peritonitis	Hypovolemic shock	Peritonitis	Peritonitis
Injury Severity Score (ISS)	25	31	37	25
Time interval between injury to presentation	30 minutes	1 hour	1 hour	30 minutes
Associated injury	Liver injury	Gastric injury, jejunal injury, colonic injury, lower extremity laceration	Cerebral Concussion Chest Contusion	Liver injury
Surgical procedure	Classical Whipple's	Classical Whipple's	Classical Whipple's	Classical Whipple's
Reconstruction	Immediate Reconstruction	Damage control surgery with delayed reconstruction	Damage control surgery with delayed reconstruction	Immediate Reconstruction
Pancreatic-enteric continuity	End-to end pancreatico-jejunosotomy	End-to end pancreatico-jejunosotomy with stent	End-to end pancreatico-jejunosotomy Without stent	End-to end pancreatico-jejunosotomy with stent
Biliary enteric reconstruction	Without stent Choledocho-jejunosotomy	Cholecysto-jejunosotomy	Cholecysto-jejunosotomy	Cholecysto-jejunosotomy
Complications	Pancreatic Leak Pneumonia Sepsis	None	Pancreatic Leak	None
30-day Mortality	Dead	Alive	Alive	Alive

In the immediate reconstruction group (2 patients), pancreatic continuity was done using end to end pancreaticojejunosotomy. In one patient, choledocho-jejunosotomy was used for biliary enteric reconstruction whereas the other patient in the group, the gallbladder was used as a conduit because much of the distal CBD was severed.

Complications included pancreatic leak (50%), sepsis (25%) and pneumonia (25%). Those patients that were suspected of pancreatic leak initially presented with signs of peritonitis, fever and tachycardia. Pancreatic leak was diagnosed with fluid findings in the peri-pancreatic space in the Whole abdominal CT-scan and rising enzyme levels were noted on the external drains

placed near the pancreatic anastomosis. All patients who had no stents used in the pancreatic reconstruction both in the delayed reconstruction and immediate reconstruction group, developed pancreatic leak. Whereas, no pancreatic leak was noted in patients who had stents placed after pancreaticojejunostomy.

Overall, 30-day mortality rate was 25% among patients who underwent Whipple's procedure for trauma. One patient died because of sepsis which developed after the patient developed pneumonia on the 5<sup>th</sup> postoperative day. This patient also developed pancreatic anastomotic leak 1 week post-operatively. There was an initial plan to return the patient to the operating room to manage the leak. But in spite of resuscitation, this patient subsequently developed multi-organ failure leading to the patient's demise.

## Discussion

Traumatic disruption of the pancreaticoduodenal complex is a rare but life-threatening condition. Despite aggressive surgical intervention, patients still suffer a high rate of complication, long ICU stay and high mortality, with studies quoting a 31-50% mortality rates.<sup>4</sup>

A possible debate among most surgeons is whether to do immediate or delayed reconstruction. The presence of pancreatic injury highlights the well-known fact that there are also injuries to multiple organs that complicate the management of these injuries. The various combinations of these presentations warrant a tailored approach towards management. Delayed reconstruction is logically advocated when at initial surgery, patient is unstable and cannot tolerate longer operative time. Nevertheless, no management plan seems to be wrong if it fits the nature, severity of trauma, patient profile, surgeon's expertise and the available resources at the time of injury.<sup>6</sup> In this series, damage control was initially done to address life threatening problems in patients, resuscitate them initially and with plans of a return to the operating suite for definite reconstruction. Immediate reconstruction was reserved only for patients who were stable intra-operatively. Temporary measures in our series was just placement of tubes to exteriorly drain the biliary tree and the pancreas. Also, several drains were placed in the pancreaticoduodenal area to

widely drain the abdomen as to prevent further contamination after the initial resection.

Pancreaticoduodenectomy in trauma patients presents the risk of leakage following anastomosis due to a soft pancreatic stump, or a non dilated and narrow main pancreatic duct.<sup>7</sup> The most important influencing factors for leak or fistula formation are the presence of a soft texture within the pancreatic remnant and a small Duct of Wirsung which complicates the achievement of a safe pancreatico-enteric anastomosis. This is a frequent event in cases of non-obstructive problems such as trauma. The presence of high tension anastomosis and poor bloody supply (secondary to blood loss) are other surgical factors associated with an increased risk of leakage.<sup>8</sup> It is accepted that, pancreatic texture and duct size are associated with leakage. In a study by Yang et al., the incidence of pancreatic leakage after Whipple's is 4.88% with a duct size greater than 3mm which is significantly different from incidence of 38.1% when the duct size was smaller than 3mm. Also they have identified that pancreatic leakage rate as 2.94% in patients with a hard pancreas compared to a higher 32.1% in those with soft pancreas.<sup>9</sup> The external drainage of the pancreatic duct using a stent reduces leak rates after pancreatic anastomosis compared to non-stented group (6.7% vs 20%).<sup>10</sup> In this series, all of the patients in the non-stented group had pancreatic leak, No patient developed pancreatic leak after placing a stent. In some of the patients, stent was not placed because of the unfamiliarity of the surgeon performing the reconstruction after Whipple's procedure. In patients wherein, no stents were placed, the invagination technique of the jejunum to pancreas was used with 2 layer technique. In those patients where a stent was placed, there was difficulty in cannulating the duct due to its small size, but the surgeons doing those cases were eventually able to cannulate the duct using a smaller Fr 5 feeding tube. In this series, it was observed that the use of stents in Whipple's procedure for trauma may reduce leak rates of pancreatic anastomosis.

In this series, the authors used cholecystojejunostomy as their choice for biliary enteric for reconstruction (75%). Historically, the use of cholecystojejunostomy for biliary enteric anastomosis has not been advocated because of the fear of the development of gallbladder

stones questioning its long term patency.<sup>11</sup> Cholecystojejunostomy is contraindicated in the presence of gallstones and cholecystitis. In this series, none of the patients had gallstone disease, thus this type of reconstruction was feasible. In literature, biliary stricture is an infrequent complication after Whipple's procedure and there was no difference in stricture formation after resection for benign (2.6%) or malignant disease (2.6%).<sup>12</sup> In this series, the biliary enteric was technically easy to do with the gallbladder as a conduit since it has a larger diameter compared to the CBD. Cholecystojejunostomy may be useful in the trauma setting in which surgeons may not be familiar to the more technically demanding choledochojejunostomy which involves the anastomosis of the non-dilated CBD. However, long term patency is still an issue when using the gallbladder for biliary enteric reconstruction. A study involving patients who had this type of reconstruction may be done to determine patency rates may be appropriate.

## Conclusion

Pancreaticoduodenectomy is an option for complex pancreatic injuries, and the type of reconstruction whether delayed or immediate should be tailored to the individual patient. The use of stents in pancreatic anastomosis in Whipple's for trauma may lessen the pancreatic leak rates, cohort or randomized controlled trial studies are needed to prove this. Cholecystojejunostomy can be an option for biliary enteric continuity, but further studies are needed to identify long term patency rates. Overall, complex pancreatic injuries still carry a high mortality rate. This series showed 25% 30-day mortality rate. Complications include sepsis, pneumonia and pancreatic anastomotic leak.

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