

Pyloric Exclusion with Biliary Diversion Compared to Primary Repair Over Tube Duodenostomy for Management of Delayed Iatrogenic Duodenal Injuries, A retrospective Study

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ABSTRACT

*Iatrogenic duodenal injuries are uncommon. Their clinical importance lies in the significant morbidity and mortality they cause if diagnosed late or treated improperly. The aim of this study is to show efficacy of pyloric exclusion with biliary diversion compared to primary repair over tube duodenostomy for treating iatrogenic duodenal injuries when discovered late (more than 48 hours). A retrospective study was conducted in the period between April 2013 and December 2014 in Ain shams university, general surgery department Cairo, Egypt. Patients admitted with delayed iatrogenic duodenal injuries were selected. 16 patients were included in the study. Six patients were treated with drainage, primary repair over tube duodenostomy and feeding through TPN and the other 10 patients underwent drainage, primary repair with omental patch, pyloric exclusion via gastrotomy and gastrojejunostomy and biliary diversion using T-tube. Demographics, clinical presentation data, laboratory and radiological investigations, operative management, post-operative morbidity and mortality were analyzed. The study included 16 patients, 10 males and 6 females with mean age 42 ± 7.5 . The causes of injury were post laparoscopic cholecystectomy ($n = 4$), after ERCP ($n = 9$), after right nephrectomy ($n = 2$) and during CBD exploration one patient. Delayed diagnosis was due to injuries not identified during the first operation, injuries treated conservatively and refusal of reoperation by patients and their relatives. 10 patients were treated by pyloric exclusion and biliary diversion after drainage and repair of injury with one death and four complications (one duodenal fistula and 3 retroperitoneal abscesses that indicated reoperation). The other 6 patients were treated with drainage of collection, primary repair of duodenal injury over tube duodenostomy, nasogastric tube for decompression of stomach and feeding by TPN with four deaths and two complications (two prolonged duodenal fistulae). **Conclusion:** Iatrogenic duodenal injuries are uncommon. They have significant morbidity and mortality if diagnosed late or treated improperly. Pyloric exclusion with biliary diversion gives the best results in cases discovered late.*

Key words: delayed duodenal injuries, pyloric exclusion, biliary diversion, duodenal fistula.

INTRODUCTION

Duodenal injuries are not common and are found in only 3.7% of all laparotomies for trauma⁽¹⁻²⁾. The retroperitoneal location of the organ, its close proximity to the head of the pancreas, the biliary ducts and the major vascular structures of the upper abdomen are all factors that increase the complexity of duodenal trauma. Further, the diagnosis of blunt duodenal injury is not easy and may be delayed with a resultant increase in morbidity and mortality⁽³⁻⁴⁾. SO it is essential to make an early diagnosis and apply judicious surgical principles for optimal outcomes.

Early diagnosis is important in preventing complications and mortality. However, in some patients, there are minimal findings on physical,

laboratory, or radiological examination. Diagnosis may then be delayed unless the physician suspects a duodenal injury. In addition, some patients do not seek early medical help^(5,6).

The aim of this study is to determine the best method for treating iatrogenic duodenal injuries when discovered late (more than 48 hours).

PATIENTS AND METHODS

A retrospective study was done from April 2013 till December 2014 in Ain shams university hospital, general surgery department (a tertiary care hospital) Cairo, Egypt. All patients presented with delayed iatrogenic duodenal injuries were included.

16 patients with duodenal injuries that were not diagnosed within the first 48 hours were treated at our Hospital. Their medical records, operative reports, charts, and radiographs were reviewed. The mechanisms of injury, the reasons for and length of delay in diagnosis, the operations and postoperative complications were noted for each patient.

The first 6 patients were treated with drainage of collection, primary repair of duodenal injury over tube duodenostomy, nasogastric tube for decompression of stomach and feeding by TPN and the other 10 patients underwent drainage of collection, primary repair with omental patch, Pyloric exclusion via gastrotomy and closure of pylorus by 3 to 4 interrupted prolene 2/0 sutures then gastrojejunostomy with biliary diversion via T-tube and feeding was done via nasojejunal tube passed through the gastrojejunostomy. Demographics, clinical presentation data, laboratory and radiological investigations, operative management, post-operative morbidity and mortality for both groups were analyzed. Patients with T-tube underwent t-tube

cholangiogram weekly till evidence of duodenal closure (**fig 9, 10, 11**).

All surviving patients were followed for at least six months. Follow-up of patients included the development of any complications and their treatment.

Statistical analysis:

Data were analyzed using Statistical Program for Social Science (SPSS) version 20.0. Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage. Chi-square (X^2) test of significance was used in order to compare proportions between two qualitative parameters. Probability (P-value) P-value <0.05 was considered significant, P-value <0.001 was considered as highly significant, P-value >0.05 was considered insignificant.

RESULTS

Sixteen patients with delayed iatrogenic duodenal injuries were included **table (1), fig (1)**.

Table (1): Demographics and associated morbidities

Age (mean, SD & range)	42±7.5 (24-56)
Sex (no,%)	
male	10 (62.5%)
female	6 (37.5%)
Co morbid conditions	
DM	2
HTN	3
ISHD	1
Morbid obesity	1

The causes of injury were post laparoscopic cholecystectomy (n = 4), after ERCP (n = 9) and after right nephrectomy (n = 2) and during CBD exploration 1 patient **fig (2)**.

Table (2): Causes of injury

• Post laparoscopic cholecystectomy	4 patients
• After ERCP	9 patients
• After right nephrectomy	2 patients
• During CBD exploration	1 patients
• Total	16 patients

The causes of delayed diagnosis were:

Injuries not identified during the first operation, injuries treated conservatively and delay due to refusal of patients and their relatives the operation after discussing the complications with them. Time elapsed from 1st surgical procedure to our operation ranged from 2 days to 18 days **table (3), fig (3).**

Table (3): Causes of delayed diagnosis.

• injuries not identified during the first operation,	9 patients
• injuries treated conservatively	5 patients
• delay due to refusal of patients and their relatives the operation	2 patients

The clinical signs, laboratory and radiological findings are shown in Table (4). When first examined in our emergency department, full history included timing and type of surgical procedure done and causes of delayed presentation. One patient had history of hematemesis, 3 had melena, 14 had persistent fever, 14 had obvious peritoneal signs and Biliary leak from abdominal drain (6 patients; 2 of nephrectomy, one of CBD exploration and 3 patients with drains after laparoscopic cholecystectomy). All patients had leucocytosis at the time of admission to our hospital. Serum amylase and lipase were measured in all patients and were increased in 12. All patients had plain abdominal radiographs; intraperitoneal free air was noted in two patients, and retro-peritoneal “air bubbles” were seen in four patients **fig (5).** Four patients had duodenograms with gastrographin, all of which suggested duodenal injuries. Double contrast computed tomograms (CT) were done in six patients. Leakage of contrast media to the retroperitoneum, air bubbles and retroperitoneal abscesses were found in all six **figs (6, 7, and 8).**

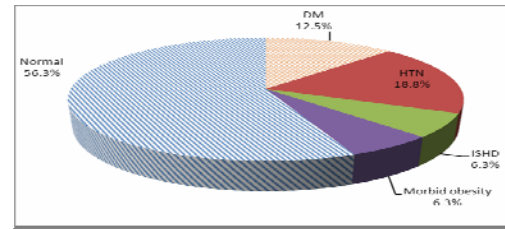


Fig. (1): Co morbid conditions.

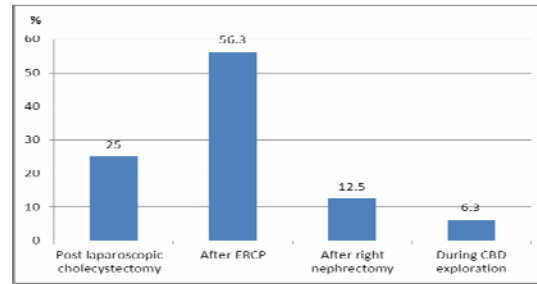


Fig (2): Causes of injury.

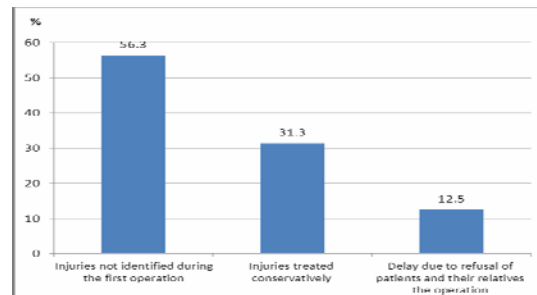


Fig (3): Causes of delayed diagnosis

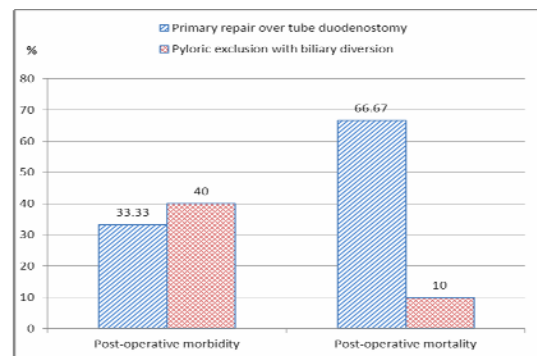


Fig. (4): Post-operative morbidity and mortality

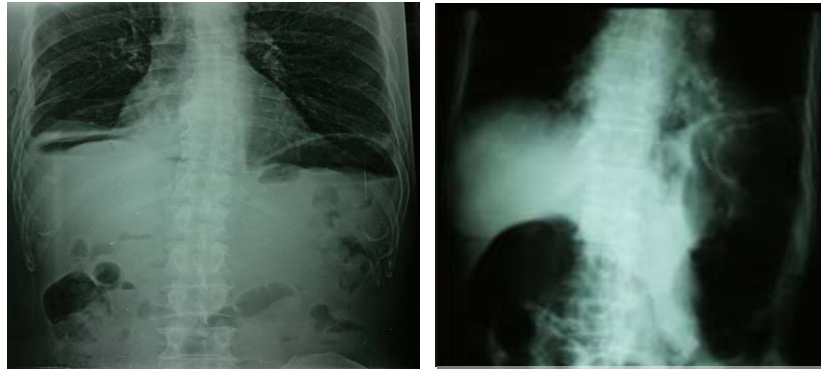


Figure (5): A) plain x-ray lower chest and upper abdomen showing free air under diaphragm due to duodenal injury. B) Plain x-ray abdomen supine showing retroperitoneal air due to duodenal injury.

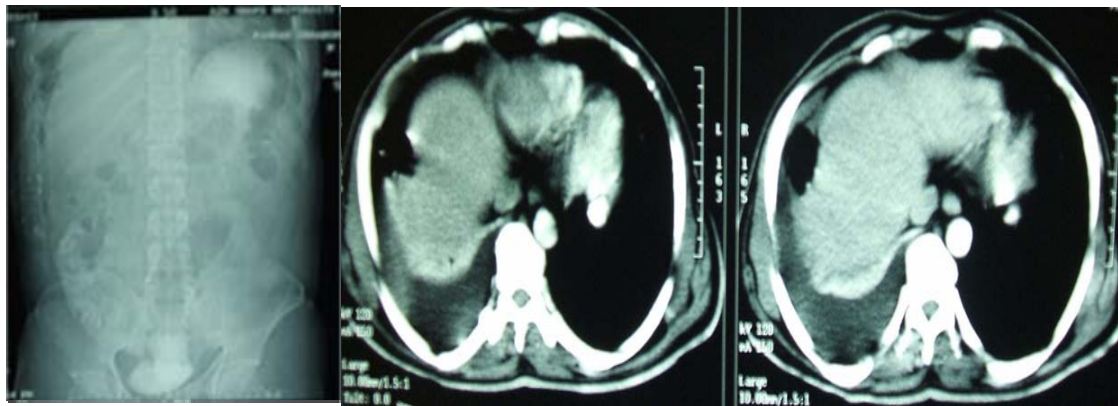


Figure (6): A) CT scan lower chest and upper abdomen (scout view) showing air in right side of abdomen due to duodenal injury. B) The same patient air and fluid collection due to duodenal injury.



Figure (7): CT scan upper abdomen showing air and fluid collection in paraduodenal space due to duodenal injury.



Figure (8): CT scan upper abdomen scout and sagittal view showing biliary stent and extensive inflammatory fluid collection in right retroperitoneal space due to duodenal injury.

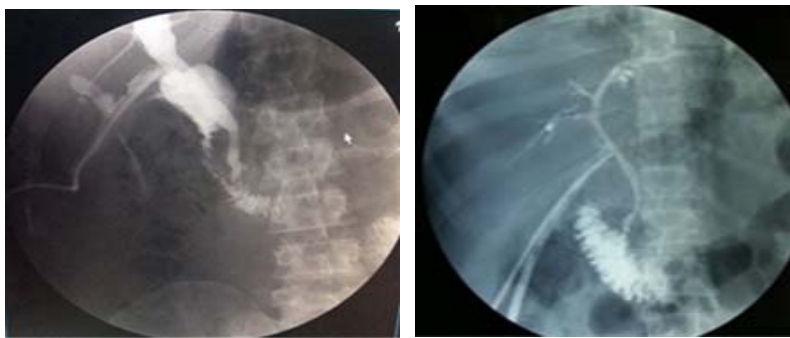


Figure (9): A) T-tube cholangiogram 2 weeks following repair of duodenal injury showing leakage of dye outside duodenum. B) 4 weeks following repair, no leakage of dye outside duodenum.

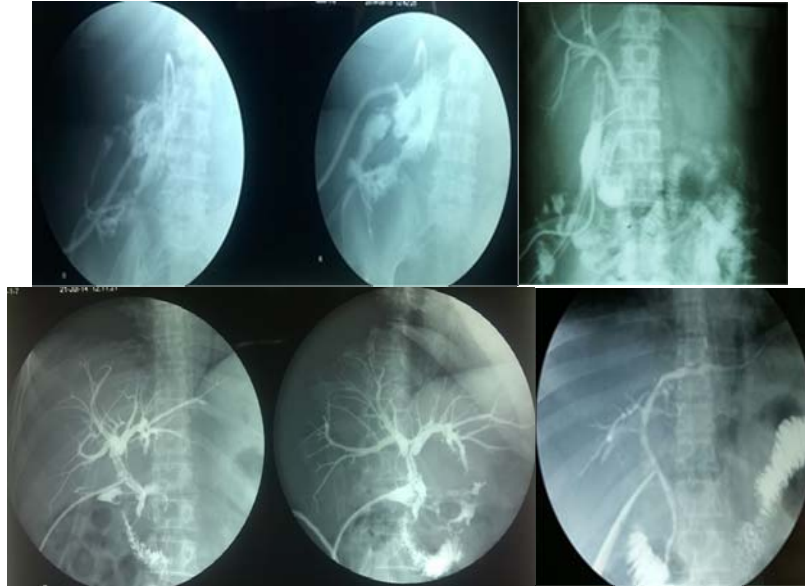


Figure (10): A) T-tube cholangiogram 2 weeks following repair of duodenal injury showing leakage of dye outside duodenum. B) 3 weeks following repair, decrease leakage of dye outside duodenum. C) 4 weeks following repair, minimal leakage of dye outside duodenum. D) 6 weeks following repair, no leakage of dye outside duodenum.



Figure (11): T-tube cholangiogram 2 weeks following repair of duodenal injury showing leakage of dye outside duodenum.

Table (4): Diagnostic work up.

<i>Clinical findings</i>	<i>Laboratory investigations</i>	<i>Radiological findings</i>
Haematemesis (1 patients) Melena (3 patients) Fever (14 patients) Peritoneal signs (14 patients) Biliary leak from abdominal drain (6 patients)	Raised amylase level (12 patients) Leucocytosis (16 patients)	Retroperitoneal "air bubble" (4/16 patients) Intraperitoneal free air (2/16 patients) duodenograms with gastrographin; Leakage of contrast media (4/4) computed tomograms (CT); Leakage of contrast media to the retroperitoneum, air bubbles and retroperitoneal abscesses (6/6).

Intraoperative findings:

Full exploration of abdomen was done. Koucherization of duodenum was done routinely in all patients. 6 patients were found to have the perforation anterior all of them in 1st and 2nd parts and those were found to have free peritoneal collection in the general peritoneal cavity. 9 patients had posterior perforation and the collection was found in retroperitoneal space except for one patient in which collection was found to be extended in all retroperitoneal space and opens into general peritoneal cavity lateral to the caecum. One patient had medial perforation which was not identified intra operative except after methelene blue injection.

Operative management:

The 1st 6 patients were treated with drainage of collection, primary repair of duodenal injury over tube duodenostomy, nasogastric tube for decompression of stomach and feeding through TPN (Total parenteral nutrition) with four deaths and two complications (two prolonged duodenal fistulae). The other 10 patients were treated by pyloric exclusion (closure of pylorus via gastrotomy and closure of pylorus by 3 to 4 interrupted prolene 0/2 sutures then gastrojejunostomy) with biliary diversion via T-tube and feeding was done via nasojejunal tube passed through the gastrojejunostomy and repair of injury and omental patch with one death and four complications (one duodenal fistula and 3 retroperitoneal abscesses).

Table (5): Operative management, post-operative nutrition, post-operative morbidities and mortality

	<i>The 1st 6 patients</i>	<i>The other 10 patients</i>
Operative management		
• Drainage of abscess and collection	Done with wide pore tube drain	Done with wide pore tube drain
• Repair of defect	primary repair of duodenal injury over tube duodenostomy, tube duodenostomy and nasogastric tube for decompression of the stomach	Primary repair of duodenal injury and omental patch. Retrograde duodenostomy via tube passed through opening in upper jejunum done in 2 patients only.
• Decompression		
• Pyloric exclusion and biliary diversion	Not done	closure of pylorus via gastrotomy and closure of pylorus by 3 to 4 interrupted vicryl 0/2 sutures then gastrojejunostomy with biliary diversion via T-tube (done for all patients)
Post-operative nutrition	TPN (Total parenteral nutrition)	Enteral feeding through nasojejunal tube passed through the gastrojejunostomy.
Post-operative morbidity	two prolonged duodenal fistulae	One prolonged duodenal fistula and 3 retroperitoneal abscesses indicated reoperation for drainage.
Post-operative mortality	4/6	1/10

This table shows no statistically significant difference between both groups as regard morbidity, using Chi-square test (χ^2 : 0.071), with p-value (0.788 NS), while mortality shows statistically significant difference between the two groups using Chi-square test (χ^2 : 4.278), with p-value (0.043 S) **fig (4)**.

DISCUSSION

Duodenal injuries occur in about 3%–5% of patients with intra-abdominal injuries⁽⁷⁾. Factors influencing the prognosis of duodenal injuries include the timing of the intervention, associated injuries, and the choice of procedure^(3,6). However, the interval from injury to operation plays the most important part in determining the incidence of duodenum-related morbidity and mortality⁽⁸⁾.

Delay in surgical treatment causes duodenal injury to be more complex. At the time of exploration, the tissues are inflamed that suturing of perforations and lacerations or resection may be technically difficult and ill-advised. In

addition, there may be extensive retroperitoneal abscess formation.

The importance of early diagnosis is evident from surgical statistics, **Lucas and Ledgerwood**⁽⁹⁾ reported that the mortality increased from 11% to 40% when the diagnosis was made more than 24 hours after the injury. Others have also documented an increase in mortality and morbidity such as fistula, after diagnostic delays^(10,11).

The key to diagnosis of iatrogenic duodenal injury is a high index of suspicion. Serum amylase and lipase levels, although markers of injury, they are not diagnostic^(12,13). So if suspicion of duodenal injury continues in the face of equivocal radiographic signs, surgical exploration is the next step^(14,15). But at exploration, however, small wounds of the duodenum may be difficult to see. Important findings include bile staining of the retroperitoneum, small bubbles of entrapped air in the periduodenal tissues, and small periduodenal hematomas.

The vast majority of duodenal injuries may be managed by simple procedures of primary repair, but delayed diagnosis usually indicates complex procedures.

Pyloric exclusion procedure is popularized by **Jordan in the early 1970s**. It consists of primary repair of the duodenal wound followed by closure with non-absorbable sutures of the pylorus, accomplished through a gastrotomy incision on the greater curvature of the antrum. Alternatively, a staple line may be placed across the pylorus. A gastrojejunostomy is then performed at the gastrotomy site ⁽¹⁶⁾.

In our patients causes of injury included laparoscopic cholecystectomy (4 patients), ERCP (9 patients), right nephrectomy (2 patients) and during CBD exploration 1 patient. The causes of delayed diagnosis were injuries not identified during the first operation; injuries treated conservatively and delay due to refusal of patients and their relatives the operation after discussing the complications with them.

Duodenal injuries are extremely rare complications of laparoscopic cholecystectomy but fatal. Mechanism of duodenal injuries during LC include duodenum adherent to the gallbladder, careless dissection and thermal injury. The thermal injuries are difficult to identify during the operation because duodenal juices is poured into the peritoneal cavity hours later ^(18, 19, 20).

ERCP-related perforations occur in about 1% of patients but carries a death rate of 16% to 18%. The clinical presentation of ERCP perforation usually is variable but frequently mild ^(21, 22).

In our patients the clinical signs included history of surgical procedure and exact timing, haematemesis occurred in one patient, 3 patients had melena, 14 had persistent fever, and 14 had obvious peritoneal signs and biliary leak through the abdominal drain after operation in 6 patients; 2 of nephrectomy, one of CBD exploration and 3 patients with drains after lap cholecystectomy.

All patients had leucocytosis at admission. Serum amylase and lipase were measured in all patients and were increased in 12 patients. All patients had plain abdominal radiographs; intraperitoneal free air was noted in two patients, and retro-peritoneal "air bubbles" were seen in four patients. Four patients had duodenograms with gastrographin, all of which suggested duodenal injuries. Double contrast computed tomograms (CT) were done in six patients.

Leakage of contrast media to the retroperitoneum, air bubbles and retroperitoneal abscesses were found in all six.

Fang et al., in 1999. Found Abdominal radiographs were helpful in only eight from 18 patients after blunt abdominal trauma with a sensitivity of 44%, whereas traditional contrast upper gastrointestinal series or CT with enteral contrast were 100% sensitive and specific in these patients.

In this work The 1st 6 patients were treated with drainage of collection, primary repair of duodenal injury over tube duodenostomy, nasogastric tube for decompression of stomach and feeding through TPN (Total parenteral nutrition) but the results were misleading with four deaths and two complications (two prolonged duodenal fistulae). After that we shifted to pyloric exclusion combined with biliary diversion and the results were very good with only one mortality and three complications. Pyloric exclusion was effected by sutures to divert the flow of gastric contents for two to three months. **Kashuk et al.** ⁽¹¹⁾ and **Cone and Eidt** ⁽⁶⁾ recommended pyloric exclusion for those patients with duodenal injury after blunt abdominal trauma whose operative treatment was delayed for more than 24 hours.

In **Fang et al.** series 12 patients were treated in this way. All survived and only one patient developed a duodenal fistula, which closed spontaneously after supportive treatment.

The use of duodenal repair and tube decompression in the management of duodenal injuries is controversial ^(23, 24, and 25). **Stone and Fabian** ⁽²⁵⁾ recommended routine duodenal decompression, while **Ivatury et al.** ⁽²³⁾ thought that a decompressing enterostomy did not improve results and might contribute to morbidity and mortality.

Nutritional support is an integral component of critical care. **Moore et al.** ⁽²⁶⁾ in their clinical study showed that enteral nutrition was well tolerated in severely injured patients, and that early feeding through the gut reduced infective complications in stressed patients. In our series, the 1st group had total parenteral nutrition (TPN), while the others being fed through a nasojejunal tube this helps to avoid TPN-related complications, and was well tolerated in most patients.

In this study, mortality and complications were high in 1st group (mortality; 4/6,

complications 2/6 patients).compared to the 2nd group (mortality; 1/10, complications 4/10 patients).

Asensio and colleagues ^(1, 27) noted a 0% to 17% incidence of duodenal fistula, with an average rate of 6.6%. Other complications reported with duodenal trauma include (1) intra-abdominal abscess, 10.9% to 18.4%; (2) pancreatitis, 2.5% to 14.9%; (3) duodenal obstruction, 1.1% to 1.8%; and (4) bile duct fistula, 1.3%. The overall mortality rate of duodenal injuries continues to be significant, with an average of 17%.

CONCLUSION

Early diagnosis of iatrogenic duodenal injury will reduce the morbidity and mortality. To avoid unnecessary delay, any patient with suspected injury should be evaluated early by an experienced surgeon; an upper gastrointestinal series or CT should be considered if duodenal injury is suspected. Pyloric exclusion plus biliary diversion and early enteral feeding through a nasojejun tube passing through the gastrojejunostomy, in addition to adequate drainage, all will improve the prognosis and keep the mortality low.

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