

Our experience in management of traumatic duodenal injuries in two tertiary hospitals in Egypt

Original Article

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ABSTRACT

Background: The management of duodenal trauma remains controversial. This research is to evaluate how we handle duodenal trauma with various methods to find the best approach, and to discuss the complications in patient outcomes.

Patients and Methods: This retrospective study conducted from January 2014 to December 2023, a total of 64 individuals with abdominal trauma associated with duodenal injury were brought to the emergency departments of Tanta and Banha University hospitals. Operative techniques used for duodenal repair were recorded. All duodenal injuries were graded.

Results: A sum of 64 individuals with duodenal injuries was found, and their ages varied from 18 to 62 years old. The rate of duodenal perforation was discovered to be much higher in males, with 79.7%. A total of 70 duodenal injuries were found. Grade II was the most frequent grade, found in 39 (60.9%) patients. In this research, only three patients had isolated duodenal injuries. Primary repair of duodenal perforation was the most performed procedure (28 (43.8%) cases). The average duration of hospital stay ranged from 4 to 39 days. Thirty-two (50%) patients experienced complications after surgery. The predominant intra-abdominal complication was the development of a duodenal leakage in 11 (17.1%) patients. The mortality rate in our study was 10.9% with a total of 7 cases.

Conclusion: Traumatic perforation of the duodenum is associated with high morbidity and mortality. Primary repair should be the initial approach considered for most injuries. A future prospective study is necessary with a large group of people; and more precise recommendations are necessary.

Key Words: Duodenal trauma, postoperative leakage, primary repair, pyloric exclusion.

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INTRODUCTION

There is still debate over how to manage duodenal trauma. Injuries like these are not common, with even large centers seeing only 10–20 cases/year despite reporting on hundreds of patients^[1].

In adults, duodenal injuries occur in 0.2–0.6% of all trauma cases, and 1–4.7% of abdominal trauma cases^[2,3]. Between 68 and 86.5% of patients have additional injuries, and 23–40% of the cases involve significant vascular injury. The treatment of duodenal trauma is significantly affected by the presence and type of associated injuries^[4]. In adults, duodenal injury is primarily caused by penetrating trauma, making up 53.6–90% of cases. Blunt trauma is the most common cause of pediatric duodenal injury^[2,4,5].

Throughout time, the strategies for treating duodenal injuries have changed and are now based on specific principles that focus on being highly suspicious, thorough surgical exposure, and tailored surgical interventions based on the severity of the injury^[6].

Controversy still surrounds the most effective techniques for managing duodenal perforations. The latest attitude to treat traumatic duodenal injury involves decreasing the choice of complicated procedures and opting for simpler repair techniques by suturing the defect^[7]. Repairing multiple or a delayed injury can be difficult from a technical standpoint, and there are many different methods for doing so. Delayed diagnosis frequently results in diminished chances of survival. Ongoing discussion continues regarding the ideal repair choice to handle duodenal trauma between different repair methods and the use of gastric diversion procedures like pyloric exclusion^[8].

This research aims to evaluate how we handle duodenal trauma with various methods to find the best approach, and to discuss the complications in patient outcomes for those with duodenal trauma.

PATIENTS AND METHODS:

Study design

This retrospective study investigated the use of various techniques for repairing duodenal injuries. From January 2014 to December 2023, a total of 64 individuals with abdominal trauma (both penetrating and blunt) associated with duodenal injury were brought to the emergency departments of Tanta and Benha University hospitals.

The information gathered comprised demographic details, gender, age, cause of injury, and initial vital signs upon admission. Also, the interval between admission and surgery, specific information on the grade and location of the duodenal injury, additional intra-abdominal organ injuries, surgical procedures, duration of hospitalization, and occurrences of complications (such as duodenal fistulas) and death were recorded. A surgical procedure performed within the first 24 h after being admitted to the emergency department was categorized as early intervention. The duodenal injury was considered isolated if it occurred without any other serious injuries being present in other structures such as the liver, spleen, intestine, and major vessels.

Duodenal wounds were categorized according to the Organ Injury Scale established by the American Association for the Surgery of Trauma (AAST) (Table 1)^[9].

The patients over 18 years old who required surgical intervention for duodenal trauma were eligible for the study. Criteria for exclusion were death within 24 h of admission, and nonserious injuries (Grade I) not needing surgery.

In the study period, patients were initially stabilized in the emergency room before undergoing early laparotomy. Every patient was given antibiotics both before and during the operation. If needed, antibiotics were used continuously after the surgery. Every patient had a peritoneal drainage tube inserted and placed in the vicinity of the duodenal suture line.

A Kocher maneuver was performed to explore and mobilize the duodenum. During laparotomy, all patients were diagnosed and had their duodenal injuries graded. The surgeon decided on operative repair based on the guidelines and his experiences. The decision was made considering the level of damage to the duodenum as shown in (Figs 1, 2), the involvement of multiple organs, the extent of edema and friability of the duodenum, the time between injury and treatment, and the overall condition of the patient.

Outcome and follow-up

The primary outcome was successful repair of the duodenal injuries with minimal postoperative complications.

The secondary outcome was decrease overall hospital stay and burden on the health care system

Hospital duration and postoperative complications were documented, with a minimum follow-up of 6 months.

Ethical consideration

Approval for this study was granted by the Faculty of Medicine's Research Ethics Committee at Tanta University, with the reference number (36264PR233/6/23). All surgical procedures that were used adhered to the regulations and guidelines of the 1964 Helsinki Declaration and subsequent revisions.

Statistical analysis

Sample size

For sample size estimation the G* power 3.1 software (Universities, Dusseldorf, Germany) was used. The sample size was calculated based on the decrease of the overall postoperative complications, especially leakage which is the primary outcome of the current study with 95% power, 0.05 type one error (2 tailed), and an effect size of 0.9.

Data processing was performed using Statistical analysis was done using IBM SPSS statistics for windows, Version 26.0. Armonk, NY: IBM Corp. Categorical parameters were presented as number and percentage, while quantitative ones were presented as mean and standard deviation. One-way analysis of variance test was used to compare the quantitative variables across the groups, while χ^2 test analysis was deployed for comparing the rate of complications between the groups. The probability value was adopted at less than 0.05.

RESULTS:

Between January 2014 and December 2023, trauma patients were received in the emergency department of our hospital. A sum of 81 individuals with duodenal injuries was found throughout a 10-year study through clinical workup. A total of 17 patients were excluded from the analysis, 12 patients due to death within the first 24 h, while 5 cases with Grade I injuries or treated conservatively. Out of the 64 patients left, their ages varied from 18 to 62 years old with an average of 30.4 years. The rate of duodenal perforation was discovered to be much higher in males, with 79.7% compared with females. A total of 70 duodenal injuries were found, with 22 in the first part of the duodenum, 20 in the second, 20 in the third, and 8 in the fourth part. In some cases, more than one segment was injured. All duodenal injuries were assessed using the American Association for the Surgery of Trauma grading scale (Table 1)^[9] Grade II was the most frequent grade, found in 39 (60.9%) patients.

Penetrating trauma caused duodenal injury in 44 (68.8%) patients (with 6 (13.6%) cases of gunshot wounds and 38 (86.4%) cases of stab wounds), while blunt trauma was found in 20 (31.2%) patients. The majority of patients with duodenal injuries underwent surgery within 1–36 h (with an average of 5.6 h) after being admitted to the hospital. Fourteen (21.9%) patients arrived at the hospital in hypovolemic shock, as shown in (Table 2).

In this research, 61 patients suffered injuries to abdominal organs other than the duodenum (95.3%), while only three patients had isolated duodenal injuries. A total of 79 related injuries were found among these 61 patients. Out of 61 cases, the liver was the most injured organ (16 patients), with the small bowel following closely (13 patients), and the colon coming in third (nine patients), as shown in (Table 3).

Primary repair of duodenal perforation was the most performed procedure (28 (43.8%) cases), followed by primary repair of perforation with diversion, e.g., a gastrojejunostomy (22, 34.4%), resection anastomosis

(12, 18.8%), and two patients had initial damage control surgery (DCS) before undergoing a Whipple procedure after that. The average duration of hospital stay ranged from 4 to 39 days, with a mean of 15.7, with the highest duration statistically significantly found after the Whipple operation, and the shortest in primary repair, in addition to the shortest duration to surgery was statistically significantly found in Whipple procedure, as shown in (Table 4).

Total 32 (50%) patients experienced complications after surgery. The predominant intra-abdominal complication was the development of a duodenal leakage in 11 (17.1%) patients. In 7 (63.6%) cases, the leaks were handled conservatively; the duodenal fistula closed on its own in 5 of the 7 (71.4%) cases and 2 cases had passed away. Four (34.4%) patients needed another surgery to repair the fistula and one had passed away. The mortality rate in our study was 10.9% with a total of 7 cases; one patient died from hemorrhagic shock 48 h after surgery and the remaining deaths occurred later because of sepsis and multiorgan failure, as shown in (Table 5).

Table 1: American Association for the Surgery of Trauma Duodenal Injury Classification^[8]

Grade	Injury Type	Injury Characteristics
I	Hematoma Laceration	Involving single portion of duodenum Partial thickness, no perforation
II	Hematoma Laceration	Involving > 1 portion of the duodenum Disruption of < 50% of the circumference
III	Laceration	Disruption of 50–75% of circumference of D2 Disruption of 50–100% of circumference of D1, D3, or D4
IV	Laceration	Disruption of >75% of circumference of D2 Involving ampulla or distal common bile duct
V	Laceration Vascular	Massive disruption of duodenopancreatic complex Devascularization of the duodenum

Table 2: Descriptive statistics of the studied patients (n=64)

Variables	Mean±SD	Range
Age	30.4±11.5	(18–62)
		No. (%)
Sex		
Male		51 (79.7)
Female		13 (19.4)
Site of duodenal trauma (n=70)		
D1		22 (31.4)
D2		20 (28.6)
D3		20 (28.6)
D4		8 (11.4)
Degree of duodenal trauma		
II		39 (60.9)
III		21 (32.9)
IV		2 (3.1)
V		2 (3.1)
Hemodynamics at admission		

Stable	50 (78.1)	
Shocked	14 (21.9)	
Type of trauma		
Penetrating	44 (68.8)	
Blunt	20 (31.2)	
Duration to surgery (h)	5.5±7.3	(1–36)
Length of hospital Stay (days)	15.7±19.4	(4–39)

Table 3: Distribution of injuries associated with duodenal trauma (n=64)

Injuries	N (%)
No associated injuries	3 (4.7)
Associated injuries:	61 (95.3)
Liver	16 (25)
Small bowel	13 (20.3)
Colon	9 (14)
Major vascular	8 (12.5)
Stomach	8 (12.5)
Spleen	8 (12.5)
Kidney	8 (12.5)
Gallbladder	6 (9.4)
Pancreas	2 (3.1)
Common bile duct	1 (1.6)

Table 4: Relationship between the surgical technique and independent variables studied patients (n=64)

	Primary repair (n=28)	Primary repair+ gastrojejunostomy (n=22)	Resection (n=12)	Whipple operation (n=2)	Test of significance P value
Age	30.3±9.8	30.7±15	30.5±16.2	43±0.2	F= 0.59 0.6
Duration to surgery (h)	5.8±3.1	6.9±1.2	3.75±1.8	3±0.1	F=5.6 0.001*
Length of hospital stay (day)	9.5±8.8	15.6±7.7	22.8±13.4	38±0.1	F=10 <0.0001*
Risk of complications	14 (50)	8 (36.4)	8 (66.7)	2 (100)	X ² =5.13 0.1

Table 5: Distribution of postoperative complications of the studied patients (n=64)

Complications	N (%)
No complication	32 (50)
Complication rate:	32 (50)
Subtypes of complications	
Wound infection	23 (35.9)
Duodenal leakage	11 (17.1)
Chest infection	7 (10.9)
Ileus	6 (9.3)
Burst abdomen.	5 (7.8)
Liver abscess	5 (7.8)
Deep vein thrombosis	3 (4.7)
Pancreatic fistula	1 (1.5)
Death	7 (10.9)

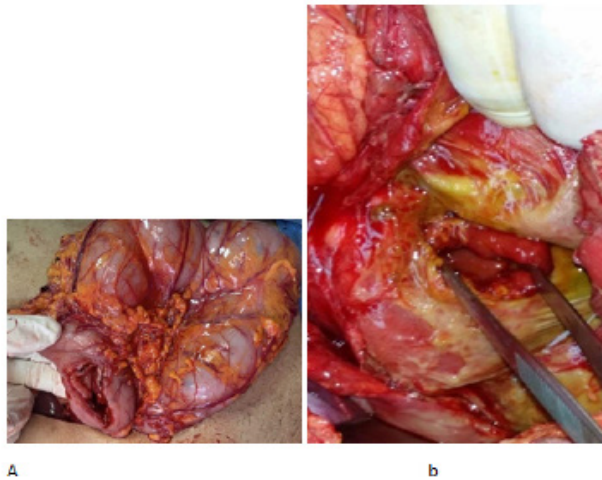


Fig. 1a: Intraoperative image confirming the diagnosis of duodenal injury. **b:** Intraoperative image confirming the diagnosis of duodenal injury.



Fig. 2: Intraoperative image confirming primary repair of trauma in second part duodenum.

DISCUSSION

Incidences of duodenal injuries make up of average of about 2% of all abdominal injuries^[10]. According to the literature, 25% of injuries are caused by blunt abdominal trauma, with the remaining percentage resulting from penetrating trauma^[11]. Although most reported series focus on penetrating injuries, blunt injuries make up a smaller percentage ranging from 0.2 to 2.7%^[12]. One study showed a higher incidence of blunt abdominal trauma of about 89% (56/63) of the patients^[13]. In our research, duodenal injury was more common in 44 (68.8%) patients because of penetrating trauma, compared with 20 (31.2%) patients who had blunt trauma.

Duodenal injuries caused by blunt trauma are more complicated than those caused by penetrating trauma. Literature indicates that blunt trauma causes greater tissue damage at both microscopic and macroscopic levels and triggers a heightened inflammatory reaction Good statement^[14]. These elements could potentially hinder the healing process, resulting in the separation of the suture line and its consequences. How the injury occurred greatly affects how it is managed and the result. There are primarily three pathogenic mechanisms that are caused by blunt visceral injuries, either acting alone or together^[15,16].

1- Direct force could potentially compress the intestine between the vertebrae and the front of the abdomen, such as in instances of steering wheel or seat belt injuries. 2- A rapid acceleration and deceleration in speed cause a cutting force, like a high fall. 3- A sudden rise in pressure inside the bowel can lead to bursting injuries caused by falls, or sports.

Due to its position behind the peritoneum and close to various organs like the right kidney, liver, common bile duct, and transverse colon, the duodenum is seldom injured alone. Hence, a solitary injury to the duodenum is a notable anomaly, particularly if it is the result of blunt force trauma. The liver (17%) and colon (13%) are the most affected organs in cases of duodenal injury. Even though it is not common, isolated duodenal laceration can occur, and our research includes 3 cases. Most patients in this research study suffered injuries to abdominal organs aside from the duodenum, at a rate of 61 (95.3%) patients. A total of 79 injuries related to these 61 patients were discovered. The liver was the organ most injured in 16 (25%) patients, followed by the small bowel in 13 (20.3%) patients, and the colon in nine (14%) patients.

Santos and colleagues conducted a review of 15 published studies that examined a combined total of 1042 patients with duodenal injuries. The duodenum's second segment is the most frequently injured, comprising 36% of all injuries, followed by the third, fourth, and first segments at 18, 15, and 13% each, respectively. Injuries were identified in several parts in 18% of cases^[12]. In our research, duodenal injuries were distributed as follows: 31.4% in the first part, 28.6% in the second, 28.6% in the third, and 11.4% in the fourth. About 9% of cases had injuries in multiple segments.

The surgical treatment of duodenal injury is a topic of debate, with no agreement on the best course of action. Different surgical interventions can be evaluated depending on factors such as the seriousness of the injury and when it is presented, along with any related injuries. The aim of the present research was to outline the pattern of surgical interventions carried out

for duodenal trauma and the associated results over a span of 10 years from 2014 to 2023.

Although previous literature shows a shift towards less invasive procedures for high-grade duodenal injuries, it should be emphasized that grade V injuries still necessitate complex procedures. Grade V injuries to the duodenum result in extensive damage to the duodeno-pancreatic complex and loss of blood supply, leading to severe consequences. The findings indicate that grade V injury is a notable standalone factor contributing to mortality^[17]. If surgeons are faced with a complicated duodenal injury, hemodynamic instability and/or major associated injuries, DCS should be the standard approach. Postponement of definitive reconstructive surgery is necessary until the patient has been sufficiently resuscitated and the reversible factors leading to imminent death have been addressed^[18]. Complex surgery is still necessary for reconstruction or repair in subsequent returns to the operating room, even if a patient survives the initial DCS^[17]. During our research, we observed two type (V) cases treated using the Whipple procedure.

Over the past ten years, there has been a change in the field of literature towards simpler surgical techniques instead of complicated procedures for treating duodenal injuries^[19–22]. There was a trend towards a higher overall complication rate and longer hospital stay in the pyloric exclusion group. There was no variation in mortality rates between patients treated with primary repair or pyloric exclusion Excellent^[21].

Additionally, in 2014 the Western Trauma Association released guidelines on the treatment flowchart for duodenal injuries^[23]. These guidelines showcase the changing landscape of surgical methods for repairing the duodenum. The Western Trauma Association algorithm suggests using basic methods for repairing most duodenal wounds, with tension-free primary closure as the preferred first surgical option, even for more severe injuries. Furthermore, Siboni and colleagues have recently published findings from a retrospective study showing that performing a basic repair for isolated blunt duodenal trauma resulted in a shorter hospital stay and no difference in mortality rates compared with more complicated surgeries^[24].

In our research, most of the cases underwent simple surgeries. Primary repair was performed in 28 (43.8%) cases, primary repair with gastrojejunostomy in 22 (34.4%) cases, and resection and anastomosis in 12 (18.8%) cases.

Thirty-two (50%) patients experienced postoperative complications. In 11 (17.1%) patients, the main abdominal complication was the occurrence

of a duodenal leakage. In 7 (63.6%) cases, these leaks were handled conservatively. The duodenal fistula spontaneously healed in 5 (71.4%) of the 7 cases. Four (34.4%) patients needed another surgery to fix the fistula. Three patients passed away while having an active fistula. Additional complications included wound and chest infection at rates of 35.9% and 10.9%, respectively, as well as paralytic ileus at 9.4% and liver abscess at 7.8%. In additional research, postsurgery complications can consist of abscess formation (15%), fistula from suture line dehiscence (6%), duodenal obstruction (0.9%), and recurrent pancreatitis (0.5%)^[12].

In our study, the leak rate was 17.1%, consistent with the literature which reported rates between 7 and 15%^[12,25]. The probable reason could be tardiness in arriving at the surgery center. As a result of this postponement, a stronger inflammatory environment was formed in the duodenal tissue, resulting in hindered healing. Different research found that the rate of postoperative duodenal leakage was 32.7%, even in cases of grade II or III injury, with the reason being that about 88% of the cohort had blunt trauma injuries^[26]. This is because a healthy retroperitoneum can obstruct the leakage of bowel contents, thus avoiding panperitonitis. In fact, retroperitonitis may go unnoticed postinjury as there is a low bacterial count in the duodenum and the pancreatic bicarbonate can neutralize the stomach acid^[27]. A delayed diagnosis could lead to higher contamination and inflammation at the surgical site, potentially leading to slower wound healing and a higher chance of postoperative leakage. Therefore, their findings indicate that the duration between the injury and the surgery could be the most critical factor in a controlled setting, and pyloric exclusion may not be able to prevent postoperative leakage. Patients who undergo a delayed operation require careful planning of surgical approach and vigilant monitoring^[28].

Mortality from duodenal trauma can be categorized into two types: early mortality occurring within the first 48 h postinjury, and late mortality occurring after 48 h. Of the deaths related to duodenal trauma, 75% occur early and are typically linked to bleeding and injuries to the central nervous system. The primary causes of delayed deaths are sepsis, duodenal fistula, and multiple organ failure. A few studies have reported the mortality rate linked to duodenal trauma to be between 4 and 30%^[12,29–31]. The mortality in our study was 10.9% (7 cases). One death occurred 48 h postsurgery due to irreversible hemorrhagic shock. The remaining deaths occurred later because of sepsis and multi-organ failure.

CONCLUSION

Traumatic perforation of the duodenum is associated with high morbidity and mortality. Primary repair should be the initial approach considered for most injuries. The study's primary constraints are its retrospective design, small and diverse center cohort, which may lead to significant biases like selection or survival bias.

A future prospective study is necessary with a large group of people; however, conducting this trial would be difficult because of the low occurrence of duodenal injuries. The surgeons had different levels of skill and experience. This could disrupt the uniformity of the quality of procedures and choices in the field of surgery. Ultimately, the absence of explicit guidelines meant that a surgeon's choice was based on their intuitive evaluation or overall impression. Therefore, more precise recommendations are necessary.

CONFLICT OF INTEREST

There are no conflicts of interest.

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