Original Article

TRAUMATIC DUODENAL INJURY: A DIAGNOSTIC AND MANAGEMENT DILEMMA

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ABSTRACT

Background: Duodenal injuries are challenging and can lead to significant morbidity and mortality in pediatric patients. The management of these injuries has evolved over the years, and understanding the nuances of pediatric duodenal injury is crucial for optimizing patient care. The objective of this study is to understand the nuances of pediatric duodenal injury by evaluating our record of previous years in our department.

Materials & Methods: A retrospective study was conducted at The Children's Hospital, University of Child Health Sciences, Lahore, analyzing patient records of traumatic duodenal injuries from April 2017 to November 2019. Data on patient demographics, mode of injury, clinical presentation, diagnosis, management, complications, and outcomes were collected and reviewed.

Results: Seventeen pediatric patients with traumatic duodenal injuries were included in the study, with the majority being males presenting with blunt trauma abdomen. Most common presenting complaints included abdominal discomfort, bilious vomiting, and abdominal distension. Surgical intervention was pursued for all patients, and associated injuries were observed in 23.5% of patients. The classification of duodenal injuries varied, with Grade III injuries being the most prevalent. Postoperative complications and mortality were also noted.

Conclusion: Blunt abdominal trauma, mainly from falls and road traffic accidents, was the most common cause of pediatric duodenal injuries. Limited access to contrast-enhanced CT highlighted the importance of clinical assessment and basic imaging in guiding timely intervention, while a multidisciplinary approach remained crucial for managing severe cases.

Keyword: Pediatric, Traumatic Duodenal Injury, Case Series

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INTRODUCTION

Duodenal injuries are one of the most notorious injuries and pose a serious morbidity and mortality risk in all patients regardless of their age groups. The mortality associated with these injuries rise up to 25%.[1] The duodenum lies in a relatively protected area of the abdomen i.e., in the retroperitoneum, and thus only a small percentage of blunt trauma injuries will result in its damage. A similar fact may render its early diagnosis and ultimate management a tough task. Its relative position to the surrounding structures makes it a high likelihood to be associated with other injuries.[2] The most common mechanism of injury in the pediatric age group leading to duodenal injury is the direct hit to the epigastrium and that may

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be due to road traffic accidents, fall directly on the abdomen, or handle bar injuries in the playground.[3] Blunt abdominal trauma induces duodenal injury through mechanisms such as crushing, compression, and traction. The duodenum may be crushed between a rigid external object and the spine during such trauma. Additionally, sudden acceleration or deceleration forces at the duodenal attachment point, specifically the ligament of Treitz, can elevate intraluminal pressure and cause traction on the duodenum resulting in tearing of the lumen.[4]

The ever-evolving medical profession has seen the management recommendation for duodenal injuries change a lot over the years, especially in the pediatric age groups. The doctrines of operative management involving duodenal trauma revolve around these decisions, damage control, non-viable tissue resection, restoration of the gastrointestinal continuity, along with possibility of a diversion of the contents of the gastrointestinal tract including bile and pancreatic enzymes, ultimately allowing the repair to heal alongside a feeding access during this time.[5] The management options have evolved from tube duodenostomies and duodenal diverticulization to the primary repair with an option of pyloric exclusion depending upon the complexity of the injury.[2] Understanding the nuances of pediatric duodenal injury is essential for healthcare professionals to provide optimal care for these vulnerable patients.

MATERIALS & METHODS

This is a retrospective study focusing on the analysis of series of cases involving patients who were diagnosed with duodenal injuries due to trauma, at The Children's Hospital, University of Child Health Sciences, Lahore, Pakistan. The study period spans from April 2017 to November 2019, during which the team meticulously collected and reviewed data related to patient demographics, mode of injury, clinical presentation, diagnosis, management, complications, and the final outcomes of the patients. Study approval was obtained by the Institutional Review Board of University of Child Health Sciences, The Children's Hospital, Lahore. No: 919/CH-UCHS dated 24-05-2024

RESULTS

During the period of this study, we had 17 patients with traumatic duodenal injury of which 12 were male and 5 were female. The mean age of presentation was 7.16 years. The majority of the patients in the study had the mechanism of injury as blunt trauma abdomen either with a history of fall, road traffic accident, or trauma to the abdomen via something falling on the patient's abdomen. Only 1 patient had a firearm injury. None of the cases in this study were identified as non-accidental injuries. All injuries had a clear traumatic mechanism consistent with accidental causes, and there were no concerns regarding inflicted trauma based on history, clinical assessment, or imaging findings. The prevalent presenting complaints included abdominal discomfort, vomiting with bile, and abdominal swelling. We observed that the patients presenting with altered consciousness had a 100% mortality rate and also patients with relatively milder symptoms had a higher mortality rate compared to other groups as they may have misled the surgeon in making a timely decision.

Preoperative imaging was done in all of the patients, but CT scan of the abdomen and pelvis was not available in the emergency department at our hospital during the study period. As a result, imaging was limited to X-ray and ultrasound, which were used as the primary diagnostic modalities to guide clinical decision-making. The erect X-ray of the abdomen and pelvis was non-specific in 11 cases. Among the remaining cases, three demonstrated air-fluid levels, one showed pneumoperitoneum, and two exhibited haziness. Additionally, ultrasound was performed in all patients,

Table 1

Grade	Type of Injury	Description of Injury
I	Hematoma	Involving single portion of duodenum
	Laceration	Partial thickness, no perforation
II	Hematoma	Involving more than one portion
	Laceration	Disruption <50% of circumference
III	Laceration	Disruption 50%-75% of circumference of D2
		Disruption 50%-100% of circumference of D1,D3,D4
IV	Laceration	Disruption >75% of circumference of D2
		Involving ampulla or distal common bile duct
V	Laceration	Massive disruption of duodeno-pancreatic complex
	Vascular	Devascularization of duodenum

revealing bowel dilatation with mild ascites, mild to moderate free fluid in the pelvis, and, in some cases, gross debris-laden ascitic fluid. These imaging findings played a role in the overall clinical assessment and decision-making for surgical intervention.

Following optimization in accordance with the ATLS protocol, surgical intervention was pursued for all patients. Surgical exploration was indicated based on clinical and imaging findings. Patients with peritonitis, hemodynamic instability, or persistent abdominal distension underwent immediate laparotomy. Additionally, pneumoperitoneum, debris-laden ascitic fluid, or significant bowel dilatation with free fluid on imaging warranted exploration. In cases with non-specific findings, worsening clinical status or failure to improve with conservative management guided the decision for surgery. Based on the American Association for the Surgery of Trauma's classification system for duodenal injuries, the traumatic rupture of the duodenum was categorized as Grade II in 3 patients, Grade III in 9 patients, 4 patients categorized as Grade IV and only one patient was having a Grade V injury. (Table 2) (Figure 1)

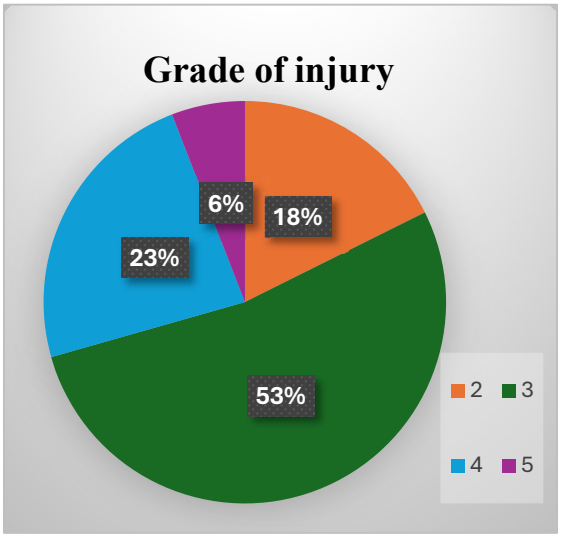

Figure 1

Table 2

Additional supportive procedure & Procedure performed Cross-Tabulation				
		Procedure Performed		Total
		End to end duodenoduodenal anastomosis	Repair of perforation with/ without omental coverage of anastomosis	
Additional supportive procedure	Duodenostomy, cholecystostomy & feeding jejunostomy	2	3	5
	Duodenostomy & feeding jejunostomy	0	1	1
	Duodenostomy, cholecystostom, gastrojejunostomy & pyloric exclusion	1	2	3
	Tripple drainage & pyloric exclusion	1	1	2
	Feeding jejunostomy	0	1	1
	Cholecystostomy & Feeding jejunostomy	1	0	1
Total		5	8	13

About 23.5 percent of patients had associated injuries which included liver laceration, pancreatic injury, and jejunal and colonic perforations. Among these patients we saw that there was a 100 percent mortality in the patients with an associated pancreatic injury. In our study, we observed that 5 patients underwent end-to-end anastomosis while 12 patients underwent repair of the perforation with or without omental coverage. Additional supportive procedures were performed in 13 of these patients and included tube duodenostomy, cholecystostomy, feeding jejunostomy, and pyloric exclusion. (Table 3)

Table 3

Clinical features * Final outcome Crosstabulation				
		Final outcome		Total
		Survived	Died	
Clinical Features	Pain abdomen, vomiting	8	3	11
	Pain abdomen, distension	1	0	1
	Pain abdomen, vomiting, altered consciousness	0	1	1
	Pain abdomen, vomiting, distension	2	1	3
	Pain abdomen, hematemesis	1	0	1
Total		12	5	17

Three patients were re-explored for anastomotic leakage (2) and retroperitoneal collection (1). Five patients (29.4%) succumbed in the postoperative period in our study. An association between the grade of injury and the final outcome is shown in the table above.

In our study, we also observed that 3 patients who underwent re-exploration survived ultimately which may have been due to an early diagnosis of a complication followed by an early intervention.

DISCUSSION

The management of traumatic duodenal injury in pediatric patients poses significant challenges due to the complex anatomy, the potential for delayed presentation, and the risk of associated injuries.[6] The predominant cause of duodenal injury in our study was blunt trauma abdomen and this aligns with findings from other research indicating that blunt mechanisms are the most frequent causes of duodenal injuries. The most common blunt mechanisms in our series were falls and road traffic accidents.[7] Due to their close anatomical location to other organs, these injuries seldom occur in isolation.[8] Morbidity and late mortality in duodenal injuries are generally associated with sepsis and/or other intra-abdominal complications, especially dehiscence of the duodenal suture line. Nonetheless, identifying the most effective method to repair the injured duodenum to avoid leaks at the duodenal suture line has proven challenging.[9] A literature review highlights that in many resource-limited settings, advanced imaging modalities like CT scans are often unavailable in emergency situations. Similar constraints have been highlighted in studies carried out in Africa.[10] Consequently, healthcare providers rely more heavily on clinical assessments, X-rays, and ultrasound for diagnosing abdominal injuries. This reliance underscores the importance of clinical judgment and the need for improved access to advanced imaging technologies in such environments.[11] In a study carried out in Texas, they observed that the majority of duodenal injuries were of Grade I and II (59.3%) and only 53.1% of their patients underwent exploration which was in contrast to our study as our study showed that about 82% of patients had a higher than Grade II injury and 100% of the patients underwent exploration.[12] In another study carried out in Indianapolis,

they observed associated injuries in 67% of patients whereas in our study this was found to be true in 23.5% of patients.[13] In a similar study the grade of injuries was found to be I or II in the majority of the cases. In a more recent study in Virginia that was also a multi-center retrospective study the percentage of associated injuries was significantly higher than our study but the grade of injury was more comparable to our findings.[9]

A case report from New Delhi reported the management of duodenal injury by simple repair along with duodenal decompression achieved by the triple tube technique.[14] Another study from Morocco has advocated for the conservative management of minor duodenal injuries and has shown favorable outcomes in their series.[15] Another case report from New Delhi has advocated for the use of Roux-en-Y duodenojejunostomy for a major duodenal injury leading to a significant defect.[16] In a retrospective analysis carried out in the USA primary repair was carried out in 80% of patients undergoing operative management for duodenal injury.[9] In our study however 5 (29.4%) patients underwent repair of the primary perforation without any additional procedures and the rest of the patients either had triple drainage with or without pyloric exclusion.

The choice of surgical intervention for duodenal injuries varies significantly across different healthcare settings. In high-resource environments, the availability of advanced imaging allows for more tailored surgical approaches based on detailed preoperative assessments. In contrast, resource-limited settings often necessitate a more generalized approach due to constraints in diagnostic capabilities.[17] This variation highlights the ongoing debate between individualized versus standardized surgical protocols and emphasizes the need for context-specific strategies to optimize patient outcomes.[18]

Our study showed that an associated pancreatic injury and a Grade V injury showed a 100% percent mortality rate similarly a presentation with altered consciousness had a worse outcome. This was corroborated by other international studies.[9] A recent study reviewing the medical literature also showed that complex duodenal injuries, defined as Grade III or higher, had significantly higher morbidity and mortality.[19]

The mortality rate in our study was 29.4% which was comparable to 24% in an international multi-center retrospective analysis.[9] In another study treatment of children with blunt duodenal injuries at Pediatric trauma centers certified by the American College of Surgeons was linked to lower odds of complications compared to non-certified centers.[20] This may explain the comparable mortality rates of our study to the international standards.

CONCLUSION

Blunt abdominal trauma, particularly from falls and road traffic accidents, was the leading cause of pediatric duodenal injuries in our study. The absence of contrast-enhanced CT in the emergency setting posed a diagnostic challenge, making clinical assessment and basic imaging essential for timely decision-making. We observed that patients with higher-grade injuries, especially those with pancreatic involvement, had significantly higher mortality. Notably, children presenting with altered consciousness had a universally fatal outcome, while even those with seemingly mild symptoms required careful evaluation to prevent delays in intervention. Early recognition and timely re-exploration for complications played a crucial role in improving survival, underscoring the need for close postoperative monitoring and a proactive surgical approach. The treatment process, particularly for more severe injuries, should consistently implement a multidisciplinary approach.

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CONFLICT OF INTEREST

None

AUTHOR's CONTRIBUTION

CEA: Manuscript Writing Data Analysis
NT: Supervision of the Project manuscript writing Guidance Review
MBM: Curation of the Study Supervision of the Project Manuscript review
ZS: Manuscript Editing
MUA: Date Collection
AAC: Data Collection

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