

# Duodenal Trauma: Incidence and Management in Penetrating and Blunt Abdominal Trauma

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## ABSTRACT

**Rationale:** Duodenal injuries are rare and most common due to penetrating abdominal trauma, especially gunshot wounds, with greatest prevalence among young men. Achieving simpler and more effective surgical procedures also contributes to the reduction of mortality and morbidity rates.

**Objective:** Review cases of penetrating and blunt duodenal trauma, the complexity of the injuries, incidence, management as well as morbidity and mortality.

**Materials and methods:** At Grajaú General Hospital, between January 2010 and May 2014, a retrospective analysis of 1,039 patients' medical records who had undergone emergency exploratory laparotomies was done. From these cases, 298 were caused by blunt and penetrating abdominal traumas, and 11 suffered duodenal traumas.

**Results:** It was observed that there was a predominance of young adults (mean age 26.48 years) and all patients were males (100%), of which one injury was from blunt abdominal trauma, three from stab wounds, and seven caused by firearm. Most of the duodenal injuries were classified as grade II injuries and most commonly involved the fourth portion of the duodenum. We emphasize the association with injuries to other organs, especially the liver and the small intestine. In the cases we analyzed, we highlight the importance of time between entry of service and surgery in all patients being less than 6 hours. The most common surgery performed to repair these injuries was duodenorrhaphy (90.9%). In this series, there were four deaths. Postoperative complications included duodenal fistulae with spontaneous resolution.

**Conclusion:** Duodenal injuries are rare, and are most commonly due to penetrating abdominal trauma, especially gunshot wounds, with the greatest prevalence among young men. There is a need for early diagnosis and rapid surgical intervention, shortened and effective surgical procedures, due to the morbidity/mortality and high complexity of these injuries. This emphasizes the importance of early intervention in the short time before surgical procedure takes place.

**Keywords:** Abdominal trauma, Duodenal/trauma, Duodenum/injuries, Wounds and injuries.

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## RESUMO

**Racional:** As lesões duodenais são raras e quando identificadas habitualmente se associam ao trauma abdominal penetrante, especialmente ferimentos por arma de fogo, com maior prevalência entre os homens jovens. A utilização de procedimentos cirúrgicos mais simples e eficazes também contribui para a redução das taxas de mortalidade e morbidade.

**Objetivo:** Avaliar os casos de traumatismo duodenal penetrante e contuso, a complexidade das lesões, incidência, manejo bem como morbidade e mortalidade.

**Métodos:** Análise retrospectiva de 1039 prontuários médicos de pacientes atendidos no Hospital Geral de Grajaú, entre janeiro de 2010 e maio de 2014, que foram submetidos à laparotomia exploradora de emergência. Destes casos, 298 apresentavam traumas abdominais contusos ou penetrantes, sendo que destes, 11 apresentavam traumas duodenais.

**Resultados:** Observou-se predominância de adultos jovens (idade média de 26,48 anos) e todos os pacientes eram do sexo masculino (100%), dos quais 1 apresentava traumatismo abdominal contuso, 3 de ferimentos por arma branca e 7 por arma de fogo. A maioria das lesões duodenais foram classificadas como lesões de Grau II e mais comumente envolvidos na quarta porção do duodeno. Enfatizamos a associação com lesões a outros órgãos, especialmente ao fígado e ao intestino delgado. Nos casos analisados, destacamos a importância do tempo entre a entrada do serviço e a cirurgia em todos os pacientes com menos de 6 horas. A cirurgia mais comum realizada para reparar essas lesões foi duodenorrhaphy (90,9%). Nesta série, houve 4 mortes. As complicações pós-operatórias incluíram fístulas duodenais com resolução espontânea.

**Conclusão:** As lesões duodenais são raras e são mais frequentes perante ferimentos abdominais penetrantes, especialmente ferimentos por arma de fogo, com maior prevalência entre homens jovens. É necessário um diagnóstico precoce e uma intervenção cirúrgica rápida, procedimentos cirúrgicos devem ser abreviados, devido à morbidade/mortalidade e alta complexidade dessas lesões. A intervenção deve ser precoce e o procedimento cirúrgico deve ser preciso e eficaz.

**Palabras claves:** Duodeno/lesões, Duodenal/trauma, Ferimentos e lesões, Trauma abdominal.

## INTRODUCTION

Duodenal injuries are an important area of interest for surgeons who work in emergency surgery and trauma, as they are associated with high morbidity and mortality.<sup>1</sup> Being predominantly a retroperitoneal organ, this type of injury is often associated with high-impact trauma

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and thus concomitant injuries to other organs, such as liver, spleen, and pancreas are common. In addition to the factors mentioned above, especially the location and early diagnosis of duodenal injuries remain a challenge.<sup>1,2</sup>

Statistically, duodenal injury occurs in about 3 to 5% of abdominal trauma, and penetrating injuries are responsible for most cases.<sup>3-7</sup> The morbidity and mortality of this type of injury is directly related to diagnostic delay and associated injuries.<sup>1,3</sup>

As for the classification of injuries, the American Association for Surgery of Trauma (AAST) guidelines<sup>8</sup> were used and they divide the extent of duodenal trauma into degrees of severity ranging from I to V according to Table 1.

With regard to the surgical treatment, most duodenal lesions (about 80%) can be corrected primarily after careful debridement of the injured tissue. However, other techniques may be employed, such as the technique of triple ostomy, duodenal resection, duodenal diverticularization, pyloric exclusion pancreatoduodenectomy (Whipple procedure).<sup>2,5,9,10</sup> Moreover, they are susceptible to technical discussion among surgeons due to its complexity in the trauma setting, especially if damage control is needed.

But even with the correct application of surgical techniques, the following complications may still occur: Dehiscence, anastomotic fistula, pancreatitis, peritonitis, intraabdominal abscess, and duodenal obstruction; fistula is the most common complication.<sup>2,3</sup>

**OBJECTIVE**

This study aims to retrospectively analyze penetrating and blunt duodenal trauma, treated at the Department of General Surgery and Trauma of the Universidade de

Santo Amaro – Grajaú General Hospital between January 2010 and May 2014.

**MATERIALS AND METHODS**

The medical records of 1,039 patients who underwent laparotomy between January 2010 and May 2014 were analyzed, and out of these, 298 were performed due to abdominal trauma. Among these are 11 duodenal injuries, which were used for the analysis of this study. The severity of duodenal injury was classified according to the AAST Organ Injury Scaling. The elements selected for analysis were age, sex, degree of duodenal injury, trauma mechanism, Injury Severity Score (ISS), associated injuries to other organs, length of stay in hospital services, surgical procedures used, complications, and mortality.

The most common surgical treatment of duodenal injuries was duodenorrhaphy (primary repair of the injury). However, the most common postoperative complication was fistula of the anastomosis.

**RESULTS**

During the time interval of this study, 1,039 exploratory laparotomies were performed, and 298 laparotomies for closed and penetrating trauma (n = 298).

Indications for the 298 laparotomies performed in this service consist of: 61 closed/blunt abdominal trauma (BAT), 116 injuries by firearms (FA), 120 stab wounds (SW), 1 by FA and SW simultaneously. In this context, 11 duodenal injuries were identified. Out of these cases, the duodenal injuries were caused in one case by BAT, three by SW, and seven by FA. The results are shown in Table 2.

Of the 11 cases examined with duodenal injury, all were males aged between 17 and 52 years (mean 26.45 years); 4 patients died (deaths were observed in all groups), days of hospitalization ranged from 1 to 65 (average 15.81 days); ISS ranging from 18 to 51 (mean 28.45); the time intervals between admission to the service and the surgical procedure include 7 cases waiting less than 1 hour, 3 cases waiting between 1 and 6 hours, and 1 case between 12 and 18 hours.

With regard to the degree of duodenal injury, 3 cases had grade I, 7 patients had grade II injury, and 1 patient had a grade III. The portion of the duodenum most affected was the fourth, with 1 case sustaining injury to

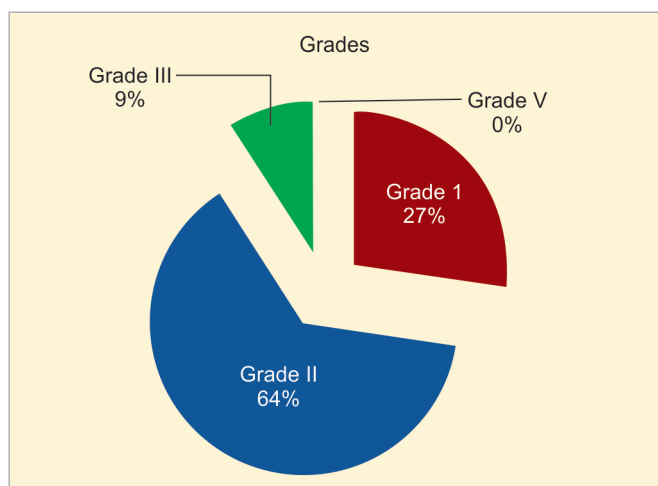
**Table 1:** Duodenal injury classification according to the American Society for Surgery of Trauma (AAST)

Organ injured	Grade	Characteristics of the injury
Duodenum	I	Hematoma: Injury involving a single portion
		Laceration: Superficial injury without perforation
	II	Hematoma: Injury involving more than a single portion
		Laceration: laceration <50% of the circumference
	III	Laceration: Rupture of 50–75% of the circumference D2
IV	Rupture 50–100% of the circumference of D1, D3, and D4	
	Rupture of 75% of the circumference D2	
V	Laceration: Involving ampulla or common bile duct	
	Laceration: Massive destruction of pancreaticoduodenal complex	
		Devascularization of the duodenum

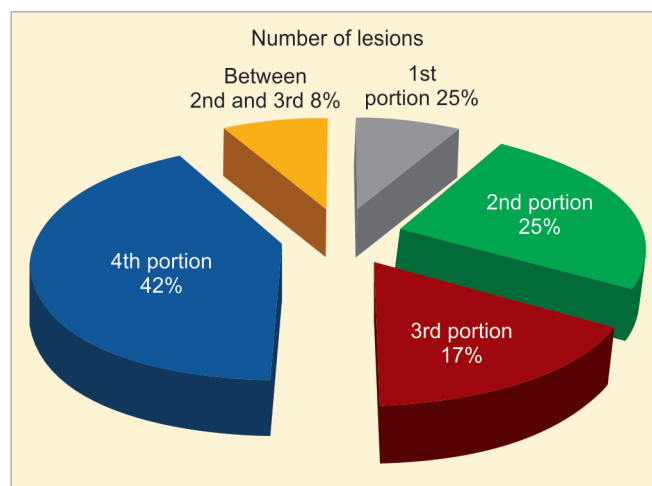
**Table 2:** Relative incidence of duodenal injuries on the types of duodenal trauma

Incidence	Percentage
DT/BAT	1.64
DT/FA	5.98
DT/SW	2.47





**Graph 1:** Classification of the degree of duodenal injury in abdominal trauma treated at the Grajaú General Hospital



**Graph 2:** Duodenal portions damaged × amount of damage per portion

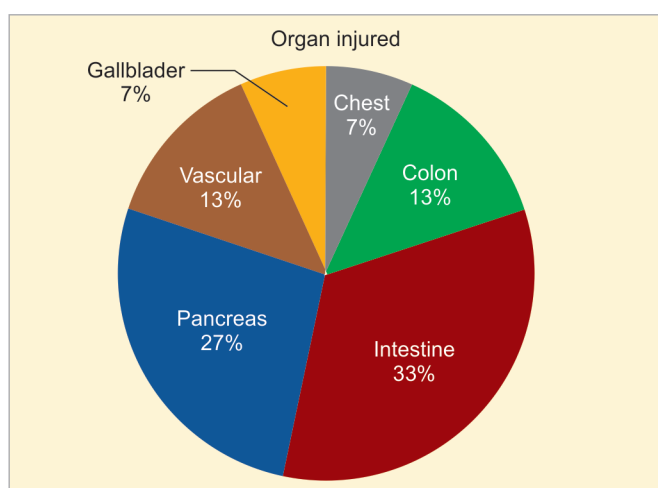
the first portion, 3 in the second, 2 in the third, 5 in the fourth, and 1 between the second and third portions. Data are provided in Graphs 1 and 2.

Among the 11 cases of duodenal injury, 1 had injury associated with the gallbladder, 2 cases with injuries in the colon, 5 with intestinal injuries, 4 with pancreatic injuries, 2 with vascular injuries, 1 with chest injury, 5 with liver lesions, and 2 with gastric lesions. None had diaphragmatic or splenic or renal injury associated (Graph 3).

Primary closure of the duodenal injury was performed in 10 cases (duodenorrhaphy) and in 1 case duodenal surgery was not necessary, despite having been opened for laparotomy. Two cases were complicated by fistulas.

## DISCUSSION

Despite the fact that duodenal injuries present with high complexity and low incidence, young adult males are the largest portion of the population affected by these injuries according to literature,<sup>5,8,9</sup> and was also observed in this



**Graph 3:** Affected organs × number of lesions associated with duodenal injury

study. Most injuries are penetrating, with a predominance of FA injuries, corroborating the literature.

According to Ordoñez et al,<sup>6</sup> the incidence of duodenal injuries varies between 3 and 5% of laparotomies in trauma. After evaluating 44 patients with penetrating abdominal trauma, most were by FA. Fraga et al<sup>1</sup> analyzed 86 cases of traumatic duodenal injury, and the injury by FA prevailed (87%). In this study the incidence of duodenal trauma was 3.69%, which is in accordance with the statistics found in the literature, demonstrating the low incidence of this type of injury, reinforcing the need for professionals involved to have a high index of suspicion for this type of injury.

Among the duodenal traumas analyzed in this study, injuries that involved the fourth part of the duodenum were most common (45.45%). However, according to Assensio et al,<sup>2</sup> the most injured part was the second (33.3%) and even less frequently injured was the first portion (14.4%). Fraga et al<sup>1</sup> describe the second duodenal portion as the most affected (57.1%) and the fourth with the lowest rate of injury (11.7%). Therefore, the literature points to the second duodenal portion as being the most affected; however, the data in this study do not support this finding.

Among the injured duodenal portions analyzed, the extent of duodenal damage was studied, showing a majority of grade II injuries (63.63%). These results are consistent with the literature and with findings by Fraga et al,<sup>1</sup> which note that the frequencies of grade II and III lesions are the most common, representing 90.9% of the injuries.

Typically, these lesions have been associated with injuries to other organs, and as described in the literature, it is rare to find the presence of an isolated injury. Assensio et al<sup>2</sup> describe that liver injury (16.9%) is most commonly associated to duodenal injury, followed by pancreatic



injury (11.6%), small intestine (11.5%), and colon (11.3%). According to Pandey et al,<sup>11</sup> the liver is the organ most affected, followed by colon (43%) and pancreas (14%). In this study, the associated injuries observed were most prevalent in the liver and small intestine with incidence of both of 45.45%.

The treatment of duodenal lesions varies according to the severity of each individual case, and can involve anything from primary closure to a Whipple procedure.<sup>11,12</sup> However, according to Ordonez et al<sup>6</sup>, in more severe cases, mainly those associated with multiple organ injuries & hemodynamic instability (accounting for 25% of deaths - hypovolemic shock) it is recommended to perform damage control surgery briefly in order to put the patient in a better position for definitive treatment. Primary duodenal repair is the main intervention in this study (90.9%), as described in the literature.

In order to benefit the patient, it is important that the time interval between entry to the hospital and the surgical procedure is minimized. In 90.9% of cases analyzed in this study, this time period was up to 6 hours. Pandey et al<sup>11</sup> demonstrate that most of the patients analyzed were received at the service within 6 hours after penetrating trauma duodenum and between 12 and 24 hours after blunt trauma. All patients were addressed surgically between 24 and 48 hours after admission to the service.

Even with all the surgical techniques and the reduction in time between the patient's arrival at the service and the surgical intervention, postoperative complications exist, with the most common being the development of fistulas, with other complications not found in this study. We observed two cases in this series of anastomotic fistula (18.1%), but both showed spontaneous closure.

Ordoñez et al<sup>6</sup> demonstrated a predominance of fistulas as the main postoperative complication of surgical treatment of duodenal injury. In a sample of 36 duodenal injuries, 12 developed anastomotic leaks (33%), among which seven closed spontaneously. In a meta-analysis of 15 case series by Assensio et al,<sup>13</sup> out of 1,408 patients with traumatic duodenal injuries who underwent surgical repair, 6.6% developed fistulas.

The high mortality rate related to duodenal trauma is what drives investigations at different centers. In the present study, these injuries accounted for 36.36% of deaths, and in the literature, mortality rates can range from 5.3 to 30%. However, mortality directly attributed to the duodenal lesion itself is about 10% as a result of complications revolving around repair of the injury, which occurs 1 to 2 weeks after trauma.<sup>9,14,15</sup> Compared with the literature, the percentage of deaths was higher in this study; however, the factors that contributed to the increased incidence were the following: High ISS, the type of duodenal injury, and associated organ damage.

## CONCLUSION

Duodenal injuries are rare, and are most commonly due to penetrating abdominal trauma, especially gunshot wounds, with the greatest prevalence among young men. Due to the high complexity of these injuries, rapid diagnosis, early surgical intervention, and shortened surgical procedures are of great importance to decrease morbidity and mortality, emphasizing the importance of agility in emergency service in the short time leading up to the surgical procedure. Achieving simpler and more effective surgical procedures also contributes to the reduction of mortality and morbidity rates.

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