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Gastric perforation in blunt abdominal trauma.
Report of two cases and review of literature

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Gastric perforation in blunt abdominal trauma. Report of two cases and review of literature.

Gastric perforations as a result of blunt abdominal traumas are rare, with a reported incidence of less than 2%. Usually associated with other solid visceral injuries, isolated gastric ruptures following a blunt abdominal injury are extremely uncommon. The severity of injury, timing of presentation, time elapsed since the last meal, as well as the presence of concomitant injuries are important prognostic factors. Contrast-enhanced CT scan is the gold-standard diagnostic tool in haemodinamically stable patients and allows to detect or raise suspicion of injuries to hollow viscera in about 87% of cases. The authors report two cases of patients suffering from gastric injury following a blunt abdominal trauma. The first one with a double gastric laceration treated with suture repair. The second one with a wide laceration and tissue loss along the greater gastric curvature requiring a wedge resection. Both patients had an uneventful recovery.
Authors present a brief review of the literature; a search on PubMed using the key words "blunt abdominal trauma" and "gastric injury" was performed, including all studies published in the last 20 years. Finally, the main data extracted from four reviews were examined.

KEY WORDS: Abdominal trauma, Gastric injury, Hollow viscus perforation

Introduction

Blunt abdominal traumas following assaults, road traffic accidents and falls often result in injury to solid organs (liver, spleen and kidney), diaphragm, pancreas and retroperitonaeum. Hollow viscera, namely stomach, duodenum, small bowel, colon, rectum and urinary bladder are injured with an incidence that ranges from 4 to 15% [1,2]. Among them, gastric perforation is a remarkably rare condition, occurring with a reported incidence of 0.02-1.7% [3].

Managing traumatic hollow viscus injury is a major challenge for both surgeons and anaesthesiologists. Unlike solid visceral injury which can be treated non-operatively, early surgical intervention is mandatory in case of hollow viscus injury. As the incidence of such injuries following a blunt abdominal trauma is low, surgeons exposure to this condition can be limited. Therefore a high index of suspicion is necessary in order to prevent delays in diagnosis and treatment which increase both morbidity and mortality [4]. Because few centers have extensive experience in this field, epidemiological data about the incidence, prevalence, diagnosis, and outcomes of these injuries are limited.
The rarity of gastric perforations resulting from blunt abdominal traumas, together with the inconsistent diagnostic yield from standard investigations has led to this condition being invariably recognized at laparotomy. The authors report two cases of gastric perforation as a result of blunt abdominal traumas following a bicycle and motorcycle accidents.

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Case experience

Case N. 1

A 17 years old boy presented to the Emergency Department with a history of trauma. About an hour after lunch, while riding his bicycle he run into a car and the handlebar hit his abdomen. On arrival, he was fully conscious, normotensive, tachycardic (heart rate 108/min). On examination, a circular abrasion, imprint of the bicycle handlebar, was clearly visible in the epigastrium, and the upper abdominal quadrants were tender to palpation. A contrast-enhanced CT was obtained, which showed a left pneumothorax, free air around the stomach, and a small fluid collection in the lesser sac (Figs. 1, 2). A chest drain was inserted at the left fifth intercostal space, on the anterior axillary line, and the patient was transferred to the operating room for emergency laparotomy. At laparotomy free fluid with undigested food particles was present in the abdominal cavity. A full thickness perforation of the gastric body, measuring 7 cm, along the longitudinal gastric axis was promptly recognized. This was classified as grade II gastric injury [5] (Table I). No other intraperitoneal injuries were detected. The complete exploration of the stomach, achieved by opening the lesser sac, showed a second full thickness perforation on the posterior gastric wall. Both lesions were repaired with double layer sutures. The postoperative course was uneventful. The chest drain was removed on the third postoperative day and oral feeding was resumed on the seventh postoperative day. The patient was discharged on the 9th postoperative day.

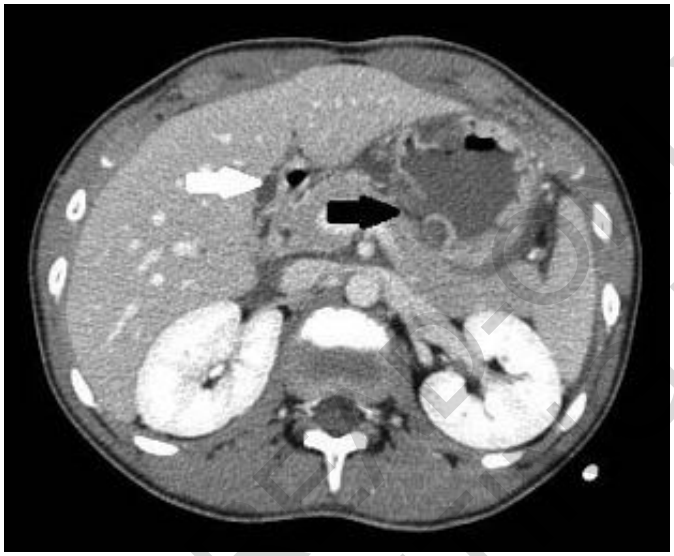

Fig. 1: Case 1, CT at admission, axial view: free air around the stomach (white arrow), and fluid collection in the lesser sac (black arrow).

Case N. 2

A 25 years old woman, passenger of a motocycle, had fallen off against the guard rail. She had her last meal one hour before the accident. On examination in emergency room, the patient was tachycardic (heart rate 130/min), and mildly hypotensive. The abdomen was tender, with guarding and rebound tenderness, suggesting peritonitis. After a brief fluid resuscitation, a contrast-enhanced CT-scan was obtained, showing pneumoperitonaeum and free fluid in the left subphrenic space. Liver and splenic grade II injuries, without active bleeding, were also detected. At laparotomy, a full thickness perforation, about 6 cm long, along the greater gastric curvature, with significant tissue devascularization, was observed (grade IV). The injuries to liver and spleen did not require treatment. A left diaphragmatic tear, of about 4 cm in length, and a left ovarian cyst bleeding were also detected.

A wedge resection, along the greater curvature, with a linear cutting stapler was performed, together with ovarian cyst haemostasis and repair of the diaphragmatic tear. The postoperative course was uneventful: oral feeding was resumed on the 10th postoperative day, because of the development of a mild hyperamylasemia, probably due to pancreatic contusion. The patient was discharged on the 14th postoperative day.

TABLE I - *Grading of gastric injuries.*

Grade I	Intramural hematoma < 3 cm Partial thickness laceration	
Grade II	Laceration	< 2 cm in GE junction/pylorus < 5 cm in proximal one-third < 10 cm in distal two-third
Grade III	Laceration	≥ 2 cm in GE junction/pylorus≥ ≥ 5 cm in proximal one-third≥ ≥ 10 cm in distal two-third
Grade IV	Vascular	Tissue loss/devascularization < two-third stomach
Grade V	Vascular	Tissue loss/devascularization ≥ two-third stomach

Discussion

A search was carried out on PubMed using the keywords "gastric injury" and "blunt abdominal trauma", including all studies published from January 2000 to July 2020. A total of 130 studies were obtained, most of whom were single case reports. Therefore, a further selection was made by adding the keyword "review", which brought down the total number of significant publications to 15. Authors selected, among them, four studies with complete and comparable clinical documentation.

In 2001 in a retrospective multicentre study involving 4 major Trauma centres, the Brazilian group led by Bruscagin reported 33 gastric injuries following blunt abdominal traumas [6]. In 2004, Tejerina Alvarez et al. published the result of a retrospective study on 1300 blunt abdominal traumas occurred over 28 years and reported 7 gastric injuries (0.5%) [7].

In 2007 Oncel et al. published the experience of a single level 1 trauma centre, reporting 25 gastric injuries out of a total of 35.033 blunt abdominal traumas (0.07%) [8]. Hermosa et al. in 2008 reported 25 gastric injuries out of 2.083 blunt abdominal injuries (1.2%) occurred in a single centre over 20 years [9]. Available clinical data extracted from the reported studies have been resumed in Table II.

The low incidence of gastric perforation as a result of a blunt abdominal trauma is due to several factors that include the shielding provided by the thoracic cage, the relative mobility of the stomach and the gastric wall thickness [10]. Classically, gastric perforations following a blunt abdominal trauma have been put down to three mechanisms: 1) External compression resulting in an acute and intense rise of the intra-abdominal pressure. This mechanism applies especially when the stomach is distended due to a massive increase of the intra gastric pressure. It may also explain the occurrence of gastric tears following the Heimlich manoeuvre. 2) Rapid deceleration causes a differential movement among adjacent structures resulting in shear forces which can cause hollow and solid visceral organs and vascular pedicles to tear, particularly at relatively fixed points. 3) Crushed intra-abdominal contents between the anterior abdominal wall and the vertebral column or the dorsal aspect of the thoracic cage.

Gastric perforations may occur at any point of the stomach, the most common being the anterior wall (40%), followed by the greater curvature (23%), the lesser curvature (15%) and the posterior wall (15%). Such perforations are invariably isolated; to date only a few cases of a double gastric perforation as a result of blunt abdominal trauma have been described [11].

In the first case reported here, both deceleration and compression mechanisms were involved, as evidenced by the imprint of the bicycle handlebar, creating a double

TABLE II - *Review of literature*

Author - year of publication	Bruscagin 2001	Tejerina Alvarez 2004	Oncel 2007	Hermosa 2008
Period of observation	1982-1996	1973-2001	1992-2005	1987-2006
Number of patients	33	7	25	25
Male/female	26/7	5/2	15/10	18/7
Median age	26	33	37	35
Injury scale:				
- grade I	21 (63.6%)	-		-
- grade II	7 (21.2%)	4 (57.1%)		20 (80%)
- grade III	4 (12.1%)	3 (42.9%)		4 (16%)
- grade IV	1 (3%)	-		1 (4%)
Localization				
- anterior wall		4 (57.1%)		12 (48%)
- posterior wall		2 (28.6%)		5 (20%)
- lesser curvature		1 (14.3%)		1 (4%)
- grater curvature		-		7 (328%)
Associated lesions	31 (93.9%)	6 (85.5%)	20 (80%)	22 (88%)
Treatment				
- None	8 (24.2%)	-		-
- Simple suture	24 (72.7%)	7 (100%)		22 (88%)
- Gastric resection	1 (3%)	-		3 (12%)
Hospital stay (days)	14	30	19	17
Morbidity	12%	71%		60%
Mortality	9%	-	24%	4%

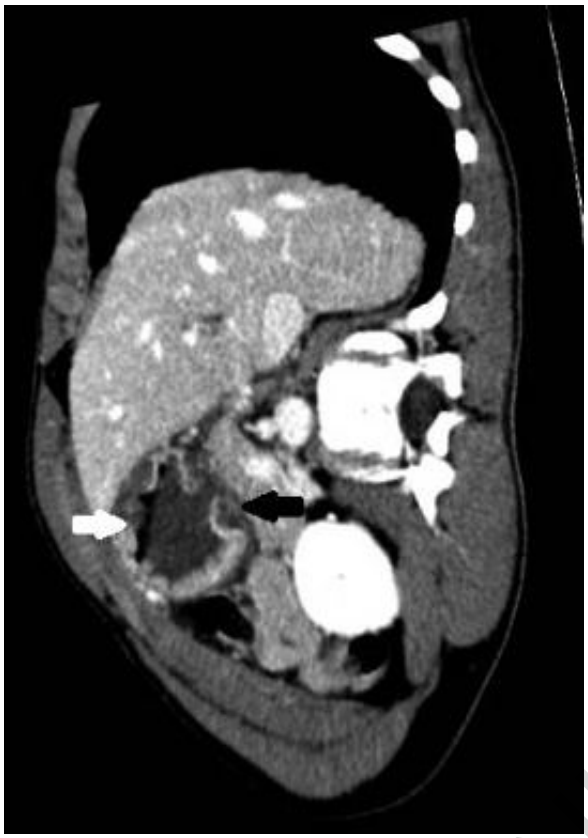

Fig. 2: Case 1, CT at admission, sagittal view: free air around the stomach (white arrow), and fluid collection in the lesser sac (black arrow).

full thickness laceration of the gastric wall. In the second case, the larger gastric injury could be probably due to the acute and intense rise of the intra-abdominal pressure and to the physiologic postprandial distention of the stomach.

Gastric perforations as a result of blunt abdominal trauma are usually associated with other intra- and extra-abdominal injuries; isolated blunt gastric ruptures are uncommon. The most common associated injury is to the spleen, followed by thoracic injuries [10,12]. The failure to reliably distinguish hollow visceral injury from solid visceral injury can delay the decision to perform a laparotomy, particularly in haemodynamically stable patients. Currently, helical computed tomography is warranted in the setting of hemodynamic stability. The telltale signs on CT scan include unexplained free fluid, pneumoperitoneum, bowel wall thickening, mesenteric fat stranding, mesenteric haematoma, extravasation of bowel content and intraperitoneal blood. However, close clinical monitoring is mandatory, since a negative CT scan may miss a bowel perforation in 13% of cases [13]. In our first case, the clinical examination did not reveal any haemodynamic instability or peritonitis. The presence of free air at CT scan suggested a hollow viscus perforation and led to emergency laparotomy. The exam was also useful in detecting a left pneumothorax, otherwise asymptomatic and undetected at the chest x-ray obtained in the emergency room.

The surgical strategy should include proper debridement and straightening of the jagged edges of the laceration. Repair of the stomach with a two-layer suture is the treatment of choice for gastric lacerations classified as grades II or III [14]. Nasogastric drainage, thorough peritoneal lavage and drainage are necessary. To assess the integrity of the repair, methylene blue solution test is useful. Complete exploration of the stomach, achieved by opening the lesser sac, should be performed to search for any missed perforation. Given the extent of the injuries, primary repair will not be feasible in patients with gastric injuries classified as grades IV and V (tissue loss and devascularization). Depending on the location of the tissue loss and the extent of devascularization, a sub-total or more rarely a total gastrectomy may be required. In our first patient, the opening of the lesser sac was determinant in detecting the posterior wall laceration; in the second case, the extent of tissue loss along the greater gastric curve suggested the feasibility of a gastric wedge resection, without interruption of digestive continuity.

Conclusions

Gastric rupture as a result of blunt abdominal trauma is rare and even rarer is the occurrence of a double gastric laceration. In haemodynamically stable patients, when the trauma is classified as "major" and when clinical examination suggests peritoneal irritation, a CT scan is mandatory. Early detection and prompt intervention are key in preventing septic complications. Although gastric rupture usually occurs at a single site, during laparotomy, surgeons should be aware of the possibility of multiple site perforations and all efforts should be made to look for them. Emergency surgeons should be skilled to perform gastric repair according to the grade of the injury, ranging from simple sutures to standard partial or total gastrectomy, as well as atypical resections.

Riassunto

Le perforazioni gastriche dovute a trauma addominale chiuso sono rare, con un'incidenza riportata inferiore al 2%. Spesso associate ad altre lesioni di organi parenchimatosi, le lesioni gastriche isolate sono estremamente rare. La gravità della lesione, il timing chirurgico, il tempo trascorso dall'ultimo pasto e la presenza di lesioni associate costituiscono importanti fattori prognostici. La TC con mezzo di contrasto è lo strumento diagnostico di scelta nei pazienti traumatizzati emodinamicamente

stabili e consente di identificare o di sospettare una lesione di viscere cavo nell'87% dei casi.
Gli Autori riportano due casi di pazienti affetti da lesione gastrica a seguito di trauma addominale chiuso. Il primo, con una doppia lacerazione gastrica, a carico delle pareti anteriore e posteriore, sottoposto a raffia in doppio strato. La seconda, con una estesa lacerazione con perdita tissutale lungo la grande curvatura, è stata sottoposta a "wedge resection" con suturatrice lineare, senza interruzione della continuità digestiva. Entrambi i pazienti avevano lesioni associate. Il decorso postoperatorio è stato favorevole.
Viene presentata, inoltre, una sintetica revisione della letteratura: è stata condotta una ricerca su PubMed utilizzando le parole chiave "blunt abdominal trauma" e "gastric injury", includendo i lavori scientifici degli ultimi 20 anni; vengono confrontati, infine, i dati clinici estratti dalle quattro più complete review sull'argomento.

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