Isolated duodenal rupture due to go-karting accidents – braking news

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ABSTRACT

INTRODUCTION Isolated duodenal injury due to blunt abdominal trauma is extremely rare. We present a series of three such injuries due to go-karting accidents, which presented to our hospital over 5 months.

CASE REPORTS Between October 2007 and February 2008, three cases of D3/D4 duodenal rupture presented to our hospital after go-karting accidents. Trauma occurred as a result of the steering wheel impacting on the abdomen. All patients presented similarly with symptoms of epigastric and right upper quadrant pain. In all cases, computed tomography scanning was highly suggestive of duodenal injury and, in particular, demonstrated presence of retroperitoneal air centred around the duodenum. Treatment required laparotomy and operative repair in all cases.

CONCLUSIONS Duodenal injury presents insidiously due to its retroperitoneal position. A low threshold for investigating patients presenting with epigastric and right upper quadrant pain should be adopted along with active clinical vigilance to exclude serious and life-threatening trauma after go-karting accidents.

KEYWORDS

Duodenal rupture – Go-karting – Trauma

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Go-karting is a very popular recreational activity in the UK with easy access to race tracks throughout the country. However, due to the relatively high speeds and lack of seat belt restraint requirements, there are numerous injuries and a significant number of deaths world-wide each year.¹ Small bowel injury as a result of any blunt abdominal trauma is rare (3.6%).² Cases of isolated small bowel injury after blunt trauma are even less common (1%) with the majority (58–70%) associated with multiple injuries.^{2,3} Isolated duodenal injuries are extremely uncommon.

We present three cases of isolated duodenal ruptures, of the D3/D4 segment, due to go-karting accidents occurring over a period of 5 months. Difficulties in clinical diagnosis of duodenal injury and the likelihood of significant complications^{2,3} justifies maintaining a high index of suspicion with early investigation for patients attending with similar presentations.

Case reports

Case 1

A healthy 29-year-old woman was brought to the accident and emergency department complaining of epigastric and right

upper quadrant pain after crashing a go-kart into the side barriers of the track. Blunt abdominal trauma was sustained as the steering wheel impacted on her epigastrium during the crash. She was normotensive and had a pulse rate of 92 beats/min. There was tenderness in the right upper quadrant; however, the abdomen was soft and there was no guarding. Her white cell count (WCC) was raised at 26×10^9 cells/l and the haemoglobin (Hb) was normal at 12.1 g/dl. The amylase level was normal at 51 U/l. Chest and plain abdominal radiographs were unremarkable with no free air demonstrated.

She was admitted and had an ultrasound scan of the abdomen the next day which demonstrated minimal peri-hepatic fluid (Fig. 1A) and normal solid organs. Blood investigations showed improvement and the WCC reduced to 12.1×10^9 cells/l. The patient remained stable with no worsening of her signs or symptoms. It was, therefore, decided to treat her conservatively and a computed tomography (CT) scan was performed to exclude any serious injury. This demonstrated a rupture in the wall of the early third part of duodenum, air pockets and a fluid collection in the retroperitoneal spaces (Fig. 1B), particularly in the retropancreatic and right anterior pararenal spaces. Some

free fluid in the abdomen and bilateral pleural effusions were also noted. The patient subsequently deteriorated clinically and biochemically with a rising C-reactive protein (CRP) level, elevated at 591 mg/l.

The patient had a laparotomy where she was found to have an isolated 1-cm laceration on the inferior aspect of the third part of the duodenum, just posterior to the superior mesenteric vessels. There were no other apparent injuries. She had a primary repair with an omental patch. Seven days post laparotomy, she developed a low output fistula of 15–20 ml output per day, from the repair site. This was managed with a radiological drain and sealed after 8 weeks, following serial reductions in the size of the radiological drains. The patient made a good recovery and, on routine follow-up, 6 months later, the patient continues to do well.

Case 2

A 29-year-old woman, under similar circumstances to Case 1, presented with epigastric pain and abdominal bruising following a go-karting accident. She sustained a duodenal D4 rupture which was diagnosed on CT scan based on findings of severe distortion of the duodenum with extensive retroperitoneal air pockets and a collection (Fig. 2A). A small adjacent pancreatic contusion was also seen (Fig. 2B). The duodenal injury was repaired at laparotomy by duodenojejunostomy at our local tertiary specialist centre. The pancreatic injury did not require intervention and probably did not contribute significantly to the clinical manifestation. We have, therefore, included this case in our report. She made a good recovery.

Case 3

A 29-year-old man presented on the same day as Case 1 with pain and tenderness in the epigastrium and right upper quadrant with haematemesis. He had sustained blunt trauma to the abdomen in a similar manner while go-karting on the same excursion. Deterioration within 24 h prompted an abdominal CT scan which demonstrated a high likelihood of isolated D3 duodenal injury which was repaired at laparotomy on day 2.

Discussion

Go-karting is an ever increasingly popular recreational sport enjoyed by amateurs and professionals alike. Reports dating back to the 1970s have questioned the safety of this pursuit, particularly in relation to blunt abdominal trauma. Abrupt deceleration and striking the steering wheel in collisions has been implicated as the cause of most blunt abdominal injuries.⁴ There are very few reports of duodenal injuries from go-karting accidents.

Miller *et al.*⁴ described 12 cases of go-karting accidents with no duodenal injuries but one transection of the mid-jejunum. A report from Hong Kong with a series of 42 go-karting injuries of all types included two (4.8%) patients who sustained blunt abdominal trauma resulting in visceral injury.¹ However, the duodenum was not injured in either of these cases. In another report, also from Hong Kong,⁵ two of three cases did involve duodenal rupture, one an isolated injury of the duodenojejunal flexure and the other associated with a liver laceration.

Isolated D3 or D4 injury is particularly rare in blunt abdominal trauma of any aetiology. Duodenal ruptures are suggested to be the least commonly affected segment of the small bowel following blunt abdominal trauma, with the jejunum being the most.⁵ A 6-year study on blunt duodenal rupture, found the incidence to be 0.2%, with the most commonly injured duodenal segment being D2. D3 ruptures accounted for 17% of this study's cases and many of these were associated with other injuries.⁷

An accepted mechanism for bowel rupture is compression of the fluid-gas filled viscus against the spine, causing tearing of the mesentery.⁶ With respect to go-karting injuries, compression is likely to be between the steering wheel and the spine.⁷ Others suggest that rapid deceleration and inertial stress of the small bowel to tethering structures, such as the ligament of Treitz and hepatoduodenal ligament cause rupture at these sites.⁸ In our series, all three lacerations were in proximity of the superior mesenteric vessels. This raises the possibility that compression forces of the duodenum between the superior mesenteric vessels and spine may be a causal factor.

Being a hollow structure, the duodenum is far less likely to get injured as it probably tends to get decompressed on

impact. The intraluminal contents of the duodenum could provide a cushioning effect as they get squeezed between the spine and the extrinsic pressure of the steering wheel. A solid organ like the pancreas which lies just anterior to the duodenum is far more likely to get injured by such a mechanism and, therefore, isolated injury to the duodenum in our series associated with this sport was particularly interesting. Obviously, the strategic placement of the steering wheel close to the epigastrium while using a go-karting vehicle makes this area particularly vulnerable.

Diagnosis of small bowel rupture is notoriously difficult. Due to the retroperitoneal location of the duodenum, the onset of symptoms can be more insidious and the clinical examination unreliable, as was demonstrated by Case 1. Ultrasound and CT scan form the mainstay of initial investigation. Ultrasound is used mainly to demonstrate free intraperitoneal fluid and to screen for any obvious solid organ injury. Bode *et al.*⁹ reported ultrasound to have correctly identified patients for laparotomy after blunt abdominal trauma in 100% of 1671 cases. Sensitivity, specificity and accuracy of detecting intra-abdominal injury were 88%, 100% and 99%, respectively.⁹ However, the sensitivity for detecting intestinal injury has been reported as 34.7% by sonography alone.¹⁰ CT more clearly demonstrates the anatomy and has been reported to be diagnostic of bowel injury in 88% of blunt abdominal trauma cases.¹¹ However, CT may add to delay in surgery when a laparotomy is necessary.

Delays in operative treatment of bowel injury could affect outcome.² We believe that a CT scan should be done early in patients with epigastric pain who have sustained a go-karting injury. Mortality for small bowel injury has been reported to be as high as 25.7%, and higher if diagnosis is delayed beyond 24 h.^{2,5} Prognosis is worse where there are multiple injuries or if the racing track was outdoors. The latter is thought to be due to higher potential velocities and, therefore, injuring forces.¹ These characteristics in the history should, therefore, reduce the threshold to investigate patients aggressively to exclude potential small bowel injuries.

Conclusions

Go-karting is an increasingly popular sport. This will inevitably result in more go-karting related injuries presenting to our emergency departments. Our case series highlights three remarkably similar cases of isolated duodenal rupture at D3 or D4 from go-karting accidents. From our experience, we would recommend that a high index of suspicion should be maintained for potential duodenal injury even if clinical symptoms are minimal or equivocal after go-karting accidents. The high steering wheel and lack of seat belts puts drivers of go-karts at increased risk of

sustaining these types of injuries. Even in the absence of abdominal wall signs or an acute abdomen, we recommend early investigation with contrast CT. On CT scan, the presence of retroperitoneal air close to the duodenum should especially alert one to this form of injury.

There is currently no legislation for the protection of the public attending go-karting venues. In particular, the use of seat belts is not mandatory. We feel that this needs to be reviewed to help prevent potentially life-threatening injuries.

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