Case Report

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Blunt Abdominal Wall Disruption by Seatbelt Injury; A Case Report and Review of the Literature

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ABSTRACT

With the introduction of the use of seatbelts in cars, mortality following motor vehicle crashes has decreased significantly. However, two patterns of injuries, the 'seatbelt sign' and 'seatbelt syndrome' have emerged. Injuries may consist of traumatic abdominal wall disruption. We present two cases of severe abdominal wall disruption caused by a seatbelt injury and treated with primary repair. A review of the literature is provided. Two patients were brought in after a high velocity Motor Vehicle Collision. Both presented with an acute abdomen and a seatbelt sign upon which the decision was made to perform emergency laparotomies. Both patients had an abdominal wall disruption along the seatbelt sign. These disruptions were primarily closed and during six months of follow-up no complications occurred. A disruption of the abdominal wall is a rare complication. However, it is a diagnosis that may not be missed as patients have a higher risk of morbidity and mortality. CT-scanning is an accurate method to detect disruptions. Closure of blunt traumatic abdominal wall disruption can be done primarily with sutures or addition of a mesh. In both cases of the severe abdominal wall disruption, primary repair without mesh in the acute phase was successful. When a laparotomy is not indicated, the abdominal wall must be assessed for disruption. If there is a disruption primary repair is a good option.

Keywords: Trauma; Abdominal wall disruption; Seat belt injury; Safety belt; Blunt abdominal wall injury.

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Introduction

When the seatbelts were introduced in cars, morbidity and mortality rates following motor vehicle crashes (MVC) have dropped considerably [1]. However, distinctive patterns of injuries after high velocity MVC's have emerged. These patterns are described as the 'seatbelt sign' and 'seatbelt syndrome'. The 'seatbelt sign' was described by Doersch and Dozier in 1968 [2] and is a bruising pattern across the torso that follows the course of the seatbelt after a high velocity MVC. In the 'seatbelt syndrome' this bruising is accompanied by intra-abdominal injury [3]. The likelihood of intra-abdominal injury in patients with a 'seatbelt sign' is increased up to 4-20 percent [4].

The combination of injuries is associated with the type of seatbelt used. Severe injuries to the head, spine and gastrointestinal tract are highly associated with 2-point or lap belt seatbelts. Solid viscus organs are especially afflicted in patients with a mal-positioned lap belt [5]. Also, a unique vertebral fracture is associated with 2-point seatbelts: the Chance fracture. This fracture is caused by a flexion-distraction mechanism with forced flexion of the spine across a fixed fulcrum. This results in a fracture of posterior elements of the spine, usually at thoracolumbar level [6]. In 3-point seatbelts, deceleration forces are more evenly divided over the thoracic-, abdominal- and pelvic region. Therefore, injuries of the neck, clavicles, ribs and sternum as well as hollow and solid viscus injuries are more often seen [7]. The patterns for each region per seatbelt type are summarized in Table 1.

Lesions of the abdominal wall due to seat belt injury have been rarely described. So far only one systematic review has described a larger series of 55 cases of Traumatic Abdominal Wall Hernia (TAWH) after blunt abdominal trauma [8]. It has been estimated that 1% of all abdominal blunt trauma results in a TAWH [9]. Various types of injury resulting in TAWH have been described in single case reports differing from bullhorns to a handlebar [10]. Only a small number of articles report TAWH or traumatic abdominal wall disruption caused by seatbelt injuries [11]. We present two cases of severe blunt abdominal wall disruption caused by seatbelt injuries with an emphasis on the review of current literature.

Case Report

Travelling in the same car, two patients were restrained in a 3-point seatbelt and crashed into a stationary sand truck at 80 km/h (50 mph). They were rescued from the scene and brought to hospital by ambulance.

Case 1

The 23-year-old female front seat passenger was examined according to the ATLS® guidelines. On examination her vital parameters showed a Respiratory Rate (RR) of 20/min with a saturation of 97%, Heart Rate (HR) of 69/min, and a blood pressure (BP) of 95/70 mmHg. On abdominal examination tenderness and guarding was noted as well as bruising along the seatbelt which was recognized as the 'seatbelt sign'. Additional imaging of chest and pelvis showed no abnormalities. A Focused Abdominal Sonography for Trauma (FAST) showed free fluid around liver, spleen, mesenteries and the pelvic cavity. She was responsive to fluid resuscitation and a CT-scan was performed. The CT-scan showed free intra-abdominal fluid and air as well as a grade I laceration of the 4th segment of the liver. Laboratory tests showed a CRP of 200mg/L, hemoglobin of 5.1 mmol/L, hematocrit of 0.23 L/L, a platelet count of 118×10^9/L and a leukocyte count of 14.7×10^9/L. Analysis of arterial blood gas showed a pH of 7.33, a pCO_2 of 32, a pO_2 of 297, an HCO_3^- of 15.0 and a Base Excess of -12.0. The finding of free air, an acute abdomen and the 'seatbelt sign' mandated an exploratory laparotomy. A standard midline incision was made around the umbilicus. During systematic inspection of the abdomen, tears in the small intestine were observed at 25 cm and 80 cm from Treitz, both requiring resection. In total, approximately 100 cm of small bowel was resected and two side-to-side anastomoses were made using a Gastro Intestinal Anastomosis (GIA) stapler. Examination of the abdominal wall showed a complete horizontal disruption along the horizontal path of the seatbelt. The rectus abdominis muscle, internal rectus muscle, external rectus muscle and transverse abdominal muscle were lacerated up to the lateral costal margins on both sides (Figures 1, 2, and 3). These were primarily reconstructed using Ethicon© (Cincinnati, Ohio, United States) Vicryl 1.0 sutures. The anterior sheath of the rectus abdominis muscle was partly intact on both sides but the muscle itself was mostly transected (Figures 3 and 4). One silicon drain was left intra-abdominally and the midline incision was closed. In the degloved areas between the wall and skin a subcutaneous drain was left on both sides. Post-operatively the patient was admitted to the Intensive Care Unit (ICU). All drains were removed on day six and the patient was discharged after 11 days in good medical condition. After six months of follow-up she made a good recovery. At this time an ultrasound was made to assess integrity of the abdominal wall and no herniation was noted. She was referred to a physiotherapist to start core-stability exercises.

Case 2

The 31-year-old male driver was also examined according to the ATLS® guidelines. On examination

Table 1. Summary of injuries of each region per seatbelt type [7-9].

Region	2-point seatbelt	3-point seatbelt
Head and Neck	Fractures of Skull and cervical spine. Traumatic brain injury	Ecchymosis of neck, Transsection of Aorta
Chest	-	Fractures of clavicle, sternum and ribs
Thoracolumbar spine	Chance fracture	-
Abdomen	Tears of hollow viscous and mesenterium. Laceration of spleen, stomach, liver and pancreas	Tears of hollow viscous and mesenterium.
Pelvis	Fractures of pelvis	Fractures of Pelvis

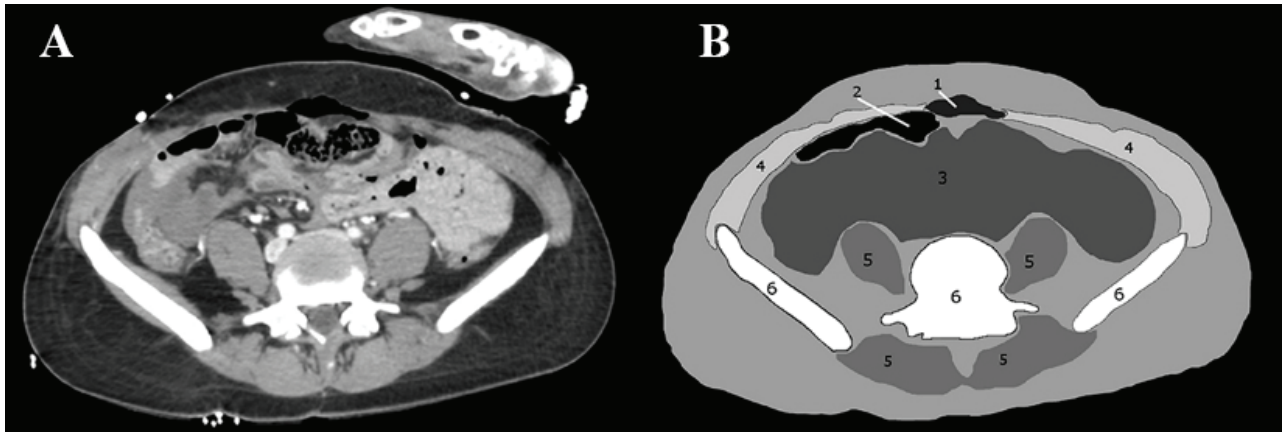

Fig. 1. CT-scan (A) and schematic view (B) on level of the abdominal wall disruption; in schematic view: 1. Free pocket of air in between rectus abdominis muscles; 2. Free pockets of air adjacent to abdominal wall; 3. Intestines; 4. Abdominal wall containing external oblique, internal oblique and transverse abdominal muscle; 5. Psoas muscles; 6. Iliac crest and top of fifth lumbar vertebra

Fig. 2. A sagittal CT-scan at the level of the inferior vena cava with pockets of intra-abdominal free air and the abdominal wall disruption (arrow) present.

Fig. 3. An intra-operative picture displaying the ruptured abdominal wall, intact anterior sheath and area of degloving injury.

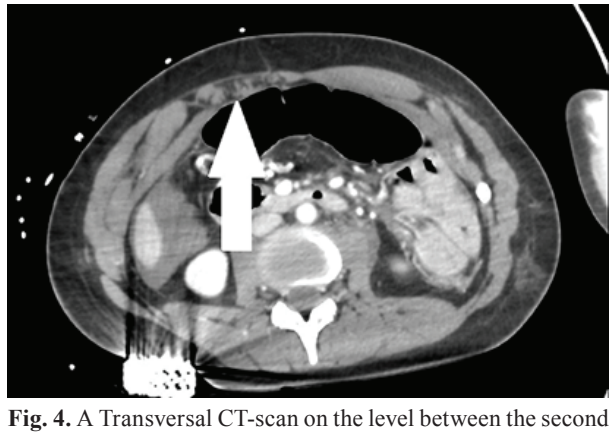

Fig. 4. A Transversal CT-scan on the level between the second and third lumbar vertebra showing an intact right anterior rectus abdominis muscle sheath and a transected right rectus abdominis muscle.

his vital parameters showed a RR of 12/min with a saturation of 98%, HR of 88 bpm with a blood pressure of 130/70 mmHg. On abdominal examination he had tenderness with strong guarding and a seatbelt sign was noted. FAST as well as CT-scan showed free fluid around the liver, the intestines and in the pelvic cavity. No signs of intravascular contrast leakage or free air were noted. Laboratory results showed a hemoglobin of 8.4 mmol/L, hematocrit of 0.39 L/L, a platelet count of 281×10^9/L and a leukocyte count of 15.1×10^9/L. Analysis of arterial blood gas showed a pH of 7.36, a pCO_2 of 34, a pO_2 of 262 an active HCO_3^- of 18.7 and a Base Excess of −5.5. Given these findings an explorative laparotomy was performed by a second surgical team. Along the small intestines some bleeding from small mesenterial tears was suture-ligated. At 160 and 230 cm from Treitz, lacerations of the small intestine were noted and a total 70 cm of ileum was resected. Also, the appendix was resected because of

injury of the mesoappendix. A tear was found in the sigmoid colon and a wedge resection was performed. All resection sites were anastomosed side-to-side using sutures in the ileum and a GIA stapler at the sigmoid. On further exploration, the left and right transverse abdominal muscles were disrupted, the internal and external rectus muscles remaining intact. The abdominal wall disruption was repaired using interrupted Ethicon© Vicryl absorbable sutures. Also, degloving injuries of the skin at the sites of disruption were found. After leaving a drain in this area the abdomen was closed primarily and the patient was transferred to the ICU. On the first day post trauma on ICU the patient was successfully extubated and the next day he was transferred to the trauma ward. The drain was removed after four days. He could be discharged after nine days in good medical condition. Six months later, during follow-up, an ultrasound of the abdominal wall was made and no complications were noted.

Discussion

The introduction of the seatbelt led to a significant reduction in mortality and morbidity after MVC's. Wearing a seat belt is known to cause injuries, especially when the seatbelt is not worn correctly. However, the seatbelt is effective in reducing life threatening injuries when used correctly [12]. Seat belt injuries can cause abdominal wall rupture. The integrity of the abdominal wall can be assessed on CT images (Figure 1). A sensitivity of 98% to assess abdominal wall disruption with a CT scan has been reported [13]. Another finding indicative of abdominal wall disruption is the finding of subcutaneous emphysema or extra-abdominal free gas without breakage of the skin. This can be a clue as the free gas must have originated from the ruptured intestines and diffused subcutaneously through the disrupted abdominal wall layers.

When a patient presents with a 'seatbelt sign', the clinician should have a high index of suspicion for both intra-abdominal injury and abdominal wall rupture. The integrity of the abdominal wall should be assessed critically on CT-imaging. When a laparotomy is performed, abdominal wall integrity should also be assessed especially when subcutaneous emphysema is present. When a laparotomy is not deemed necessary the abdominal wall integrity must be assessed on CT-imaging.

Higher risk of hollow visceral injury has been reported when patients present with a 'seatbelt sign' but substantial injury to the abdominal wall itself after blunt trauma is very rare [8]. When the abdominal wall is disrupted the intestines are able to herniate through this disruption. However, usually patients are supine during admission and gravity prevents the intestines from herniating. Due to the rarity and the absent hernia, it is a notoriously difficult diagnosis to make. Delays of up to 9 days post-MVC have been reported when a laparotomy was not necessary [8]. Patients with a delayed diagnosis of TAWH have added mortality and morbidity [14] especially in patients with multiple injuries. Management of the abdominal wall disruption depends on the time of diagnosis, the extent of the injury and the concomitant injuries. The general consensus is to use a synthetic mesh and repair the disruption after 6 weeks to let the primary tissue damage subside [15]. Mesh repair in an acute setting with abdominal contamination has also been described as an acceptable method for closure [15]. We described successful primarily closure using heavy interrupted sutures in two cases of severe abdominal wall disruption and hollow viscus injury after seatbelt injury. After 6 months no complications occurred and abdominal wall integrity was confirmed by ultrasound.

In conclusion, intra-abdominal injuries after a MVC are well reported and people with a seatbelt sign have a higher likelihood of having intra-abdominal injuries when presented. Abdominal wall disruption however, is a rare injury and in case of non-operative management may lead to traumatic abdominal wall hernia. CT-scan is 98% sensitive for abdominal wall disruption and can exclude disruption in these cases. We presented two acute cases with severe abdominal wall disruption and hollow viscus injury due to seatbelt injury. In both cases, primary repair without mesh in the acute phase was successful. A tailored approach for every situation should be made.

Conflict of Interest: None declared.

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