Blunt abdominal trauma: changing patterns in diagnostic and treatment strategies
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A seatbelt sign following a car accident: look for internal abdominal injury

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ABSTRACT

We present three patients, a 55 year old man, a 69 year old woman and a 25 year old man, all with seatbelt signs following a car accident. The 3 patients exhibited a range of injuries that can all occur with blunt trauma, such as rib fractures. In one patient, however, the symptoms of internal abdominal injury occurred several days after the accident. The presence of a seatbelt sign is associated with an increased risk of internal abdominal injury. We therefore advise that a computed tomography CT scan of the abdomen is made in patients who present with a seatbelt sign, even if an abdominal ultrasound does not reveal any signs of injury.

Ladies and gentlemen,

A ‘seat belt sign’ consists of ecchymosis and excoriations of the abdominal wall caused by compressive stress and the shear forces of the seat belt. This phenomenon was described for the first time in 1962.\(^1\) Since the introduction of the three-point seat-belt, this type of injury can also be found on the thorax and neck. The presence of a ‘seat belt sign’ should alert doctors to be aware of the possibility of intra abdominal injury.

In this lecture we will present three patients with blunt abdominal injury who exhibited a ‘seat belt sign’ when physically examined. The management issues related to this physical diagnostic finding will be discussed in this article.

Patient A, a 55 year old Polish man, was involved in a one-sided car accident as substitute driver. The driver ran head-on into a tree. Immediately after the accident the patient was transported to the trauma unit and evaluated according to the ATLS protocol where he was found to be A,B,C-stable with a Glasgow Coma Score (D) of 14 (E4M6V4) after an obvious use of alcohol. Physical examination (E) revealed a ‘seat belt sign’ on the abdomen (Figure 1). Except for a rib fracture of the first left and right ribs, no abnormalities were found on radiological findings (X-ray of the pelvis, ultrasound of the abdomen, CT scan of the brain, cervical spine, thorax [with intravenous contrast]). The patient was admitted to the hospital for observation and on the next day he was discharged after a ‘tertiary survey’ (a second complete physical examination conducted with the aim of detecting any injuries which may have been missed earlier). After 8 days, the patient reported to the hospital with a swollen abdomen, nausea and vomiting. On physical examination the patient appeared unwell; he had a distended abdomen without peristalsis. Laboratory investigation revealed there were no infections. A CT scan with an intravenous contrast of the abdomen revealed a caliber jump at the terminal ileum, possibly caused by an internal herniation of the intestines caused by a tear in the mesenterium (Figure 2). An ischemic terminal ileum was encountered during explorative laparotomy and, for that reason, an ileocecal resection was performed. A herniation was not detected. The patient left hospital 10 days later in a good physical condition.
Patient B, a 45 year old man drove into the back of a lorry after having fallen asleep. The patient was evaluated A, B, C, D stable during assessment in the shock room in accordance with the guidelines. Physical examination showed a ‘seat belt sign’ on the left side of the lower part of the abdomen and a tender abdomen. The ultrasonography revealed free fluid in the cavum Dougas, we therefore, decided to perform a CT scan of the abdomen with intravenous contrast. At the mesocolon of the sigmoid, extravasation of contrast fluid was detected (Figure 3) and a sigmoid resection with primary anastomosis was executed. The postoperative period went well and after 5 days the patient left hospital in a good condition.
Figure 3. CT scan of the abdomen with intravenous contrast (venous phase) showed extravasation of contrast fluid at the mesocolon of the sigmoid.

Figure 4. CT scan showed a contrast extravasation localized near the left mammalian artery and a traumatic arteriovenous fistula between the left colic artery and the superior mesenteric vein.
Patient C, a 69 year old woman, was involved in a car-accident. She was reviewed in the trauma room following the ATLS criteria. On arrival the patient was A, B, C, D stable. During the physical examination a seat belt sign was detected and the abdomen was slightly tender. An X-ray of the thorax revealed a fracture of the first rib on both sides and a hematothorax on the right side. When a thorax drain was inserted, 200 ml of blood was evacuated. The ultrasound showed no abnormalities. After preparation with Tavegil® and Dexamethason®, which were used because of an iodine allergy, a CT of the thorax and abdomen with intravenous contrast was performed. These revealed multiple rib fractures on both sides, with a drained hematothorax on the right, a fracture of the sternum, and multiple fractures of the pelvis. Liquid was present near the duodenum and in the retroperitoneum. Intra-abdominal blood and air were both absent. Moreover, contrast extravasation was found in a localized area near the left mammalian artery and a traumatic arteriovenous fistula was discovered between the left colic artery and the superior mesenteric vein (Figure 4). Both were treated with angiography and embolization with coils (Figures 5 a,b). The patient did not develop complications and 1 week after the accident she was discharged from hospital in a good condition.

Figure 5. Angiography of the traumatic arteriovenous fistula between left colic artery and superior mesenteric vein. Before (a) and after (b) treatment with coil embolisation.
Blunt trauma to the abdomen accompanied by mesenterial injury arises from the mechanisms of deceleration and compression. A wide spectrum of injuries, varying from contusions to lacerations of the abdominal wall and the mesenterium, can occur. Even full blown devascularisation of fragments of the intestines may be manifest.

**TRAUMA MECHANISM**

Blunt trauma to the abdomen accompanied by mesenterial injury arises from the mechanisms of deceleration and compression. A wide spectrum of injuries, varying from contusions to lacerations of the abdominal wall and the mesenterium, can occur. Even full blown devascularisation of fragments of the intestines may be manifest.

**EPIDEMIOLOGY**

The presence of a ‘seat belt sign’ is associated with a higher risk of intra-abdominal injury. The prevalence of intra-abdominal injury in the presence of a ‘seat belt sign’ is 10–21% and 2% if a seatbelt sign is not present.\(^2\,^3\)

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*Abnormalities in physical examination of the abdomen, pelvis or lumbar spine
Abnormal X-ray of pelvis, lumbar spine or chest
Abnormal FAST
Base excess < -3
Systolic blood pressure < 90 mm Hg
Long bone fractures

**Figure 6.** Flow chart of the diagnostic and treatment process in patients with blunt abdominal injury. Minimal: minimal free fluid intra-abdominal and/or small tear in the mesenterium.
A seatbelt sign following a car accident: look for internal abdominal injury

DIAGNOSTIC

From the case histories described above, it appears that diagnosing intra-abdominal injury on the basis of clinical and radiological presentation can be difficult. Physical examination can offer some useful indications, but symptoms such as abdominal pain, a distended abdomen, decreased peristalsis, hypotension or shock are present in only 13–64% of patients in the acute phase. Making an ultrasound of the abdomen is a non-invasive, quick investigation, but it is only suitable for detecting free fluid. The sensitivity and specificity for the detection of a hemoperitoneum by using an ultrasound are 26 and 96% respectively. The sensitivity for the identification of an injury to a solid organ is even lower (40–50%). In the latter case a hemoperitoneum is observed in 29–44%. In every trauma patient a screening ultrasound of the abdomen is performed. A CT scan is executed if free fluid is present as it is a sign of possible organ injury. The sensitivity and specificity of a CT scan is 82 and 99% respectively. A CT scan is recommended if there is any clinical evidence of intra-abdominal injury, such as a ‘seat belt sign’. It is even speculated that an ultrasound is redundant if a ‘seat belt sign’ is present as the seat belt sign is usually indicative of more extensive injuries being present which cannot be detected with the ultrasound (because of its low sensitivity). Therefore, the only correct course of action is to perform a CT scan.

TREATMENT

An imperative indication for a laparotomy is the intra-abdominal presence of free air. Patients with a limited amount of free fluid without (parenchymatous) organ injury, (judged on the basis of a CT scan), or patients with minimal mesenterial damage can be treated conservatively. A DPL (diagnostic peritoneal lavage) can be carried out on these patients to differentiate between an injury to a hollow organ (intestine, gallbladder), an active bleeding or an injury to the pancreas. Any deterioration in the condition of the patient is an indication that a new CT scan or laparotomy should be performed. Extensive mesenterial injuries accompanied by a lot of free fluid demands direct surgical intervention. In the case of the vascular injuries (Patient C), an endovascular treatment performed by an intervention radiologist is preferable. Currently this latter treatment is not available in every hospital but, because of the progress in interventional radiology, this may change in the coming years. Because of the high sensitivity of a CT scan, a cooperative patient who has a ‘seat belt sign’, and no indicative signs of injury on the CT scan, can be safely discharged from hospital. Comprehensive information about any possible complications is essential. If a general practitioner detects a ‘seat belt sign’ during the physical examination of a patient who has had a car accident, this patient should be referred to hospital
for additional investigations. The Flowchart (Figure 6) illustrates our strategy for the diagnostic and therapeutic pathway.

Ladies and gentlemen, after the introduction of the obligation to wear a seat belt, the morbidity and mortality rates of car accident related injuries have drastically declined. However, a new phenomenon has now appeared: ‘the seat belt sign’. If a ‘seat belt sign’ is present, one should be aware of the presence of intra-abdominal injury and therefore a CT scan should be performed accessible.
REFERENCES