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Case Report

Case Report of Complete Duodenal Transection and Bilateral Diaphragmatic Rupture Secondary to Seatbelt in High Speed Motor Vehicle Collision

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Received: July 09, 2020; **Published:** July 31, 2020

Abstract

The seatbelt sign in adult trauma patients is a harbinger of potential thoracoabdominal trauma which typically occurs after a high-speed motor vehicle collision (MVC). It is an important physical exam clue in the identification of injury patterns for the clinician. The injuries associated with a seat belt sign include thoracoabdominal trauma and spinal injuries. Among these are Chance fractures, characterized by hyperflexion injuries to the spine. We present a case of a 37-year old woman involved in a high speed MVC that presented with an associated seatbelt sign. The patient we describe included a complex constellation of injuries including a complete transection of the duodenum, bilateral diaphragmatic rupture, and Chance fracture. Included is a thorough literature review and a detailed discussion of her surgical management and hospital course.

Keywords: *Duodenal Transection; Bilateral Diaphragmatic Rupture; Seatbelt; Motor Vehicle Collision*

Introduction

The seatbelt sign in adult trauma patients is a harbinger of potential thoracoabdominal trauma which typically occurs after a high-speed motor vehicle collision (MVC).

Case Presentation

The patient is a 37-year old female that was a restrained rear driver-side passenger of a car that struck a semi-truck at highway speeds head on. No extrication was required. She was brought to an outside hospital emergency room (ER) alert and oriented but her condition quickly deteriorated. She became hypotensive and tachycardic and increasingly somnolent. Per Advanced Trauma Life Support (ATLS) she was intubated and had bilateral chest tubes placed for bilateral pneumothoraces. She received 4 units of blood, stabilized and transferred to our Level 1 trauma center in West Texas, approximately 150 miles away via air ambulance. She arrived to our ER four hours after her accident. Based on physical exam findings, a focused assessment with sonography in trauma (FAST) exam, and rapid trauma computerized tomography (CT) scans per standard trauma protocol, she was urgently taken to the operating room.

Upon an exploratory laparotomy, her injuries include a complete transection of the first portion of her duodenum just distal to pylorus, with entire stomach residing in the left hemithorax (Figure 1), small traumatic duodenotomy at juncture of 2nd and 3rd portion, 15 cm bilateral transverse disruption of diaphragms. avulsion of branches of superior mesenteric vein (SMV), grade I splenic laceration, and glisson capsule denuded under surface of right lobe of liver. No obvious pancreatic injury was found.

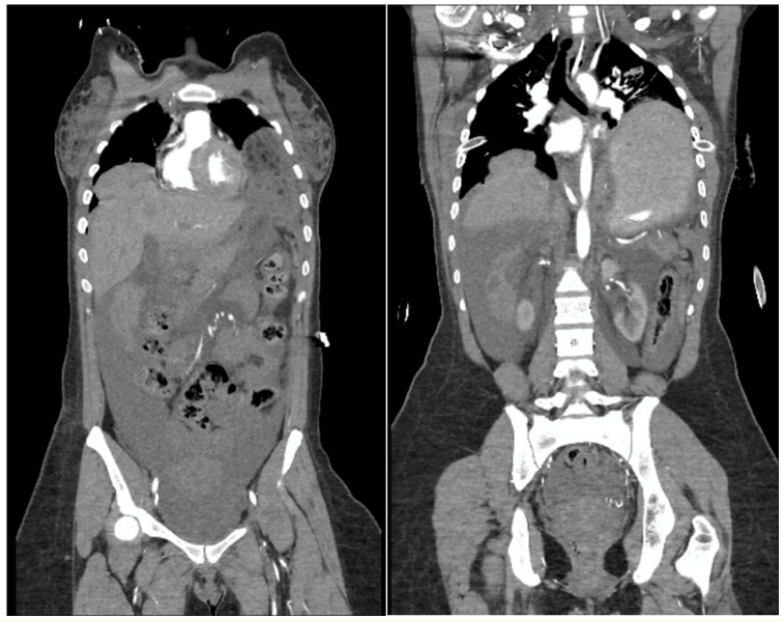

Figure 1: *CT body shows visualization of coiled NG tube within the stomach, which is in the chest. In addition, massive hemoperitoneum can be visualized.*

She was found to have additional injuries including right-sided rib fractures (8^{th}, 9^{th}, 10^{th} ribs laterally), bilateral pneumothoraces, bilateral L1 transverse process fractures, bilateral supratentorial and infratentorial lacunar infarctions, cerebral infarcts, right-sided hemiparesis, acute kidney injury, likely related to myoglobinuria/rhabdomyolysis. A magnetic resonance imaging (MRI) of the lumbar spine was performed which revealed posterior ligamentous injury and soft tissue contusions of cervical spine and an unstable spinal injury at T12/L1 with ligamentous disruption, spinal cord contusion and ventral epidural hematoma at this level (Figure 2).

After the multiple surgeries requiring a tracheostomy and a long stay in the intensive care unit, the patient was discharged about two and half months after the traumatic incident.

Operative treatment

On her initial surgery, the patient underwent an emergent exploratory laparotomy with evacuation of moderate amount of hemoperitoneum. Her bilateral diaphragmatic tears were repaired primarily. She received a pyloric exclusion. Avulsed branches of the SMV were oversewn. The abdomen was left open and efforts were made to stabilize the patient and take her to intensive care unit (ICU) for further resuscitation.

On postoperative day 2, the patient underwent a re-exploration with Bill-Roth II gastrojejunostomy, Braun enteroenterostomy, cholecystectomy, and splenectomy. The patient had a prolonged hospital course and required a tracheostomy on hospital day 20. On hospital day 25, the patient underwent definitive repair of her Chance fracture with partial laminectomy of the inferior aspect of T12 and superior aspect of L-1 for removal of a hematoma with posterior spinal fusion of T-10 to L-2 with the use of O-arm and intraoperative neuronavigation for planning and placement of pedicle screws bilaterally T-10 to L-2.

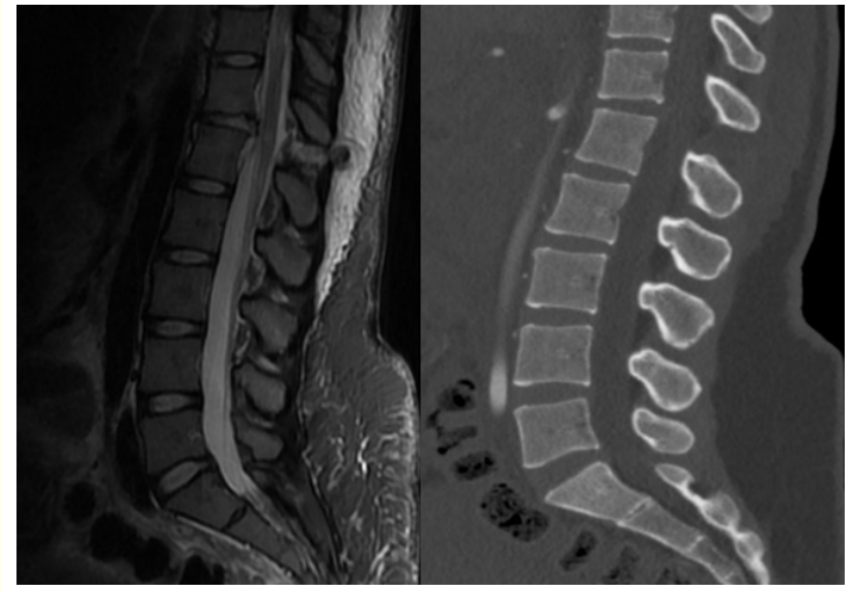

Figure 2: *Visualization and sagittal reformat of CT abdomen as well as MRI of the thoracolumbar spine shows distraction of T12-L1 distraction "Chance Fracture".*

The patient stayed at a long term acute care facility (LTAC) for 3 months after discharge and was able to walk on February of 2019 (1 year after the accident). She is following up with her physicians regularly for post-traumatic stress disorder, gastrointestinal discomfort, which she describes as "food sits at the top of my stomach" and her back pain.

Discussion

We describe an interesting case of a trauma involving a seat belt with a unique series of injuries successfully managed surgically. This report demonstrates a successful outcome, even with a high Injury Severity Score (ISS) of 35. It is a good example of a rapid transfer to a level 1 trauma center, as the index of suspicion was high for high speed deceleration injuries. According to the CDC, in the United States, over 2 million people each year are injured and over 32,000 people are killed each year from MVC's. This death rate is more than twice the average of other high-income countries [9]. This demonstrates that even with the significant reduction in car accident deaths with the invention of the seatbelt and safety features in our cars, having a robust regionalized EMS and trauma system can still help save the lives of many people.

The seatbelt sign was first defined by Garrett and Braunstein in 1962, only 3 years after the invention of the three-point seatbelt [7]. The sign was associated with blunt abdominal trauma as a result of the sudden deceleration. This combined with the impact of the abdominal wall on a blunt, stationary object results in a complicated constellation of injuries. These include small intestine avulsion, laceration of intestinal mesentery, and bowel perforations [4]. Chandler., *et al*. demonstrated the association between the seatbelt sign and thoracoabdominal trauma. Adult MVA victims were studied between July 1993 and January 1994; of the 117 total victims, 14 of them (12%) presented with an abdominal seatbelt sign. Of those 14, 9 victims (64%) presented with abdominal injury, 5 (36%) required surgical intervention, and 3 (21%) had small bowel perforation. On the other hand, the 103 patients that did not present with seatbelt sign had significantly fewer abdominal injuries (9; 8.7%), laparotomies (4; 3.8%), and small intestine perforations (2; 1.9%) [10].

Diaphragmatic injuries are uncommon and are an indicator of severe trauma due to the high rate of concurrent injury. Rupture occurs when the intra-abdominal pressure suddenly becomes greater than the tensile strength of the thin, flat muscle of the diaphragm. During a high speed MVC, this can occur due to hyperflexion of the torso against the seat belt straps, caused by the sudden deceleration [8]. In these severe cases, the result is a herniation of abdominal viscera through the diaphragm into the thorax. Most ruptures occur on the left hemidiaphragm, which is weaker than the right. On the right side, the liver can help distribute the force of deceleration over a larger area.

Early diagnosis of diaphragmatic ruptures is vital to proper management of the patient, otherwise pulmonary complications will occur. Historically, diagnosis of these injuries are often missed because they are overshadowed by coma, shock, and other traumatic wounds [2]. More recent diagnostic methods include radiographs, CT scanning, and laparoscopy/laparotomy that are helpful in locating acute diaphragmatic injuries. Laparoscopy still remains the best diagnostic tool for evaluating diaphragmatic injury, although this is not always necessary to make a diagnosis [3].

In addition to diaphragmatic injuries, lumbar injuries associated with the use of seat belts are also frequently reported in MVCs. Lap-type belts concentrate the forces during a collision to the lower abdomen and pelvis, which can typically sustain the stress due to their construction. However, in extreme cases, the excess force can manifest as fractures or dislocations in the lumbar spine [8]. The most common type of spinal injury as a result of the use of seat belts is the Chance fracture, which is a splitting of the spine starting from the posterior spinal elements and propagating to the anterior vertebral body [5]. During rapid deceleration, the upper body and legs are thrust forward while the pelvis is restrained by the transverse belt strap [6]. This puts the spine under great tensile stress, resulting in spinal fractures.

By this same mechanism, abdominal perforations also occur due to the increase in intra-abdominal pressure during a high speed MVC. The sudden deceleration crushes the intra-abdominal organs between the seat belt and the spine, resulting in abdominal rupture and in severe cases, complete transection of the bowel [8].

Transections of the duodenum are uncommon due to its retroperitoneal location in the abdomen [1]. Complete transection of the first part of duodenum just distal to the pylorus, as seen in our patient, is rare. It is more common to see transections in more distal segments of the duodenum. In 1967, Witte., *et al*. reports 5 separate cases of transection of the bowel, all of which were distal to the superior mesenteric vessels [4]. In 2014, Bankar., *et al*. reports a case of transection of the 3rd part of the duodenum from an MVC [11]. The details of the mechanism of injury that caused our patient's duodenal transection is unknown, but a high index of suspicion should be maintained in all cases of MVC for hidden injuries.

Conclusion

We present an interesting case of a severe traumatic abdominal injury secondary to seatbelt in a motor vehicle collision. The patient was successfully treated for duodenal perforation, bilateral traumatic diaphragmatic rupture, and severe spinal injury. Here we present a potential management sequence of such an injury.

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Volume 3 Issue 8 August 2020