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Combined aortic and diaphragmatic injury following blunt trauma: A case report

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ABSTRACT

Traumatic aortic injury associated with diaphragmatic rupture constitutes a devastating injury complex that requires prompt recognition and treatment. The incidence of diaphragmatic rupture among patients with aortic injury has been cited to be as high as 10%. Both decision-making and technical aspects associated with this injury combination can be very challenging. We describe a case of combined aortic and diaphragmatic injuries necessitating decompressive laparotomy prior to definitive aortic and diaphragm repairs. Brief literature overview of the topic is also presented, focusing on the role of modern imaging techniques in diagnosing combined aortic-diaphragmatic injury.

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INTRODUCTION

Traumatic aortic injury associated with diaphragmatic rupture is a grave diagnosis, mandating prompt recognition and treatment.[1] Among blunt trauma patients diagnosed with thoracic aortic injury, approximately 10% are found to have an associated diaphragmatic rupture.[2] The technical aspects of operative treatment of this injury complex are often very complicated.[3] We describe a case of combined aortic-diaphragmatic injury necessitating decompressive laparotomy prior to undertaking the definitive repair of the aorta and the diaphragmatic rent. Brief literature overview of the topic is also presented, focusing on the role of modern imaging techniques in the setting of combined aortic-diaphragmatic injury.

CASE REPORT

A 30-year-old man was struck by a train while walking along the railroad track. He was intubated at the scene, and promptly transported to the hospital. Upon arrival, the patient was hemodynamically unstable, with chest radiograph showing widened mediastinum and bilateral hemothoraces. Bilateral chest tubes were inserted, with significant hemodynamic improvement. His other injuries identified at the time of initial trauma bay evaluation included a large scalp laceration, an open-book pelvic fracture, and multiple facial fractures. External pelvic compression was immediately applied.

The patient underwent a focused assessment with sonography for trauma (FAST) examination, which was negative. He was then taken for computed tomographic (CT) examinations of the chest (CT angiogram, CTA), abdomen and pelvis. The CTA demonstrated aortic tear (**Figure 1**). Sagittal reconstructions of the combined CT images of the chest and abdomen demonstrated left diaphragmatic rupture (**Figure 2**). Other injuries identified on the CT of the abdomen included left renal contusion, pelvic fractures, and transverse process fracture of the fifth lumbar vertebra.

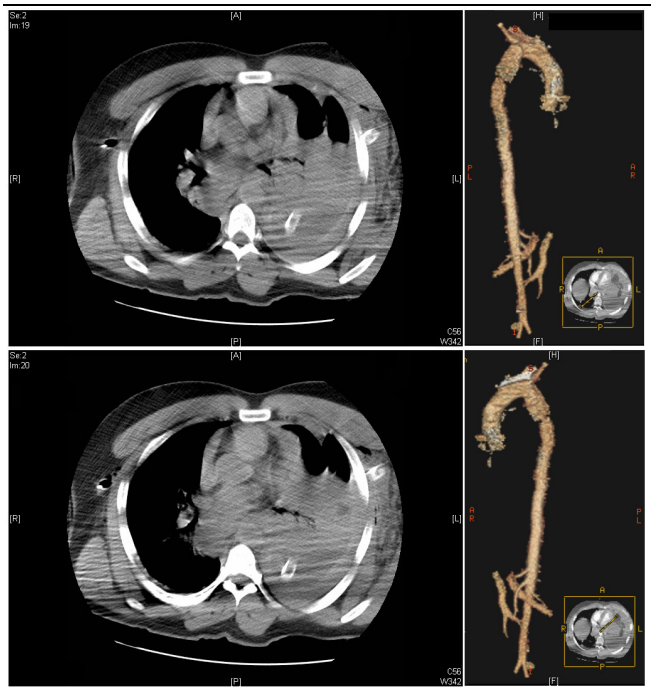

Figure 1. Computed tomographic angiography demonstrating an injury of the proximal descending aorta.

Due to a sudden increase in left thoracostomy output following the CT, the patient was emergently taken to the operating room, where a left posterior-lateral thoracotomy was performed. Upon entering the chest, the patient was noted to have severely distended small bowel loops and dilated stomach in his left hemithorax (despite the presence of a functioning, appropriately positioned nasogastric tube). After several attempts at unsuccessfully reducing the severely edematous and distended abdominal viscus back into the peritoneal cavity, the abdomen and the peritoneum were opened. The bowel and gastric contents were then emergently decompressed via a sub-diaphragmatic

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gastrostomy creation, and pulled down into the abdominal cavity. Following this maneuver, adequate visualization of intrathoracic structures was obtained, and the patient underwent repair of the descending aorta utilizing left heart bypass. Active bleeding from the left upper and lower pulmonary lobes was also controlled, followed subsequently by primary suture repair of the ruptured left diaphragm. Following diaphragmatic repair, the abdomen was temporarily closed with a damage control dressing, with plans to return for subsequent re-laparotomy.

Figure 2. Computed tomographic reconstruction following sagittal image reformatting clearly demonstrates the presence of diaphragmatic rupture and the presence of abdominal contents in the left chest cavity.

Following the initial procedure, the patient was taken to the intensive care unite (ICU). He underwent numerous subsequent procedures, including operative repair of multiple facial fractures, as well as re-laparotomies and placement of Wittmann patch for gradual closure of the abdominal fascia.[4]

The patient's ICU course was characterized by a 50-liter crystalloid and 80-unit packed red blood cell resuscitation (with additional blood product supplementation) and by multi-system organ failure. The patient required continued ventilatory support for respiratory distress and continuous renal replacement therapy for ongoing renal failure. On postoperative day three, the patient was noted to have decreasing cardiac index (2.2 liters/min/m^2), and subsequently developed fulminant heart failure. He deteriorated to refractory acidosis, refractory atrial fibrillation with periods of asystole, and further decrease in cardiac index (1.3 liters/min/m^2). Despite multitude of heroic measures taken by our team, the patient died seven days following the initial injury. His death was attributed to multi-system organ failure in association with severe blunt myocardial injury.

DISCUSSION

Diaphragmatic rupture is a well-known consequence of high-energy blunt trauma to the abdomen and chest. Diaphragmatic injury is seen in approximately 7% of thoracic injuries and 22% of thoracoabdominal injuries.[5] Left-sided injuries are approximately five times more common than right-sided injuries.[6] The association between diaphragmatic and aortic injuries resulting from high-energy blunt trauma has been previously described by Reiff et al.[7]

Diagnosis and treatment of combined thoracic aortic and diaphragmatic injuries can be very challenging, and requires a high index of suspicion .[7-8] In fact, although the diagnosis of blunt aortic injury in the case presented was readily made during the CT angiography, the diagnosis of diaphragmatic rupture was not easily apparent, and was clearly visualized only after sagittal reformatting of CT images was performed. Although chest radiograph remains a useful and inexpensive diagnostic imaging modality for diagnosing diaphragmatic rupture [9], helical CT is the modality of choice in trauma patients with suspected diaphragmatic injury in an emergent setting .[10] Modern helical CT is fast and allows diagnosis of other injuries in a multiply injured patient.[10] Helical CT is especially useful in diagnosing blunt diaphragmatic rupture when reformatted images are utilized, such as in the case presented.[11] In an otherwise stable trauma patient with suspected diaphragmatic injury, magnetic resonance imaging (MRI) offers excellent visualization of diaphragmatic anatomy.[10]

Surgical approaches used to treat blunt aortic injury vary. Since rupture of the thoracic aorta most frequently occurs at the level of the aortic isthmus (90%), the left posterolateral thoracotomy seems to be the most frequent and most reasonable approach to this injury.[12] Median sternotomy has also been described in the treatment of thoracic aortic injury.[3]

In the case presented, we utilized a combination of left posterolateral thoracotomy and decompressive laparotomy in a combined operative approach. The combination of left posterolateral thoracotomy and decompressive laparotomy proved to be effective as an immediately life-saving emergency maneuver. Massive bowel and gastric edema and distention made it extremely difficult to effectively reduce intestinal contents back into the peritoneal cavity. In addition, the large size of the diaphragmatic rent further exacerbated the difficulty of reducing the viscera back into the abdomen. Once the left chest cavity was exposed properly, expeditious aortic repair could take place and the patient could be taken back to the ICU for further resuscitation and delayed repair of the other traumatic injuries. Pretre and

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colleagues previously described the use of median sternotomy and superior median laparotomy for a similar injury complex.[3]

CONCLUSIONS

Traumatic aortic injury associated with diaphragmatic rupture is a grave injury mandating prompt recognition and treatment. Chest radiogram or helical CT can be useful in establishing the diagnosis. Technical aspects of operative treatment of this injury complex are often very challenging. When combined aortic and diaphragmatic injury is present, and difficulty in reduction of herniated abdominal contents hampers prompt aortic repair, simultaneous decompressive laparotomy can be considered as an immediately life-saving maneuver.

REFERENCES

[1] Fabian TC, Richardson JD, Croce MA, et al. Prospective study of blunt aortic injury: Multicenter trial of the American Association for the Surgery of Trauma. J Trauma 1997;42:374-380.

[2] Kulick DM, Park SJ, Harrison BS, et al. Traumatic aortic and diaphragmatic rupture in a patient with dextrocardia and situs inversus: Case report. J Trauma 1998;45:397-399.

[3] Pretre R, Maeder M, Turina M. Technical considerations in the repair of combined aortic arch and diaphragm rupture after blunt trauma. J Trauma 2001;50:952-954.

[4] Stawicki SP, Cipolla J, Bria C. Comparison of open abdomens in non-trauma and trauma patients: A retrospective study. OPUS 12 Scientist 2007;1(1):1-8.

[5] Kara E, Kaya Y, Zeybek R, et al. A case of a diaphragmatic rupture complicated with lacerations of stomach and spleen caused by a violent cough presenting with mediastinal shift. Ann Acad Med Singapore 2004;33:649-50.

[6] George L, Rehman SU, Khan FA. Diaphragmatic rupture: A complication of violent cough. Chest 2000;117:1200-1201.

[7] Reiff DA, McGwin G, Metzger J, Windham ST, Doss M, Rue LW. Identifying injuries and motor vehicle collision characteristics that together are suggestive of diaphragmatic rupture. J Trauma 2002;53:1139-1145.

[8] Patselas TN, Gallagher EG. The diagnostic dilemma of diaphragm injury. Am Surg 2002;68:633-639.

[9] Voeller GR, Reisser JR, Fabian TC, et al. Blunt diaphragm injuries. A five-year experience. Am Surg 1990;56:28-31.

[10] Barbiera F, Nicastro N, Finazzo M, et al. The role of MRI in traumatic rupture of the diaphragm. Our experience in three cases and review of the literature. Radiol Med (Torino) 2003;105:188-194.

[11] Killeen KL, Mirvis SE, Shanmuganathan K. Helical CT of diaphragmatic rupture caused by blunt trauma. AJR Am J Roentgenol 1999;173:1611-1616.

[12] Pretre R, Chilcott M. Blunt trauma to the heart and great vessels. N Engl J Med 1997;336:626-632.