

# Delayed Death Due to Aortic Laceration after Chest Blunt Trauma: An Autopsy Case

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A traumatic aortic injury due to blunt chest trauma is well recognized. However, a delayed death due to an aortic laceration after blunt chest trauma is very rare. A 49-year-old man arrived at the emergency room after falling from a height of approximately 4 m. Upon radiological examination, multiple fractures to his left ribs with a hemopneumothorax on his left side were found. After undergoing a closed thoracostomy, he was admitted to the general ward due to his vital signs being stable. After 13 hours from his admission, he complained of chest discomfort with the sudden development of massive blood drainage through his chest tube. A cardiopulmonary resuscitation was performed, where the patient then died and an autopsy was performed 36 hours after his death. On internal examination, a small laceration of the descending aorta with irritation of the tunica adventitia was revealed. Given the findings of an additional histological examination and the aforementioned findings, the author thought that the fractured fragments of the posterior ribs had irritated the tunica adventitia of the adjacent descending aorta for some time after the chest trauma and that a perforation had finally occurred. The author here reports a case of a delayed death due to an aortic laceration after a blunt chest trauma with the patient's clinical information and full autopsy findings.

**Key Words:** Aorta; Lacerations; Thoracic injuries; Delayed diagnosis; Autopsy

## Introduction

A rib fracture is a well-known complication of blunt chest trauma and usually leads to the development of lung injuries as well as a pneumothorax or hemothorax. These complications are usually treated by a simple thoracostomy and subsequent observation. Therefore, this can easily result in clinicians concentrating on other injuries rather than the rib fractures when they evaluate patients with chest trauma. An aortic laceration due to a direct irritation by fractured ribs is very rare; however, it is fatal. In addition, the possibility of an aortic laceration is increased with left sided posterior rib fractures. Furthermore it can also occur in a delayed form after

trauma. A delayed death after trauma frequently causes a medicolegal dispute. It has been reported that fractured ribs injures a descending aorta as a delayed form. However, they were mostly cases of successful treatment of this injury pattern. There has been no autopsy case with a review of the forensic pathology. The author here reports a case of a delayed death due to an aortic laceration by fractured ribs after blunt chest trauma with the patient's clinical information and full autopsy findings.

## Case Report

A healthy 49-year-old man presented to the emergency

room after he had fallen from a height of approximately 4 m at the construction site while he was working. He was initially evaluated at a local hospital, and he was transferred to the university hospital with the diagnosis of a subarachnoid hemorrhage and multiple rib fractures with a hemothorax. He presented with stable vital signs upon arrival in the emergency room and electrocardiogram showed no abnormality except tachycardia. Laboratory test was done in the emergency room and troponin T was elevated (0.259 ng/mL; reference range, 0 to 0.1) but, follow-up test was not conducted. A radiological evaluation was conducted and revealed multiple left sided rib fractures with a hemothorax. Computed tomography (CT) of the brain revealed a linear fracture of the upper frontoparietal bone with multiple acute hemorrhagic contusions and a traumatic diffuse subarachnoid hemorrhage. In addition, a chest CT further delineated his chest injuries, revealing fractures of the left first through to the 12th ribs with posterior segmental fractures of some of the upper ribs, where some of the fractured ribs pressed directly upon the descending aorta (Fig. 1). The chest CT also showed other injuries such as fractures of the left clavicle and scapula, contusion of the left lung, and a thoracic spine fracture. After 4 hours, a follow-up brain CT showed no increase in the severity of the intracranial hemorrhage. The patient was then admitted to the general ward of the Department of Neurosurgery as agreed upon by the thoracic surgeon after inserting the chest tubing. His vital signs were stable during admission. After 13 hours from his admission, he complained of chest discomfort and a massive amount of blood suddenly drained through the chest tube. Approximately more than 500 mL of blood was found in the collection bottle at this time. His vital signs subsequently became unstable with a heart rate of 120 beats per minute; and an oxygen saturation of 70%, where then a cardiopulmonary arrest occurred immediately. Despite continuous cardiopulmonary resuscitation, he was finally pronounced dead after 15 hours from admission. His family then filed a medicolegal claim.

A medicolegal autopsy was performed 36 hours after his death. On external examination, diffuse contusions were noted on the left parietal area and left shoulder.

An internal examination revealed a diffuse subgaleal hemorrhage with a linear fracture of the parietal bone, and multifocal subarachnoid hemorrhages and cerebral contusions. A fracture of the left clavicle and left scapula were noted and multiple fractures of the left ribs were revealed. After opening the thoracic cage, a hemothorax of more than 400 mL in volume and a vast amount of pleural hematoma was found in the left thoracic cavity. The injuries of the descending aorta were also revealed. A hemorrhage of the tunica adventitia of the aorta was noted and an irritation of the tunica adventitia of the descending aorta was also noted. In addition, a small laceration of the aorta was identified (Fig. 2A). The author thought that a life-threatening hemorrhage was originated from this aortic injury. And the author found multiple fractured fragments of the left posterior ribs at the same level of the aortic injury (Fig. 2B). Histological examination confirmed an aortic injury. A hemorrhage in the tunica media was noted, and a diffuse hemorrhage was noted in the tunica adventitia. Cut surfaces of the aortic laceration site were coated with fibrin, tissue from the tunica adventitia, and an external elastic lamina (Fig. 2C). These findings demonstrate the occurrence of vital reactions and that the cutting direction of the aorta went from the outside to the inside. Lacerations of the left lung were additionally noted where no remarkable injuries were noted in regards to the other internal organs. Heart was 421 g, and there were mild atherosclerotic plaques in major coronary arteries. Gross examination



**Fig. 1.** An axial computed tomography of the chest demonstrates a displaced fragment of the fourth rib impressing upon the descending aorta (the arrow indicates the tip of the fractured fragment of the rib).

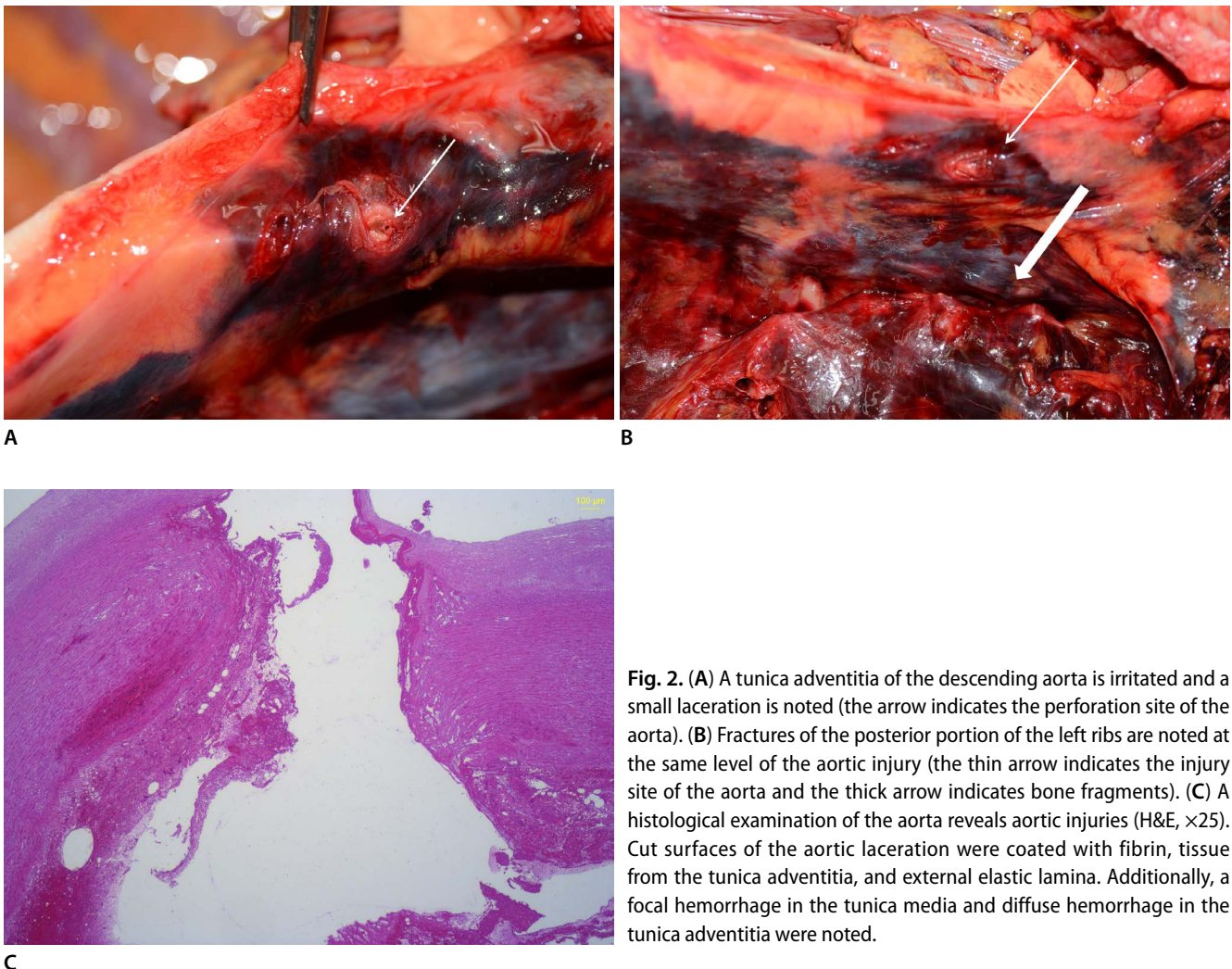
of myocardium revealed multifocal hemorrhagic lesions (Fig. 3A). Additionally, histological examination of the myocardium revealed infiltration of inflammatory cells including neutrophils with myocardial necrosis (Fig. 3B).

Moreover, blood samples from the heart and gastric content samples were collected for toxicological tests. They were analyzed by gas chromatography-mass spectrometry where no significant drugs and toxins were noted in the toxicological analysis. In addition, alcohol was not detected in the peripheral blood.

## Discussion

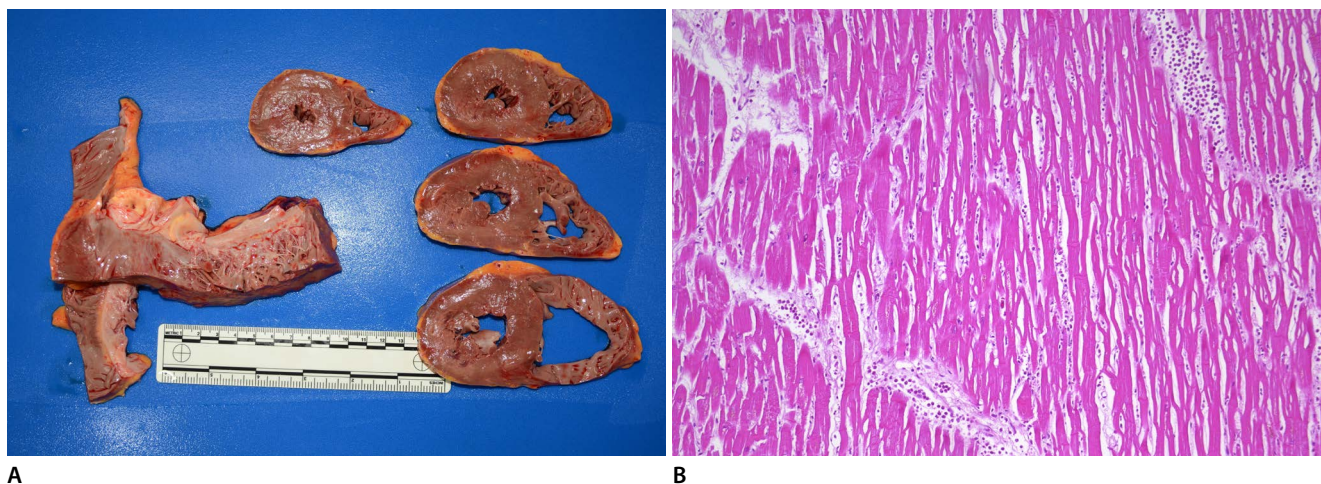
A rib fracture is a common injury experienced after blunt chest trauma and can occasionally become fatal from an associated lung or solid organ injury. However, rib

fractures are usually treated by a simple thoracostomy and subsequent observation unless there is internal organ injury. Therefore, clinicians occasionally overlook the fatal complications associated with rib fractures. On the other hand, though aortic injury resulting from a rib fracture is rare, it is still possible. Furthermore it could present in a delayed form after trauma. Boyles et al. [1] reviewed 11 cases of aortic injury caused by posterior rib fractures. Most of the cases were successfully treated and only 1 case resulted in subsequent mortality. There is no previous case report for this injury pattern with full autopsy findings. A delayed death after trauma frequently causes a medicolegal dispute. Therefore, a medicolegal consideration of such a death is important. The characteristics of these cases were as following: an aortic injury that occurred between 2 and 15 days after



**Fig. 2.** (A) A tunica adventitia of the descending aorta is irritated and a small laceration is noted (the arrow indicates the perforation site of the aorta). (B) Fractures of the posterior portion of the left ribs are noted at the same level of the aortic injury (the thin arrow indicates the injury site of the aorta and the thick arrow indicates bone fragments). (C) A histological examination of the aorta reveals aortic injuries (H&E, ×25). Cut surfaces of the aortic laceration were coated with fibrin, tissue from the tunica adventitia, and external elastic lamina. Additionally, a focal hemorrhage in the tunica media and diffuse hemorrhage in the tunica adventitia were noted.





**Fig. 3.** (A) Gross examination of myocardium revealed a mild whitish discoloration and multifocal hemorrhagic lesions in inferolateral aspect. (B) A histological examination of the myocardium revealed infiltration of inflammatory cells including neutrophils with myocardial necrosis (H&E, ×100).

the chest trauma. In all cases, the fractured ribs were left sided posterior ribs, involving the fifth to the ninth ribs. In the present case, a cardiorespiratory collapse occurred after 13 hours from the admission and his vital signs were stable during the admission. The fractured ribs were the left sided first through to the 12th ribs, and some of the upper ribs showed posterior segmental fractures. Multiple extruded rib fragments were noted at the same level of the aortic injury site at the time of the autopsy. The author thought that the rib that lacerated the aorta was the left fourth rib. Clinicians should be warned of this fatal complication that results from left posterior rib fractures, especially from the fourth through the ninth ribs. Careful observation should be conducted and a preventive surgical intervention such as a rib resection should be considered [2].

An autopsy revealed a hemothorax that was more than 400 mL in volume and a vast amount of pleural hematoma. Park et al. [3] reported a similar finding of a vast amount of pleural hematoma. The author thought that this vast amount of hematoma found in this study might contribute an abrupt massive drainage through the chest tube and an abrupt cardiovascular collapse by obstruction of the aortic laceration site or from a chest tube orifice. Moreover, an autopsy revealed a hemorrhage of the tunica adventitia and an irritated tunica adventitia of the descending aorta. Multiple extruding fractured fragments of the posterior ribs

were also revealed at the same level of the aortic injury. The author thought that these findings meant that the fractured fragments of the posterior ribs had irritated the tunica adventitia of the adjacent descending aorta for some time after the chest trauma and a laceration of the aorta finally occurred. Furthermore, the histological examination revealed the cut surfaces of the aortic laceration site were coated with fibrin, tissue from the tunica adventitia, and external elastic lamina. The author thought that these findings meant that an aortic laceration occurred while the patient was still alive (vital reaction) and that an aortic laceration occurred directionally from the outside to the inside of the aorta. Histological examination of the myocardium revealed infiltration of inflammatory cells including neutrophils with myocardial necrosis. The author assumed that he had suffered from an acute myocardial infarction, which may have contributed his fall.

A delayed death frequently causes several disputations. This case highlights various important points. In regards to the medical aspect, clinicians should not overlook the fact that a fatal complication may arise from posterior rib fractures of the left side, especially from the fourth through the ninth rib. Close observation is required and a preventive intervention should be considered if fractured bone fragments are adjacent to the descending aorta. An excessive postural change

of the patient should be also prohibited. In regards to the forensic aspect, a full autopsy with a histological examination should be performed. In the present case, the cause of the patient's fall was also discovered by an autopsy. As we know, an autopsy can unveil many obscured facts.

#### Conflicts of Interest

No potential conflict of interest relevant to this article was reported.

#### Acknowledgments

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