Forensic Identification of Traumatic Thoracic Aortic Pseudoaneurysm: A Surviving Case Report

Maoying Zhang, Jianhui Gao, Fang Shi, Jingyuan Ma, Chongya Huang, Shanzhi Gu

Abstract

Traumatic thoracic aortic pseudoaneurysm is rare and has a high mortality rate. Forensic identification in a living individual is even more rare. We herein present the case involving a 25-year-old male who developed a thoracic aortic pseudoaneurysm after a traffic accident. The debate, in this case, focused on whether a causal relationship was present between the traffic accident and the aortic pseudoaneurysm. Based on the patient’s trauma history, clinical manifestations, clear evidence of chest trauma, surgical findings, and exclusion of potential diseases, we determined that a causal relationship was present between the trauma and the aortic pseudoaneurysm. We propose that potential autogenous diseases should be excluded in the future evaluation of similar cases.

Keywords: Blunt chest trauma, forensic identification, forensic sciences, pseudoaneurysm

Introduction

Traumatic thoracic aortic pseudoaneurysm is rare and is associated with high mortality. Most reports to date have involved patients who died. The diagnosis in a living individual is even more rare. In this report, we present a case of forensic identification of a traumatic aortic pseudoaneurysm in a living patient.

Case Report

A 25-year-old male was hit by a car while crossing the road and flew approximately 12 m. After the traffic accident, he immediately developed sharp chest pain, chest tightness, shortness of breath, and profuse sweating. On admission, his blood pressure was 160/70 mmHg and pulse was 118 beats/min. On the day of the injury, a chest radiograph showed a widened mediastinum (white arrow) and left lower pulmonary contusion (black arrow). Transverse computed tomography (CT) of the chest [Figure 1b] demonstrated an irregular hematoma around the descending aorta (pseudoaneurysm) (white arrow) with a mediastinal hematoma (dashed arrow), hematopericardium (black arrow), and bilateral pleural effusion (asterisk). Subsequent CT angiography (CTA) of the chest [Figure 1c] revealed a saccular aortic aneurysm originating from the descending aorta. On the 3rd day after injury, the patient underwent descending aortic intracavitary membrane stent implantation and hemothorax drainage of the left chest. During surgery, the aortic rupture was visible and located at the beginning of the descending aorta. Postoperative CT [Figure 1d] showed the disappearance of the mediastinal hematoma, hematopericardium, and pleural effusion. Postoperative CTA [Figure 1e] showed the artificial stent at the origin of the descending aorta.

The debate, in this case, focused on whether a causal relationship was present between the traffic accident and the aortic pseudoaneurysm. The patient believed that the aneurysm was caused by trauma, whereas the responsible party believed that it arose from the natural disease instead of trauma. Both parties referred to the court to resolve the issue.

The court entrusted our forensic identification center to clarify whether a causal relationship was present between the trauma...
Therefore, In addition, 90% of blunt trauma-related death, only second to head injury. An estimated 85% of patients die before admission to the hospital. Moreover, up to 50% of initial survivors die within the first 72 h if appropriate treatment is not administered. Fortunately, the incidence of pseudoaneurysms is low in patients who have sustained blunt trauma. In 392,135 cases of blunt trauma patients reported by Shalhub et al., only 18 (0.0046%) presented with pseudoaneurysms. In general, the causes of such pseudoaneurysms include trauma, arteritis, and infectious diseases, among others. Historically, trauma accounts for the majority of pseudoaneurysms. This easily causes controversy in forensic identification, especially in living patients. In the present case, the aortic pseudoaneurysm in question occurred after the traffic accident.

A pseudoaneurysm, which lacks all three layers of the vessel, is thought to be caused by the tamponade effect of a hematoma surrounded by localized fibrous tissue. In patients with traumatic aortic pseudoaneurysm, the ascending aorta and aortic arch are more commonly affected in cases of penetrating trauma, whereas the isthmus and descending aorta are more frequently affected in blunt trauma. In addition, 90% of blunt thoracic aortic injuries occur at the isthmus of the aorta, which is located at the junction of the aortic arch and descending aorta, within 2 cm of the origin of the left subclavian artery. In the present case, the aortic injury occurred at the aortic isthmus. Although the mechanism of traumatic thoracic aortic rupture has been studied, no single theory has been established.

The underlying mechanism was likely a sudden deceleration or direct compression on the chest, which resulted in a sudden increase in chest pressure, causing the heart and great vessels to be jerked away from the posterior chest where the thoracic aorta was attached. As a result, the descending aorta isthmus bore the greatest stress relative to the fixed aorta. This led to the aortic rupture, so the blood flowed from the ruptured arterial wall and formed the pseudoaneurysm. This theory was also supported by the patient’s posttraumatic clinical manifestations such as elevated blood pressure, severe chest pain, and shortness of breath. Moreover, this patient had no other risk factors for aortic pseudoaneurysm such as atherosclerosis or hypertension.

In China, road traffic accident disability grades can be divided into ten levels. Traumatic thoracic aortic injury is a category 8 disability that can lead to a certain degree of disability compensation. No compensation is given for aortic injury caused by natural diseases. Therefore, the accuracy of forensic identification is directly related to the defendant’s compensation, which can provide help for future handling of similar cases. In the present case, we determined that the aortic pseudoaneurysm had been caused by the traffic accident for the following reasons. (1) History of trauma: the patient was involved in a pedestrian–vehicle accident. Thus, the history of trauma was clear in this case. (2) Clinical manifestations: the symptoms of sharp chest pain, chest tightness, shortness of breath, and sweating occurred immediately after the injury, which are consistent with the typical clinical manifestations of thoracic aortic injuries. (3) Clear evidence of chest trauma: chest radiography, CT, and CTA showed evidence of serious thoracic trauma, including pulmonary contusion, hemothorax, hematopericardium, and a mediastinal hematoma. Thoracic drainage was performed for the treatment of the hemothorax. In the evaluation of patients with acute chest trauma, arteriography is considered the gold standard for the diagnosis of aortic injuries. CTA is not only helpful for the early diagnosis but also it is 100% sensitive in evaluating the aneurysms. Therefore, CTA should be applied more widely in the evaluation of
traumatic aortic aneurysms. (4) Surgical findings: in this case, intraoperative examination revealed that the aorta had ruptured from the origin of the descending aorta. The typical site of aortic injury also indirectly confirmed this. (5) Exclusion of potential disease: first, the patient had no history of atherosclerosis, hypertension, familial aneurysm, or other trauma. Second, no systemic inflammation had been found in a physical examination of the patient half a year before the accident. No evidence of chronic infection (e.g., syphilis and mycotic aortitis) was found, and inflammatory markers were normal. Furthermore, the initial documentation supported the information the patient provided about his history. Third, 10 months after the trauma, the forensic examination further eliminated the above potential diseases. The results of the examination revealed no obvious abnormality in the color Doppler ultrasound report of the ascending aorta, abdominal aorta, bilateral iliac artery, or bilateral carotid artery, and his average blood pressure was 124/70 mmHg.

Therefore, we considered that the trauma was the most likely cause of this patient’s aneurysm and that there was a causal relationship between the trauma and the aortic pseudoaneurysm. We propose that potential autogenous diseases should be excluded in the future evaluation of similar cases.

Consent
We obtained written informed consent from the patient before reporting this case.

Declaration of patient consent
The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES
1. Mimasaka S, Yajima Y, Hashiyada M, Nata M, Oba M, Funayama M. A case of aortic dissection caused by blunt chest trauma. Forensic Sci Int 2003;132:5-8.
2. Ramzan MM, Fadl SA, Robinson JD. Core curriculum case illustration: Blunt traumatic thoracic aortic pseudo aneurysm. Emerg Radiol 2019;26:695-7.
3. Mészáros I, Mórocz J, Szlávi J, Schmidt J, Tornóci L, Nagy L, et al. Epidemiology and clinicopathology of aortic dissection. Chest 2000;117:1271-8.
4. Demers P, Miller C, Scott Mitchell R, Kee ST, Lynn Chagonjian RN, Dake MD. Chronic traumatic aneurysms of the descending thoracic aorta: Mid-term results of endovascular repair using first and second-generation stent-grafts. Eur J Cardiothorac Surg 2004;25:394-400.
5. Shalhub S, Starnes BW, Brenner ML, Biffl WL, Azizzadeh A, Inaba K, et al. Blunt abdominal aortic injury: A Western Trauma Association multicenter study. J Trauma Acute Care Surg 2014;77:879-85.
6. Gunn ML. Imaging of aortic and branch vessel trauma. Radiol Clin North Am 2012;50:85-103.
7. Dosios TJ, Salemis N, Angouras D, Nonas E. Blunt and penetrating trauma of the thoracic aorta and aortic arch branches: An autopsy study. J Trauma 2000;49:696-703.
8. Nzewi O, Slight RD, Zamvar V. Management of blunt thoracic aortic injury. Eur J Vasc Endovasc Surg 2006;31:18-27.
9. Creasy JD, Chiles C, Routh WD, Dyer RB. Overview of traumatic injury of the thoracic aorta. Radiographics 1997;17:27-45.
10. Lowe LH, Bulas DI, Eichelberger MD, Martin GR. Traumatic aortic injuries in children: Radiologic evaluation. AJR Am J Roentgenol 1998;170:39-42.
11. Macura KJ, Corl FM, Fishman EK, Bluemke DA. Pathogenesis in acute aortic syndromes: Aortic aneurysm leak and rupture and traumatic aortic transection. AJR Am J Roentgenol 2003;181:503-7.