Case report

The diagnosis of delayed expanding traumatic pseudoaneurysm of thoracic aorta caused by self-inflicted penetrating injury with crossbow bolt: A case report

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1. Introduction

A crossbow is an easily accessible bow weapon used for hunting or sports that shoots an arrow or bolt when a gun-like trigger is pulled. Crossbows can unexpectedly penetrate soft tissues and bones despite their low initial velocity, causing a wide range of lesions [1]. Penetrating chest trauma caused by crossbows is very rare and mostly reported as suicides, homicides, and accidental cases in forensic studies. According to a review of the literature regarding crossbow injuries, patients survived in only 17 of 55 cases (31%) [2].

Herein, we report a rare case of delayed expanding traumatic pseudoaneurysm of the thoracic aorta caused by a self-inflicted crossbow bolt injury that was successfully treated with early thoracic endovascular aortic repair (TEVAR). Although penetrating thoracic aortic injuries are typically fatal, particularly when the thoracic aorta is involved, our patient was initially hemodynamically stable without evidence of direct damage to the aortic wall, followed by enlargement of pseudoaneurysm during eight day follow up. Three-dimensional reconstruction of computed tomography (CT) images could be of greatly helpful in determining the wound tract and detecting damage to the surrounding tissue associated with minimal thoracic aorta traumatic pseudoaneurysms. This report is a reminder to emergency physicians about the importance of careful follow up for early detection of growing pseudoaneurysms, even if the bolts do not directly injure the aortic wall.

This work has been reported in line with the SCARE criteria [3].

Keywords:
- Case report
- Traumatic pseudoaneurysm
- Thoracic aortic injury
- Crossbow bolt
- Three-dimensional reconstruction
- Computed tomography

ABSTRACT

Introduction and importance: Penetrating chest trauma caused by a crossbow bolt is very rare. Herein, we report a successfully treated patient who attempted suicide by directing a crossbow to the chest cavity and developed an expanding pseudoaneurysm of the thoracic aorta during eight day follow up.

Case presentation: A 51-year-old male was admitted to the emergency department after firing a crossbow bolt twice into his left chest. At admission, the patient was hemodynamically stable and maintaining oxygenation. The bolt had already been removed from the body. Contrast-enhanced computed tomography (CT) revealed a cavity pseudoaneurysm 2.5 mm in size in the aortic arch. Three-dimensional reconstruction of the CT demonstrated wound tracts showing probable damage by the bolt. The patient was admitted to the emergency department for careful observation and transferred to the psychiatric ward on day two. Follow-up contrast-enhanced CT on day eight demonstrated rapid expansion of the pseudoaneurysm from 2.5 mm to 4.0 mm in size. We performed thoracic endovascular aortic repair (TEVAR) on day 13. The patient was uneventfully discharged on the 20th hospital day.

Clinical discussion: Emergency physicians should be aware that damage to the surrounding tissue may be accompanied by delayed expansion of an aortic pseudoaneurysm, even if the bolts do not cause direct aortic wall injury.

Conclusion: This case suggests that understanding the injury mechanism, confirming the tract of the bolts, and carefully exploring traumatic pseudoaneurysm can lead to a less invasive operation due to early detection.

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2. Presentation of case

A 51-year-old male with no medications, no allergy, no smoking, no alcohol, and relevant medical history including psychiatric disease, was admitted to our emergency department with a self-inflicted penetrating chest injury. The patient stated that he attempted suicide by firing a hand-made crossbow bolt twice into his left chest (Fig. 1). The patient was hemodynamically stable with a blood pressure of 151/83 mmHg, heart rate of 94 beats/min, and respiratory rate of 16 breaths/min. He was alert and oriented, with no apparent neurological deficit. He had two stab wounds in his left precordia area. The bolt had already been pulled out by the patient at presentation, and there was no wound in his back. His respiratory sounds were normal without subcutaneous emphysema or respiratory distress, with pulse oximetry of 97% in the room air. The abdomen was flat and soft. Ultrasonography revealed no pericardial effusion without intraperitoneal fluid. Laboratory test results showed no abnormalities. Emergency contrast-enhanced CT revealed left lung contusion, left hemopneumothorax, and a cavity pseudoaneurysm 2.5 mm in size on the aortic arch. Based on the three-dimensional image reconstructed to determine the bolt’s possible penetration route, the injuries were likely caused by the bolt (Fig. 2). The patient was given Ringer solution, human tetanus immunoglobulin, tetanus toxoid vaccine and prophylactic antibiotics (cefazolin 3 g/day) on admission. Since the patient remained hemodynamically stable, he was transferred to the psychiatric ward for psychological treatment of presented suicide ideation after careful observation in the intensive care unit for two days. On day eight, follow-up enhanced contrast CT demonstrated enlargement of the pseudoaneurysm from 2.5 mm to 4.0 mm (Fig. 3). Cardiovascular surgery consultants decided to perform TEVAR on day 13 of admission. The postoperative course went well, and the patient was discharged to aftercare on the 20th hospital day. We followed the patient for two months; he has been well without enlargement of the pseudoaneurysm.

3. Discussion

The chest and head are often the most commonly injured areas in self-harm cases with crossbow injury [4,5]. We present here a rare case of suicide attempted in an unusual way - with a crossbow. While such a patient often suffers from a mental illness or drug/alcohol dependence, our patient did not have any history of psychological disease.

Like our patient, patients with non-lethal crossbow injuries often show few symptoms and can remain conscious. The pathophysiology of traumatic pseudoaneurysm of the thoracic aorta caused by blunt chest trauma has been considered arterial wall damage from the intima towards the adventitia. On the other hand, the mechanism of traumatic thoracic aortic pseudoaneurysm caused by penetrating trauma from stabbing or bullet wounds is damage to the aorta from outside to inside [6–8]. Crossbow bolts have little kinetic energy, leading to fewer tissue injuries than those caused by bullets [9,10]. In our patient, the pseudoaneurysm may have been formed by adventitia injury by the crossbow associated with injuries to the surrounding tissue. Initially, we chose the conservative management since the size of pseudoaneurysm of the aortic arch was 2.5 mm in size on admission. Considering the benefits and disadvantages of surgical intervention, we chose conservative management and followed up our patient carefully, even after admission to the psychiatric ward, which enabled early detection of the expanding pseudoaneurysm and preventing delayed intervention.

When a bolt remains in the wound, it is easy to get information on its trajectory. However, it can be challenging to distinguish the real cause of injury after the bolt is removed from the wound. Chest radiogram is the initial screening test used for these trauma patients. Indirect signs suggestive of aortic injury are mediastinal hematoma and widening or concomitant multiple rib fractures. CT should always be performed to assess the organs involved and correctly assess the wound tract.

There is no established therapeutic strategy for traumatic aortic pseudoaneurysm; it depends on the severity of the patients’ physical condition or the expanding speed of the pseudoaneurysm. A crossbow arrow or bolt should be invariably left in situ, secured against displacement to avert new injuries or worsening of those already incurred, and should only be removed by expert physicians in the hospital [4]. In general, implantation of blood vessel prosthesis has been the established treatment for traumatic aortic pseudoaneurysm. Recently, TEVAR, a less invasive intervention, may be the first-line treatment for traumatic aortic pseudoaneurysm when the anatomical aortic requirements are met [11,12]. Our patient was at high risk for delayed rupture based on CT findings of rapid enlargement of thoracic pseudoaneurysm. Therefore, we believe the present case was a good indication of TEVAR.

4. Conclusion

When treating patients with penetrating chest trauma caused by crossbow bolts, emergency physicians should be aware that damage to the surrounding tissue may be accompanied by delayed expansion of a traumatic aortic pseudoaneurysm, even if the bolts do not directly injure the aortic wall. Close monitoring for any signs of further deterioration, as well as aggressive imaging modalities, including contrast-enhanced CT based on understanding of the injury mechanism, enabled us to avoid delays in treatment.

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Ethical approval

This case study was approved by the ethical committee of Okayama University.

Consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this
Fig. 2. The tract of arrows on computed tomography (CT) and three-dimensional reconstruction of the CT image. The path of the bolt can be seen penetrating the anterior lung.

Fig. 3. Rapid expansion of the pseudoaneurysm from 2.5 mm to 4.0 mm of the sac depth in the follow-up contrast-enhanced computed tomography on day eight of admission.

Author contribution

Shunsuke Nakamura, Taihei Yamada, Hiromichi Naito, Naoya Sakoda and Atsunori Nakao treated the patient and collected data. Shunsuke Nakamura and Atsunori Nakao wrote the paper.

Registration of research studies

Not applicable.

Guarantor

Hiromichi Naito, Atsunori Nakao.

Provenance and peer review

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Declaration of competing interest

None.

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