Successful Treatment of Penetrating Chest Injury Caused by a Crossbow

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(Received February 18, 2014; Accepted April 3, 2014)

A 67-year-old man presented with a crossbow injury sustained in a suicide attempt during which he fixed the crossbow to a table. Although he retired to bed without treatment on the day of the initial injury, his pain increased the following day, and he was admitted to our hospital. On arrival, his vital signs were stable and a 10-mm diameter crossbow arrow that had penetrated the right anterior chest remained in place. Chest computed tomography revealed suspected damage to the right middle lobe, diaphragm, and liver. A right anterior thoracotomy was performed with partial resection of the middle lobe, diaphragm repair, and arrest of hepatic bleeding. There were no complications, and his postoperative course was uneventful. On day 12 after surgery, he was transferred to the psychiatry department of another hospital for treatment of his depression.

Key words: penetrating chest injury, crossbow, suicide

INTRODUCTION

A crossbow consists of a bow fixed to a stock and is known as a Bowgun in Japan. The name "Bowgun" is a Japanese-English term derived by combining words "bow" and "gun." Crossbows were used as weapons for hunting and fighting before development of firearms. They are capable of causing fatal injuries. In other countries, crossbow injuries due to accidents, suicides, and murders have been reported. In Japan, however, there have been few reports of crossbow injuries. Here, we report a very rare case of a penetrating chest injury caused by a crossbow.

CASE HISTORY

A 67-year-old man fixed a crossbow on a table at his home and shot it at himself in a suicide attempt; he was 30 cm away from the crossbow while shooting (Fig. 1). The arrow used with the bow was 40 cm and hit the midclavicular line of the right anterior chest, which caused an injury. He retired to bed without any treatment on the day of the injury. On the following day, he attempted to remove the arrow himself, but failed. As the pain increased, he was transported by ambulance to our hospital. Physical examinations performed upon arrival showed the following: clear consciousness; blood pressure, 140/80 mmHg; heart rate, 102 beats/min; respiratory rate, 24 breaths/min; body temperature, 37.0°C; and SpO_2, 100% (O_2 6L). Chest auscultation revealed no difference in breath sounds between the left and right lungs; subcutaneous emphysema was absent. The 10-mm diameter crossbow arrow had invaginated the fifth intercostal space in the midclavicular line of the right anterior chest (Fig. 2). From the arrow length, it was presumed that about 100 mm of the arrow had penetrated the body. The patient's medical history included atrial fibrillation and hypertension. Although warfarin was administered orally for atrial fibrillation, the patient had run out of his medication 2 weeks previously and had not taken any medications since then. No history of psychiatric disorder was present. The patient had a mania for collecting knives and model guns. The arrowhead used in this case was a trimmed ice pick.

The chest radiograph shows the crossbow arrow (Fig. 3). No apparent pneumothorax or pleural effusion was present. Computed tomography (CT) (Fig. 4) suggested damage to the right middle lobe, diaphragm, and liver. The abdomen showed no apparent free air or fluid accumulation. Surgery was performed using a right anterior thoracotomy approach in the left lateral decubitus position. The arrow had penetrated the middle lobe; hence, a partial resection was performed. The arrow had also penetrated the diaphragm (Fig. 5); thus, the diaphragm was incised with an electrosurgical knife to observe the inner abdomen (the Japanese Association for Surgery of Trauma, Diaphragm injury Type Ⅲa, Hepato injury Type Ⅱ). Liver examination revealed that the arrow was not fixed in position, thereby causing only minimal damage. About 10 mm of the arrow had penetrated the liver, but this had not led to bleeding. The arrow was removed, and the wound was closed with horizontal mattress sutures. A Penrose drain was placed in the region extending from the sub-xiphoid process to the sub-diaphragm, and the diaphragm was closed with six 2-0 Ti-cron ™ horizontal mattress sutures. Absence of air leakage was confirmed by a sealing test; a 19-Fr Blake drain was positioned, and the chest wound was closed. The total duration of surgery was 120 min with blood loss of 250 g. The patient's postoperative course was favorable. On day 12 after surgery, he was

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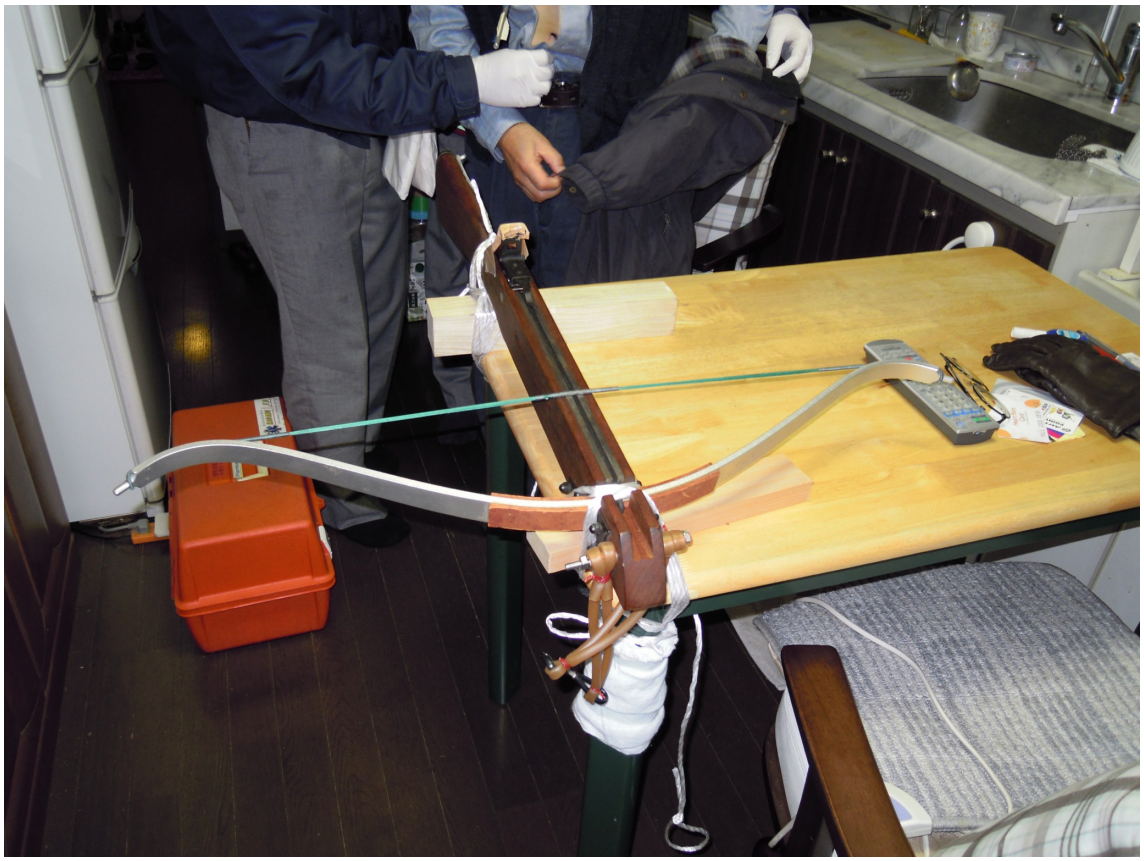

Fig. 1 A photograph of the crossbow used by the patient.

Fig. 2 A photograph of the patient with the crossbow arrow lodged in his anterior chest wall.

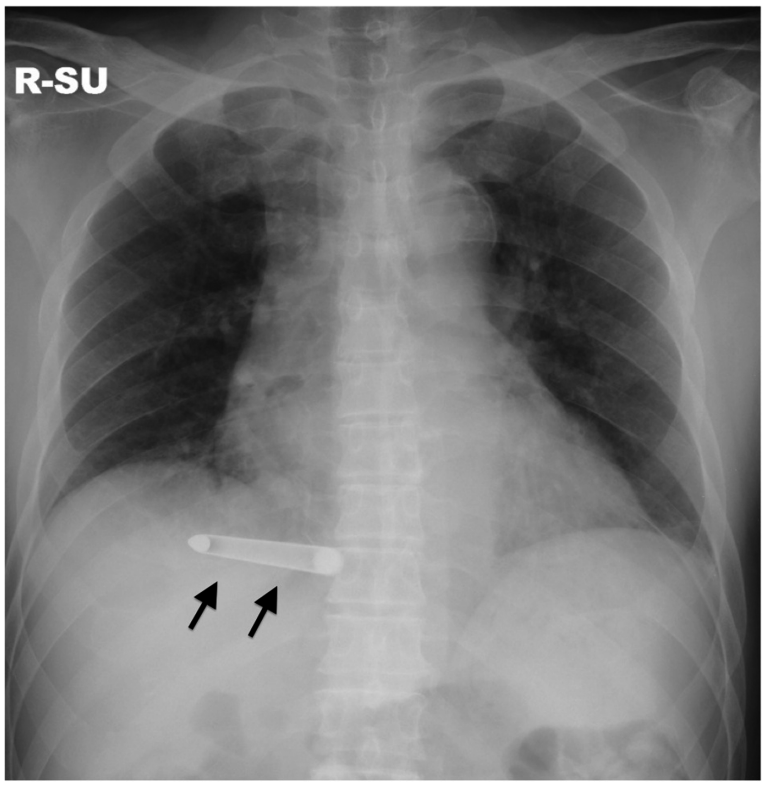

Fig. 3 A chest radiograph. The penetration of the arrow shot from the crossbow is clearly visible. No apparent pneumothorax or plural effusion was present.

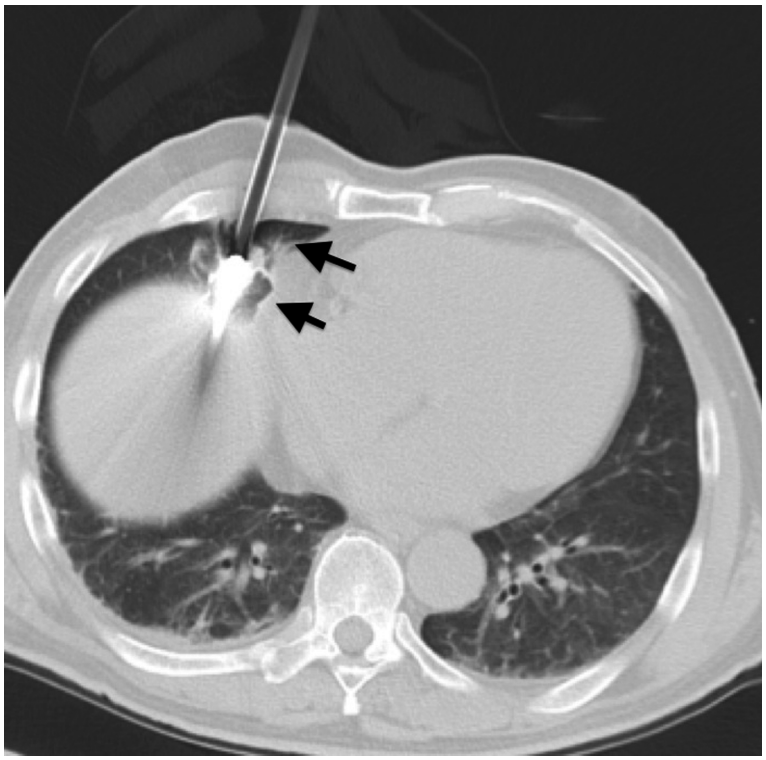

Fig. 4 A computed tomography scan. The position of the arrowhead was unclear due to an artifact arising from the arrow.

transferred to the psychiatry department of another hospital for treatment of his depression.

DISCUSSION

Crossbows sold in Japan are classified as Heavy Crossbow and are generally 60–100 cm in length, 50–70 cm in width, and 3–10 kg by weight. The effective range is 40–80 m, and the maximum speed is 60 m/s or greater [1, 2]. In other countries, the crossbow is mainly used for competition or hunting, and purchases are strictly regulated. In Japan, hunting with a crossbow is prohibited, and crossbows are sold solely for competition. Therefore, there is no regulation on the procurement of crossbows [1, 3]. Depending on the intended use, two types of arrow tips are available. A field-tip is conical and used for sports. A broadhead-tip has 2–5 blades and is used for hunting. According to overseas reports, the broadhead-tip causes deeper

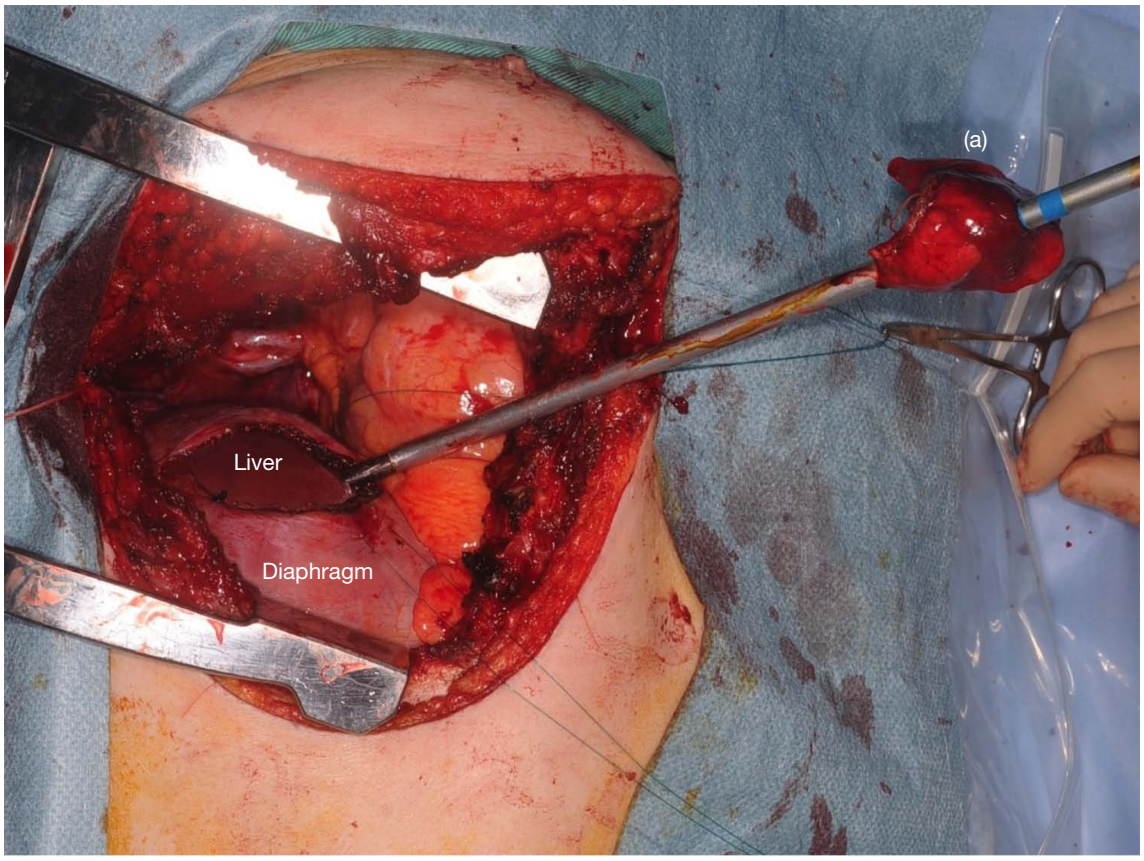

Fig. 5 An intraoperative photograph. Surgery was performed using a right anterior thoracotomy approach. The arrow of the crossbow had penetrated the middle lobe and diaphragm and reached the liver. The penetrated lung was partially resected(a). The diaphragm was incised and the liver was then observed. Despite the penetrating injury measuring 10 mm, no bleeding was observed.

incisional wounds than the field-tip, and is hence more dangerous. In a report on survivors with crossbow injuries, the field-tip was used [4–6]. In our case, the crossbow's arrowhead was made of a metal part of an icepick that was trimmed conically, similar to the shape of a field-tip. Consequently, we assumed that damages to the surrounding organs might have been relatively mild.

In Japan, there are fewer cases of penetrating than blunt chest injuries, and penetrating injuries account for 6.5–15% of all chest injuries [7]. In this case, CT suggested damage to the middle lobe, diaphragm, and liver. It was presumed that about 10 cm of the arrow might have penetrated the body. Furthermore, because the injury occurred only 1 day earlier and abdominal ultrasound examination revealed no fluid accumulation, it was anticipated that any hepatic damage would be minimal. A thoracotomy was therefore performed to examine the liver, and a 10-mm liver wound was observed with minimal bleeding.

In cases of puncture wounds, the penetrating foreign body has generally been removed by the time the patient arrives at a hospital; therefore, the direction and depth of the penetrating wound is sometimes difficult to ascertain. However, our patient presented with the arrow still penetrating his body; thus, the direction and depth of its penetration was clarified without any alteration to the circulation dynamics before surgery, which facilitated our diagnosis of organ damage [7, 8]. When an arrow remains inside the body, it has a tamponade effect on the wound arresting bleeding. Careless removal of the arrow can increase bleeding [9, 10]. Therefore, in cases where a penetrating foreign body remains lodged inside the body, it is desirable to not remove it at the location of injury, but rather during surgery, at a medical facility [11, 12]. In our case, we assumed that such a tamponade effect had occurred, which facilitated surgery with minimal blood loss.

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