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CASE REPORT

PATHOLOGY/BIOLOGY

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Fatal Suicidal Crossbow Injury—The Ability to Act

ABSTRACT: We report a case of a 58-year-old man who committed suicide using a modern crossbow. The victim shot himself in the chest with a conical field-tip arrow from close proximity. We first presumed that this was a case of homicide committed with a firearm. We were, however, subsequently proved wrong. The reasons for the primary statement were as follows: the external morphology of the entrance wound being typical of a firearm discharged from long distance; the perforation found on the victim's clothing; the absence of the firearm at the place of death; the absence of the arrow in the wound. All of these reasons forced us initially to conclude that the case was one of homicide. In the reported case, the man, after having been shot with an arrow, was further able to act, even though the abdominal aorta and liver were seriously injured. While the arrow was in the wound, the injuries may not have led to massive bleeding because of incomplete tamponade of the defects by the arrow shaft. Pulling the arrow out of the victim's wound track initiated massive bleeding. Despite all these injuries, the man was capable of pulling the bow string again and reloading the crossbow with the arrow used in the first attempt. This case demonstrates that forensic investigations into crossbow injuries can be very difficult, especially when the bolt has been removed from the body.

KEYWORDS: forensic science, crossbow, suicide, wound pattern, penetrating aortic injury, ability to act

Arrow injuries were quite common in the past. Nowadays suicidal (1–11), accidental (12–19) as well as homicidal (3,5,11,20–25) crossbow injuries represent extremely rare fatal events worldwide, despite the availability of crossbows in many countries. In this paper, we present an unusual case of a suicide where the victim sustained arrow-caused trauma to the trunk after having shot himself with a crossbow. This case demonstrates the relatively great capability to act despite serious abdominal injuries, including injuries to the abdominal aorta. In addition, the unusual external morphology of the sustained crossbow wound, in this particular case, resembled a gunshot wound and led to confusions at the scene of the death.

Case Report

The body of a 58-year-old man was found lying on its back beside a table in an apartment kitchen with its legs pointing toward the kitchen door (Fig. 1). The body was dressed in a cotton vest top and underwear. On the front of the vest top, there was an oval-shaped perforation with slightly fringed, brown-colored edges (sized 0.6×0.4 cm) along with a few discrete blood stains on the fabric found close to the defect (Fig. 2). At the left frontal region of the chest, an oval-shaped entrance wound (sized 0.7×0.6 cm; Fig. 3) with minor bleeding was found, which corresponded to the defect on the clothing. The entrance wound was bordered with a solid edge of black-colored skin.

In the bedroom, situated immediately next to the kitchen, there was a bunk bed with a curtain. After drawing the curtain, a crossbow (model Barnett Delta Storm crossbow with telescopic sight—draw weight 150 lb; Fig. 4) was discovered loaded with an arrow (bolt with field-tip 43 cm long). The crossbow was located on the corner of the bottom bed, laid on a folded blanket. Neither the arrow nor the bedding indicated apparent bloodstains. Further investigation into the apartment revealed a large number of various arrows covered with a thick layer of dust.

Moreover, pistol cartridges were found in the apartment, as well as a blank cartridge pistol in the desk draw. When the victim was found, the apartment door was unlocked. Before commencing the autopsy, a postmortem radiography was performed. No potential contrast projectile, however, was detected (Fig. 5). Only a minor defect on the 12th vertebra was revealed.

External examination of the body revealed an oval wound, 0.7×0.6 cm in size, with a prominent abrasion collar of brownish-black color located in the left part of the trunk. The wound edges were colored deep black and indicated burning. The internal examination revealed an isolated trunk trauma, caused by incomplete penetration of the bolt. The path of the wound led through the subcutaneous tissue, 7th left intercostal space (parasternal line), and left diaphragm arch before entering the abdominal cavity. It then continued through the left lobe of the liver, penetrated the omental bursa and abdominal aorta (Fig. 6), and ended up in the 12th thoracic vertebra's body (Fig. 7). The wound track was directed front to back, left to right and downwards. In the left part of the thoracic cavity, a small amount of blood was found (100 mL of the volume), while the abdominal cavity contained a large amount of liquid as well as coagulated blood (1500 mL of the volume).

Other significant autopsy findings included moderate atherosclerosis of the coronary arteries and aorta. The blood and urine alcohol concentrations were zero. Other toxicological investigations into the blood and urine, applying routine methods, were negative. The death was attributed to massive internal hemorrhage because of the

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FIG. 1—*The body of a 58-year-old male victim was found in an apartment kitchen.*

FIG. 2—*An oval-shaped perforation with slightly fringed, brown-colored edges was on the front of the vest top.*

complete penetration of the abdominal aorta by the arrow. The forensic conclusion that this was a case of an arrow wound caused by a mechanical weapon was supported by the following facts: no projectile or its fragments found at the end of the wound track; negative results of testing for gunshot residue on the victim's clothing and the edges of the entrance wound. In addition, on the tip of the arrow placed in the crossbow, blood was found with group

FIG. 3—*The bolt entrance wound was situated at the left frontal region of the chest, the defect was bordered with a solid edge of black-colored skin.*

FIG. 4—*The used crossbow was discovered on the corner of the bottom bed, laid on a folded blanket loaded with an arrow.*

characteristics identical to that of the victim's blood. Following the completion of the investigation and autopsy, the death was classified as a suicide.

Discussion

The wound pattern features inflicted by arrows correspond with the form of the arrow tip, or rather with its profile (26). In the case of a circular arrow tip profile, the wound pattern is usually also circular-shaped (with the arrow landing perpendicular to the surface of the body), while the wound pattern diameter either almost corresponds with the arrow tip diameter or they differ minimally. In the case of an arrow landing on the body's surface, the entrance wound can be oval-shaped. Possible variations depend on the entry angle. The wound edges can be surrounded by various skin defects, such as minor radial skin tears, abrasion collars, or a contact wipe of dirt caused by the contact of the dirty arrow tip with the skin at the moment of penetration. The injury described above can be confused either with a gunshot wound (discharged at a longer distance)

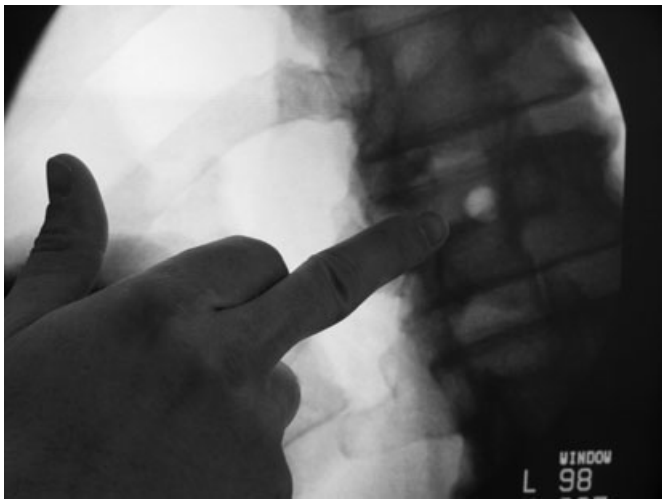

FIG. 5—*Radiograph scan revealed only a minor defect on the 12th vertebra.*

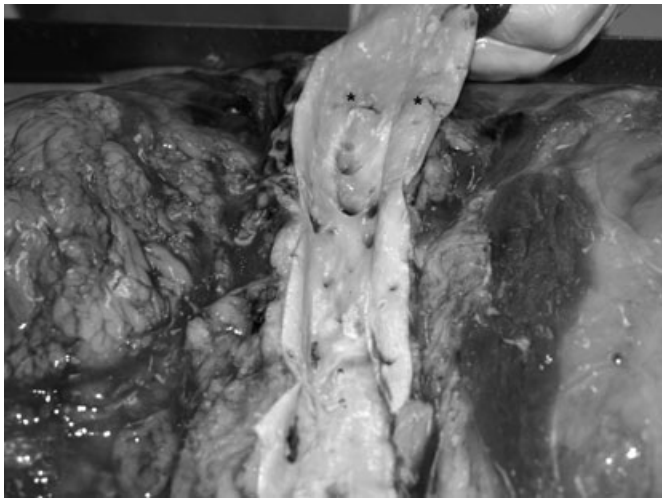

FIG. 6—*The complete penetration of the abdominal aorta caused by field-tipped arrow (highlighted*).*

FIG. 7—*The end of the wound track at the body of the 12th vertebra.*

or with a stab wound caused by an object of similar profile (such as screwdriver, thick needle, pencil, pen, or arrow).

In the case of a broad arrow tip, it is typical that the features of the entrance wound pattern are almost identical with the profile of the tip (10). Arrow tips with blades produce lacerated and contused wounds, star-shaped, or stab wounds with a corresponding number of tears; the shape can be modified by the entry angle of the arrow. The wound can be wrongly classified as a stab wound caused by scissors or by a knife repeatedly thrust into one place and pulled out at a different angle from that at which it was thrust. Target points (cast lead replicas of historical arrow tips) can inflict wedge-shaped wounds similar to stab wounds caused by single- or double-blade stabbing/cutting weapons.

The shape of the wound pattern also depends on the character of the body part inflicted. Skin fold, for instance, allows for multiple penetrations which can result in a tubular subcutaneous path of various lengths. By contrast, tangential contact of the arrow tip with the body produces scratches or skin abrasions, perhaps even lacerated wounds or incisions. If the arrow has been found pulled out or has left the body, the diagnosis of the sustained injury becomes very difficult or even impossible (25).

Broadhead arrow tips impede pulling the arrow out of the wound. The bone structure usually prevents the arrow tip from completely penetrating, although some arrows are fitted with special tips designed to puncture flat bones. Other types of arrows and darts are fitted with stabilizing components placed on the shaft, also impeding complete penetration. Around the entry as well as along the wound track, fragments of varnish or paint, perhaps even wooden or plastic splinters from the arrow shaft, can be found. If the fabric has been perforated, the wound usually contains its fibers and dirt.

Crossbow injuries are caused mainly by direct passage of the bolt (11). The extent of the injuries primarily depends on the depth of the bolt's penetration. The profile of the wound more or less corresponds to the shape of the arrow tip (e.g., circular or shaped profile); however, it also depends on the structure of the organ inflicted. Arrows and darts fired from crossbows have the ability to penetrate every type of human body cavity, the cranium included, resulting in fatal injury even from a shooting distance of dozens of meters (8). The potential of arrows to injure is based on their ability to tear or, in some case, their fragmentation effect: the direct mechanical effect related to the frontal shape of the arrow tip as well as to the structure of the affected part of the body. Arrows fired from crossbows achieve relatively low kinetic energy, therefore they neither can cause temporal cavity nor hydrodynamic impact (3); thus, arrow wound features correspond to injuries caused by low-velocity missiles and strongly resemble stab wound patterns (10). Despite their low kinetic energy, crossbow arrows have a high penetration force (27).

The case presented is remarkable in the wound pattern's unusual external morphology, resembling that of a gunshot wound caused by a firearm discharged at a long distance. The initial presumption at the crime scene was that this was a case of homicide. This fact was also supported by the absence of an arrow in the wound during the initial investigation into the victim's body.

In addition, injuries inflicted by conical arrow tips generally do not result in regular circular defects, but elliptic or fissure defects (28). Also, circular-shaped arrows do not usually produce injuries with prominent abrasion collars, unlike injuries caused by low-velocity missiles (28).

In this case, the man, after having been shot with the arrow, was further able to act, even though vital organs were injured: the abdominal aorta and liver. While the arrow was in the wound, the injuries may not have led to massive bleeding because of incomplete tamponade of the defects by the arrow shaft. Pulling the arrow out of the victim's wound track initiated massive bleeding. Despite all these injuries, the man was capable of pulling the bow string again (stretching force = 150 lb.) and reloading the crossbow with the arrow used in the first attempt. We assume the man was determined to repeat the shot after the first attempt proved unsuccessful. This rare case demonstrates the ability to act even after vital organs have been injured. Even though the bolt penetrated the liver and abdominal aorta, the injury did not result in immediate incapacitation. On the contrary, in spite of the arrow having been pulled out, the victim was able to perform a coordinated physical activity for at least several minutes. Because of increasing blood loss, the blood pressure decreased suddenly followed by rapid incapacitation.

In conclusion, immediate incapacitation after arrow penetration could be expected only if central regulatory organs are injured. Bolt lesions to the heart, lungs, or vessels in the chest region do not usually result in immediate incapacitation, even if the injuries are ultimately fatal.

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