

CASE REPORT

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In the Line of Fire—21st-Century Approach to an Ancient War Injury

ABSTRACT: Authentic black-powder muzzle-loader weapons or replicas are used today primarily for re-enactments of historic battles. A lay actor playing the role of a Prussian infantryman sustained life-threatening gunshot injuries during a recent re-enactment of a historic battle of the Sixth Coalition. As only blank historic muzzle-loading weaponry was used, the origin of the missile causing the wounding was initially unclear. Further investigation revealed a ramrod that had been propelled out of the barrel of another gunner's smooth-bore gun as cause of injury. The ramrod was hurled on a trajectory of more than 20 m, breaking the victim's shouldered barrel and hitting the victim resulting in severe abdominal, thoracic, and upper limb injuries. The critical incidents while handling muzzle-loading weaponry leading to premature discharge are elucidated. Furthermore, this report demonstrates how actual diagnostics and subsequent surgical treatment enabled this infantryman to survive an injury to which his comrades-in-arms would have succumbed 200 years ago.

KEYWORDS: forensic science, war injury, muzzle-loading weaponry, ramrod, accident analysis, black powder

At the beginning of the 19th century, the smooth-bore gun was the most common gun in European armies (Fig. 1) (1). As it was reliable, robust, and inexpensive, it was very popular around the world. It also became the most respected gun in the Americas, where it was developed into a variety of styles unique to America.

Today, these weapons are mainly used for re-enactments of historic battles. There is little or no legislative control over muzzle-loading black powder guns. This weaponry is exempted from control of the federal government if it is made prior to 1898 (U.S.A.) or 1871 (Germany) (2).

A 49-year-old man suffered life-threatening abdominal and thoracic gunshot wounds during a recent re-enactment of a battle of the War of the Sixth Coalition which originally took place near Berlin in 1813. While the origin of the missile was initially unexplained because the weaponry was blank and no projectiles were used, further investigation revealed that a ramrod, which is a gun tool to compress the black powder load in the barrel, had hit the soldier.

The Napoleonic period could have furnished many experts in muzzle-loading guns, but not so in the 21st century. Therefore, it was the aim of this work to describe the critical incidents in operating muzzle-loading weaponry leading to this accident and to describe the steps in forensic traumatology accident analysis. Furthermore, actual diagnostics and treatment are described which would enable the victim to survive an ancient war injury to which his 19th-century battlefield brethren would succumb.

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Case Report

A 49-year-old lay actor playing the role of an infantryman of the Prussian coalition sustained a penetrating wound of the abdomen, the thorax, and the right upper limb during a 2007 re-enactment of a battle of the War of the Sixth Coalition. After striking through the shouldered gun and the right upper arm, the missile penetrated the torso of the victim. The soldier fell to the ground. After realizing that he had suffered an actual injury all "battle acts" were ordered ceased. At that time there were approximately 100 soldiers and up to 3000 spectators in the war theater. The hemodynamically unstable patient was referred to the Level I Trauma Center via helicopter. Clinical investigation revealed two injuries to the surface of the torso: a stellate anterior entry wound (3 × 2 cm) inferior to the right costal arch, and a posterior exit wound (2 × 3 cm) inferior to the scapula. A burst fracture of the right humerus was accompanied by a soft-tissue injury (8 × 4 cm) at the upper arm while no vascular or nerve trauma of the limb was observed (Fig. 2).

Diagnostic computed tomography (CT) scans revealed multiple injuries between the supposed entry and exit wound: anterior fractures of the rib 7–9, burst injury of liver segments 5–8, rupture of the diaphragm, lacerations of the right lung, dorsal fracture of the 11th rib, and dissemination of bony fragments into the posterior subcutaneous soft tissue (Figs. 3 and 4).



FIG. 1—Muzzle-loader and ramrod (around 1800). Preparing the discharge, the ramrod is used to compress the black powder and to push the bullet down to the bottom of the barrel. While not in use, the ramrod is kept in a sheath below the barrel. Depending on the model of the weaponry, the ramrod itself is made of steel or wood.

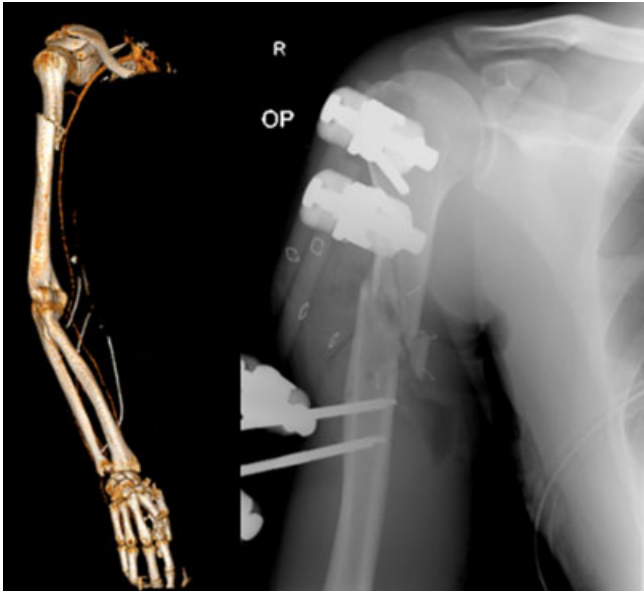


FIG. 2—Burst fracture of the right humeral bone. Plain radiography in a.p.-direction after external fixation (right), 3D postprocessing of the fracture and the intact brachial artery (left).



FIG. 3—Coronal CT image (2D postprocessing) in the emergency room showing penetration and laceration of both abdominal and thoracic cavity. No radiopaque foreign bodies were detected.

Laparotomy was performed and revealed an extensive hepatic injury with a diaphragmatic rupture. Life-threatening hepatic exsanguination made a Pringle maneuver necessary, a large hemostat was used to clamp the gastrohepatic omentum interrupting the flow

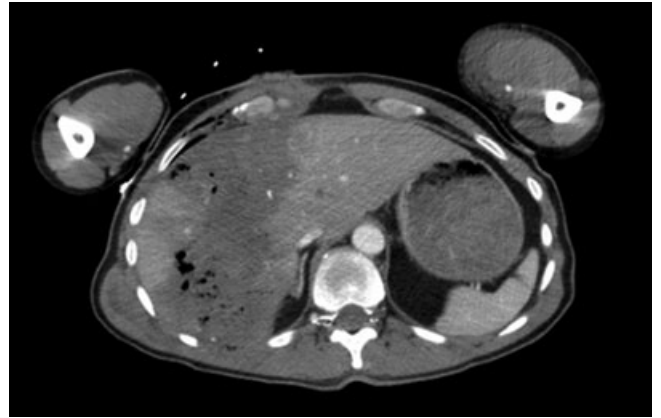


FIG. 4—Cross-sectional CT image (contrast-enhanced) showing tissue laceration at the supposed ventral entrance area. The missile track through the liver is accompanied by trapped air and massive hemorrhage. Correlation with intraoperative findings showed injury of hepatic segments 4–7 and 8.

of blood through the hepatic artery and the portal vein and thus helping to control bleeding from the liver. Control of hemorrhage was achieved with intraperitoneal packing. The fracture of the right upper arm was stabilized by an external fixator. Seventeen units of packed red cell transfusion were administered during initial emergency treatment. The patient was transferred to the intensive care unit (ICU) where core rewarming, correction of coagulopathy, and maximization of hemodynamic values took place. Re-exploration was performed after 48 h and showed no further bleeding. Internal osteosynthesis of the humeral fracture was performed after 19 days. Treatment in the ICU was necessary for 21 days; the patient was discharged 47 days after the accident occurred.

Discussion

Formal investigation revealed that another gunner was preparing a discharge of a muzzle-loading smooth-bore gun when the powder ignited prematurely. The ramrod was propelled out of the barrel and the gunner's hand. The gunner sustained minor injury of his left hand. The “explosion driven” ramrod was hurled on a trajectory of more than 20 m, breaking the victim's shouldered barrel and hitting the victim resulting in severe abdominal, thoracic, and upper limb injuries. The ramrod, broken into pieces, was later found more than 100 m behind the scene.

In consideration of the widespread use of muzzle-loading weaponry in military services in the 19th century combined with the primitive nature of black powder guns in general, accidental injuries due to misfire must have been frequent incidents. On the other hand, a discharged ramrod has been an outstanding source of injury and worth a newspaper announcement even in those days (3,4). A review of the literature reveals one single case report on a severe head injury due to a gun tool discharged from a gun during a re-enactment of a battle of the American Civil War in 1997 (5). Another report describes a barrel-cleaning brush that stuck in the barrel of a rifle and was discharged as a tandem projectile (6). In Germany, single-shot replicas of ancient muzzleloaders constructed before 1871 can be sold over the counter; age of consent (18 years) is the only legal restriction. Consequently, the use of these old-fashioned guns has been reported both for suicide and homicide (7).

In the case we presented, the penetrating power and wounding potential of the ramrod was substantial. The ramrod smashed the shouldered gun of the victim, traversed one upper arm and the

abdominal/thoracic region. Similar to ballistic considerations of an arrow, the high penetration capacity was due to the high sectional density, e.g., the high mass per cross-sectional area (8). Compared to a pistol bullet, a much larger mass pushes onto a blunt frontal surface. The ramrod itself broke into pieces while smashing the shouldered arm. One piece was found near the scene of accident; the second piece was found more than 100 m behind the scene.

Looking for the critical incident leading to the premature discharge in this case report makes it mandatory to investigate the normal technical sequences while operating a muzzle-loading rifle. Though no bullet or projectile was used, the powder mixture was compressed by a ramrod. Under normal operational conditions, the flash pan is primed with powder hereafter and the gun is ready to fire. It is foolish and can be fatal to load a muzzleloader until you are certain that there is no charge in the flash pan. Failure to do this may result in premature discharge. Smouldering residue remaining from a previous shot could also ignite the new charge and propel the ramrod out of the muzzle. In spite of the fact that formal investigation could not shed light on the circumstances leading to this accident, this might be the critical incident in the case that is presented.

Of all instruments for conducting an examination of a gunshot wound, the finger of the surgeon is the most appropriate (5). This historical principle of combat casualty care has been advanced in the late 20th century to the helical CT examination as standard diagnostic instrument for penetrating abdominal injuries (9). Considering medico legal aspects, the new generation multislice CT scanners make it possible to document the full body within a few minutes. These data bear also an enormous potential for 2D and 3D postprocessing (Fig. 2). Thus, for reconstruction purposes, one can immediately draw relevant conclusions as to what kind of ammunition or weapon inflicted the injury (10–12). Also, the angle of shot can be reconstructed (13).

The surgical approach in this case was performed in accordance to the principles of “Damage Control,” which improved survival in exsanguinating penetrating abdominal injury (14,15).

This case report demonstrates that the combination of simple unsharp historic weaponry, considered harmless due to the use of black powder and flour to make sound and smoke, with gross operating error may result in severe collateral damage.

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