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Accidental Kronlein Shot

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ABSTRACT: Head wounds constitute a major part of these injuries in firearm fatalities commonly encountered by forensic pathologists. Autopsy on a firearm victim often proves to be a complicated affair with special caution required in the interpretation of the findings. The main issue of confusion has been reported as distinguishing and deciding the entry and exit wounds of the skull where large defects are caused. Even so, other bizarre and atypical effects of firearm are seen. The classical 'Kronlein' shot has been described in literature with scattered case reports. The authors present a case in which the victim shot himself with a shotgun leading to a suicidal Kronlein shot; graphic illustrations and wound description including re-construction of the blown apart area of the head are presented.

Keywords: Kronlein, firearm fatality, suicidal, shotgun

Introduction

Wounds of high-energy centre-fire rifles and shotguns represent distinctive injuries of forensic importance. Previous studies of contact wounds have shown variability in the potential of these weapons to produce bursting wounds of the head [1]. The Kronlein shot (evisceration of the brain) is a very rare injury of the skull caused by a high-velocity bullet. The requirement for this type of low-range shot wound is a broad opening of the skull with laceration of the dura mater. In the past, several cases of this particular injury have been reported and all led to immediate death [2]. *Kronlein shot*, which can mimic an explosion injury, often cause confusion among the law enforcement authorities, as well as among the less experienced forensic pathologists [3].

Case details

The victim was a 25 years old male individual, working as a contractor in the parking lot of our facility. The household included him, his wife, mother and one child. He had a known police criminal record. The wife and mother told the history of the incident. He had a unhappy marriage; he had a usual quarrel in his house with wife in the evening, who threatened to kill herself; frustrated, he put his sawed off shot gun to his head and threatened to kill himself instead and shot himself in his head either to prove a point or unintentionally.

The police examined the scene and sent the body for autopsy. The Forensic Science Laboratory (FSL) personnel collected the blank cartridge found at scene, blasted out brain matter, pieces of skull bones and blood. The weapon of offence was a sawed off unlicensed shotgun which measured 2 feet.

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The shotgun's test shot matched with the fired cartridge. Further, the crime scene report observed that the scene and material evidence corroborated well the history of suicide.

Autopsy details

The body was received in the mortuary, along with blood stained clothes with brain matter smudged over them; the police submitted a polythene bag which contained brain tissue lifted by police/FSL personnel from the scene. PM staining was present over the back and was fixed; Rigor Mortis was present all over. Back spatter was present over the hands.

The whole of the fronto-parietal area along with parts of occipital and temporal areas of scalp was blasted apart leaving a big defect with similar findings in underlying bones. The cranial cavity was more or less empty with only a small portion of cerebral/cerebellar hemispheres present (Figure 1).

Figure 1: The wound as seen on receipt of the body in the mortuary

Entry wound of firearm (after approximation of skin margins with reconstruction, Figure 2) was present over the frontal region of scalp, just left to midline, sized 2x2 cm, with ragged, irregular and contused margins; situated 2 cm above root of nose and 170 cm above the left heel. Abraded collar of width 2-3 cm at places was present around the wound margins.

Figure 2: Collar of abrasion visible around the reconstructed wound margins of the entry wound

The wound was directed backwards and upwards to enter the cranial cavity through the frontal bones, lacerating both cerebral hemispheres (more on left side) to cause a blow-out fracture in the vertex region of scalp (representing exit wound of this firearm). There were extensive lacerations from the entry wound going downwards as two splits- the right laceration involving both supra and infra orbital regions of the face, shattering the orbital bones, causing right eye to be detached and deviated posteriorly (hanging by small lacerated strip of tissue). The left laceration involved the left supra-orbital area. Underlying tissues were ecchymosed with fractured bone pieces showing infiltration of blood into exposed trabeculae. Extensive lacerations emanating from entry wound were also seen over frontal and parietal areas of scalp with underlying tissues showing ecchymosis. The defect described as the exit wound showed infiltration of blood in exposed trabeculae of available fractured bones.

Brain matter (received in the transparent polythene bag, Figure 3) comprised of two separate pieces i.e. left and right cerebral hemispheres.

Figure 3: Polythene bag with brain which was recovered outside the cranial cavity

The left cerebral hemisphere was lacerated and disrupted extensively with frank haemorrhage; the right cerebral hemisphere was relatively intact with small lacerations seen. Multiple small metallic pellets were embedded in brain tissues which were sent for ballistic examination, Figure 4.

Figure 4: Metallic pellets embedded in the brain tissue

Discussion

The Swiss-born pioneer surgeon, Rudolf Ulrich Kronlein reported on four suicide fatalities and one attempted suicide who used the 1889 model of the Swiss repeating rifle (calibre: 7.5 mm; bullet weight: 13.8 g; bullet composed of nickel-plated cap, initial speed: 600 m/s). In this article, the authors pointed

out a distinctive feature: in a 32- year-old suicide victim he found scattering of the empty cranial cavity. The cerebrum and cerebellum were found lying next to the dead person; the brain had been separated from the spinal cord at the height of the medulla oblongata. A bullet channel, however, could not be determined [4]. Further cases were published two years later [5]. Still today, the mechanism of evisceration of the brain without a bullet channel after a so-called "Kronlein shot" is discussed [6].

There are two distinct mechanisms of ballistic injury. Crushing of tissue resulting in a permanent tract is the primary factor in wounding of most tissues and most body regions. Temporary cavitation causes radial tissue displacement and subsequent shearing, compression and especially stretching of tissue analogous to blunt trauma. In contrast to the effect in elastic tissue, temporary cavitation can contribute substantially to wounding of inelastic tissue, such as the brain. This is the case in penetrating gunshot wounds to the head. Additionally, the penetration of the bony cranium can produce secondary missiles in the form of bone or bullet fragments and a tendency of the bullet to deformation and early yaw. Most important, wounding resulting from temporary cavitation is greatly augmented by the confined space provided by the unyielding walls of the skull. Bone contact and enhanced effects of temporary cavitation result in an enlarged zone of disintegrated tissue and in high intracranial peak pressures. Morphological signs of powerful intracranial pressure effects are cortical contusion zones, indirect skull fractures and perivascular haemorrhages remote from the tract. Depending on ballistic and anatomical parameters, the intracranial effect varies from slightly more severe injury than in isolated soft tissue to an "explosive" type of injury with comminuted fractures of the skull and laceration of the brain [7].

To understand the physical mechanics of Kronlein shot, it is important to appreciate that the kinetic energy of a bullet passing through a body is utilised (or consumed) in the following five phenomena (in chronological sequence)- to travel from the cartridge up to the tip of the muzzle and then up to the victim's body; to overcome and break the resistance of skin, bones and other tissues at the site of entrance; to push the tissues aside (radial displacement), during the course of the bullet within the body; to overcome and break the resistance of skin, bones and other tissues at the site of exit and to travel from the exit of the wound up to the point where the bullet is finally found and recovered by the law enforcement authorities. How the bullet spends its energy in each of the above five parts is determined strictly by the laws of physics. For instance, it is a logical impossibility for the bullet to spend energy at, say, level 3 (used to push the tissues aside), without spending at least some energy at lower levels. It is quite possible that the bullet passes through such tough parts (a thick skull for example), that most of its energy is already consumed and hardly any is left to push the tissues aside. If however less energy is consumed in overcoming the tissues at the entrance, relatively more energy would be available in displacing the tissues aside. In the case of skull and brain, this energy (that consumed in producing cavitation) can sometimes be so excessive that it may mimic an explosion. Combination of brain expanding outwards with great force and a completely opened skull (due to union of entry and exit wounds of the skull), causes the brain to be thrown outside with great force. This is the typical *Kronlein shot* [8].

Harruff et al analyzed contact head wounds owing to 26 centerfire rifles and nine shotgun slugs and compared them with respect to weapon, ammunition, entry wound site, and projectile kinetic energy [1]. The bursting effect, defined for this study as disruption of at least 50% of the head, occurred in 25/35 of cases and was related to kinetic energy. Bursting was associated with energies <2700 ft-lbs in 12/22 cases and energies >2700 ft-lbs in 13/13 cases. The volume of gunpowder gas injected into the wound was considered as contributing to the bursting phenomenon. There was no relation of bursting to the specific entrance wound site, type of ammunition, or projectile fragmentation [1].

A case of extended suicide resulted in two fatalities due to craniocerebral gunshots from a 12-gauge shotgun firing Brenneke shotgun slugs [9]. In each case, the gunshot shattered the skull and the brain and in one case, large parts of the brain including a complete hemisphere were ejected similar to a "Kronlein shot". The location of the trajectory close to the base of the skull, the muzzle gases and the ballistic characteristics of the missile contributed to this rare form of head injury. The high mass and the large diameter of the

lead missile do not necessitate a high muzzle velocity to crush large amounts of tissue or to produce an explosive type of head injury. The wadding material and the metal screw attached to the Brenneke slug can be of forensic significance [9].

In a paper regarding reconstruction of devastating head injuries, Hejna *et. al.* comment that a devastating head injury in which a complete exenteration of both brain hemispheres occurrs is called Kronlein shot; according to the authors, the autopsy could not clearly determine the appearance of the primary gunshot wound and the entrance and exit wounds are not identified with certainty [10].

Pathak and Mangal have reported a case of fatal head injury was brought to us for autopsy examination in which the referring doctor and investigating officers suggested that the head injury occurred due to vehicular accident while actually it was a result of a homicidal attack by a country made firearm and was similar to Kronlein-Shot [11].

Case report by Risse *et. al.* on five fatal gunshot injuries in which discharge of the cranial contents had occurred owing to a skull blast [12]. Despite an appreciable explosive action with destruction of the bony cranium, the brains were not completely destroyed. In analogy to the "Kronlein shot", comparative reflections were made concerning wound ballistics. The case reports show that injury patterns resembling Kronlein shot may arise in cranial blast shots in rare cases despite destroyed projectile parts and even in a mouth shot [12].

Missliwetz *et. al.* have described pump guns as shotguns with pump action whose injuries and wound mechanisms have several special features: extremely high kinetic energy of the shot (2500 to 3500 J), frequent cases of "Kronlein shots" (exenteration of the brain) punch mark/imprint immediately adjacent to the entrance wound from the front of the pipe magazine, exit wounds from buckshot may be similar to pellet entrance injuries from a distant shotgun discharge, and the use of various shotgun cartridges (plastic ammunition, slug bullet, various lead pellets) within the same weapon [13].

To summarize the causative mechanism of this atypical firearm wound, the energy deposited as the bullet passes through the brain imparts a momentum so great that a temporary cavity is formed. Consequently, a violent wave of hydraulic pressure is applied to the cranium causing it to burst open. The effect is worsened by fractures radiating from the point of entrance giving way under pressure from the brain fluid and macerated tissue, which then burst out through the upper right side of the skull.

On an interesting note, one of the most tragic and famous assassinations involved a high velocity bullet shattering the head of President Kennedy, creating an ejection phenomenon/splatter akin to Kronlein shot. In his book, 'Hear no evil' based on scientific analysis of the JFK assassination, Thomas has commented on an experiment carried out by Discovery Channel in 2008, involving terminal ballistics duplicating Kennedy's head shot. The experiments replicated 'Kronlein Schuss' effect on dummy heads and compared it with the real wound and splatter effect of Kennedy. He further stated that Kronlein Schuss is related to hydraulic effects of cavitated brain and brain fluid on wound splatter as discussed in Forensic literature generally and in Kennedy's case specifically [14].

Conclusion

Firearm wounds are becoming quite commonplace in India and a major part of the work load of forensic pathologists. As a vast number of unlicensed firearms are used to commit crime, the atypical effects of firearm wounds caused can be confusing or downright indeterminable. The explosive appearance of these wounds further complicates issues as then they simulate explosion/vehicular wounds.

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