

## CASE REPORT

## Scientific Interpretation of Unusual Injuries Observed in a Death caused by Firing from an Unlicensed Rifled Firearm

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### Abstract :

Homicide is the act of killing one person by another. However, for convicting the accused various factors like motive, pre-planning, and circumstantial evidence are taken into consideration. There are various ways by which homicide can be accomplished. The method of using a firearm to kill a person is still less common in India as compared to western countries due to the stringent regulations to have a licensed firearm. However, people get unlicensed firearms (rifled or shotgun) from the black market. These are improvised firearms and lead to injuries which are not matching with the descriptions as per the prevailing conventional literature. This makes the interpretation of injuries by autopsy surgeons difficult to corroborate with circumstantial findings. Here we report a case where a middle-aged male is the victim of a gunshot by unknown individuals who had followed him knowing that he had withdrawn money from the bank. The gunshot is from an unlicensed rifled firearm which produced unusual injuries in multiple places. The authors had tried to deliberate the possible scientific explanation behind the causation of such an atypical pattern of injuries.

**Keywords :** Forensic ballistics; Homicide; Unlicensed rifledfirearm; Secondary cavity; Pressure waves; Hydrostatic shock.

### Introduction :

The national crime records bureau (NCRB) reports that 12.2% of all 33,727 murder victims died due to firearms in the year 2008 in India.<sup>1</sup> On comparing the deaths during a decade, there has been an increase in death by 5,465.<sup>2</sup> It is shocking to note, that Delhi heads the list of total deaths due to firearms, with 1015 deaths. The main reason behind this surge is the availability of illegal unlicensed firearms from nearby states. Here we report a case of a firearm death caused by one such illegal unlicensed rifled firearm. These firearms are improvised during manufacturing thereby producing injuries which are not matching with a description of firearm wounds in prevailing conventional literature. The autopsy surgeons and investigators also face difficulties in the interpretation of such atypical injuries in correlation with the circumstantial findings. The novelty and aim of this case report were to discuss the atypical pattern the autopsy surgeon may face in such cases. The authors have deliberated the possible scientific mechanism of atypical findings observed in this case.

### Case Report :

A middle-aged man is the victim of a fatal firearm injury by unknown individuals. He was received dead at All India Institute of Medical Sciences (AIIMS), New Delhi. The medicolegal autopsy was conducted as per the relevant provisions of CrPC and IPC. The body was subjected to radiological examination. A discontinuity was observed along the body of the mandible on the left side (Figure 1a). The chest X-ray showed haziness in the left lung fields and a loculated effusion along with the mediastinal

shift to the right side was present in the left hemothorax. (Figure 1b). Blood stains were present at multiple places along the front and back of the shirt and underlying inner garments correspondingly worn by the deceased. The upper three buttons of the shirt were missing suggestive of the struggle prior to the death. A localized red-colored contusion was present on the right parietal eminence with an underlying peri-cranial hemorrhage. A bullet entry wound surrounded by an oval-shaped muzzle imprint with burning, singeing surrounded by dried blood stains was present over the front of the left lower aspect of the face below the left zygoma region. The wound track was directed downwards, backward, and outwards with an exit wound over the lower aspect of the left side of the neck (Figure2). The track was found piercing the muscles of the face, with comminuted fracture of the underlying body of the mandible along with the middle one-third. On dissection, a diffuse hematoma was present over the left neck muscles (Figure 3a). At ear on the left internal jugular vein was present underlying hematoma with associated soft tissue contusion. After careful stripping of the dura, multiple air bubbles were found inside the brain vessels suggestive of air embolism (Figure 3b). The peritoneal cavity contained 1 liter of liquid blood mixed with blood clots. Multiple horizontal intimal tears and a single complete tear were present in the abdominal aorta along with the hemorrhagic staining of the outer walls (Figure4). The cause of death is given as Hemorrhagic shock due to firearm injury sustained to the head and neck.

The police investigations revealed that the deceased came after withdrawing money from ATM and was followed by some unknown individuals. At one point, the individuals blocked the vehicle in which the deceased came and tried to take away the bag containing the money. In this struggle, the victim got injured by a firearm. After sustaining firearm injury, the deceased walked for about 6 steps, fell down, and eventually succumbed to death. The above-mentioned scenario was confirmed after viewing the CCTV footage retrieved by the police. The missing three buttons

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### Article History

DOR : 03.07.21; DOA : 07.06.22

in the shirt examination, sub-scalp contusion, and peri-cranial hemorrhage are correlated with the help of CCTV footage.

**Discussion :**

The reported case highlights the presence of unusual atypical injuries at places far away from the firearm tract. The exit wound is found on the left side closer to the floor of the mouth. The tear in the internal jugular vein lies away from the exit wound. The anatomical landmark of the internal jugular vein is adjacent to the cervical vertebra along with the carotid artery in the carotid sheath.<sup>3</sup> The abdominal aorta, on the other hand, lies further downwards away from the exit wound and the firearm tract. There were multiple intimal tears and a single entire thickness tear present transversely placed involving the inner walls of the abdomen aorta along with hemorrhagic stains.

These injuries could be explained by the concept of the hydraulic reaction of bullets in the tissues and the formation of temporary cavity formation. The bullet transferred the energy to the medium in which it had traveled i.e., the soft tissues of the neck and the internal jugular vein causing the rupture. This accelerated the medium surrounding the path of the bullet away from it radially and created a hollow space in the form of a vacuum behind the bullet. Because of inertia, the cavity reaches its maximum diameter at any given point when the bullet has already passed that point leading to the formation of a temporary cavity. Thus, the temporary cavity formed by the motion of the tip of the bullet caused the radial displacement of tissue. This led to the generation of pressure waves that propagated through the tissue. This mechanism is called hydrostatic shock or hydraulic reaction of the bullets.<sup>4-9</sup> In this case, the pressure waves generated had propagated by displacing the blood in the blood vessel which caused the remote effects like tear in the internal jugular vein and the abdominal aortic tears.<sup>10</sup>

The incapacitation of the deceased observed in the CCTV footage was due to traumatic brain injury i.e., brain parenchyma contusion under sub-scalp contusion in summation to the blood loss from the sustained vascular injuries. These distant injuries

**Flow chart of the sequence of events:**

The bullet entered the body through an entry wound on the face and exited via the floor of mouth.



The velocity of the bullet is reduced due to the retarding force applied to the bullet by the tissue and bone.



The fracture of the mandible is due to the disruptive effects of the temporary cavity.



The pressure wave generated as a result of bullet has led to remote vascular injuries



Thus, the hydrostatic theory or hydraulic reaction of the bullet is the scientific reason behind the causation

were caused by the pressure waves of the bullet when it passes through the tissues. There are many studies that conclude mild to moderate traumatic brain injury may occur following gunshot wounds, if not detected early may lead to long-term neurological sequelae.<sup>11-13</sup> Due to the ballistic pressure waves, changes had

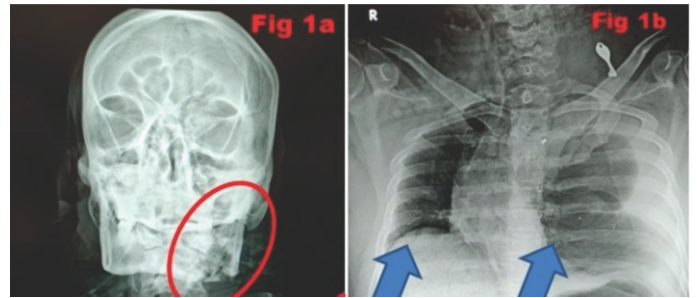


Figure 1: (a) Fracture of the body of the mandible on the left side. (b) Haziness of the left side pleural cavity with a loculated effusion suggestive of left pneumo-hemothorax along with the mediastinal shift to the right side.



Figure 2: (a) A bullet entry wound surrounded by dried blood stains. (b) Muzzle imprint. (c) Bullet entry and exit wound depicting the wound track externally (Red arrow).

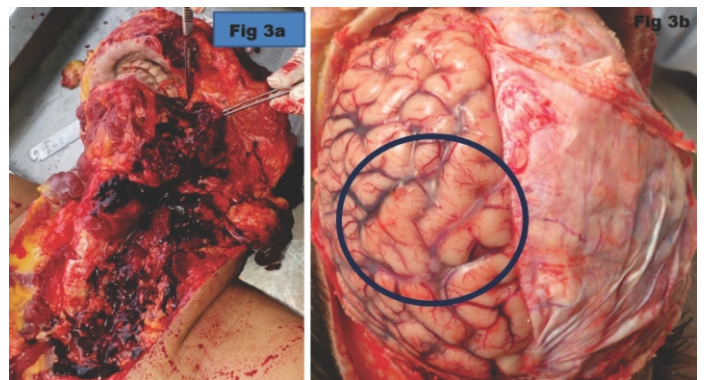


Figure 3: (a) Diffuse hematoma present over the left neck muscles. (b) Multiple air columns inside the cerebral vessels suggestive of air embolism.

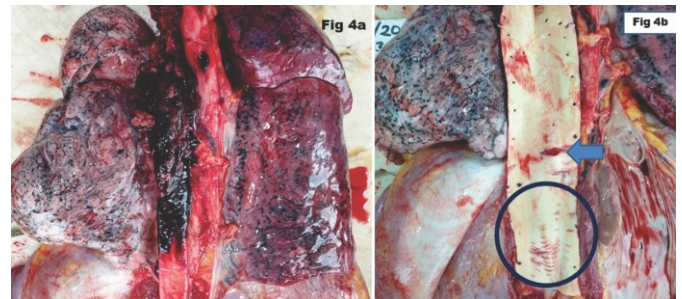


Figure 4 : (a) Hemorrhagic staining of outer walls of the thoracic aorta. (b) Multiple intimal tears and a single complete tear present in the inner wall of the abdominal aorta.

been observed in the hypothalamus and hippocampal regions of animals, when missile impact was given to the extremity.<sup>14</sup> Hence, the injuries observed outside and distant to the wound track can be correlated by the above-explained concept of hydrostatic shock.<sup>10</sup>

### Conclusion :

The chief role of the autopsy surgeon while dissecting the firearm cases is to correlate the injuries observed in best possible the scientific manner with the circumstantial and investigative findings. Even though correlating the entry wound with the exit wound through the wound track is the main objective in any firearm case, hypothesizing the other injuries with the observed firearm injuries is essential not only for a medico-legal purpose but also much needed for academic purposes.

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