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CASE REPORT

An extraordinary case of an intracranial foreign body after a gunshot to the head

C. Egger · B. Schrag · C. Brunel · J. A. Lobrinus · P. Mangin · T. Fracasso

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Abstract Intermediate targets (IT) can modify the morphology of an entrance wound, the trajectory of the bullet, and contaminate the path with fragments or material from the target. The penetration into the body of big fragments or even of an entire IT is exceptional and only rarely reported in the literature. The interpretation of a gunshot wound after contact of the bullet with IT can sometimes be very tricky as the classical morphology can be missing. The presented case is a rare example of atypical entrance wound and path due to a surprising intermediate target of a gunshot fired against the head.

Keywords Gunshot wounds · Atypical entrance wound · Intracranial foreign body · Forensic autopsy

C. Egger (✉) · P. Mangin
University Center of Legal Medicine, Lausanne - Geneva, University of Lausanne, Lausanne, Switzerland
e-mail: Coraline.Egger@chuv.ch

B. Schrag
Service of Legal Medicine, Central Institute of the Hospital of Valais, Sion, Switzerland

C. Brunel
Institute of Pathology, Lausanne University Hospital, Lausanne, Switzerland

J. A. Lobrinus
Department of Clinical Pathology, Geneva University Hospital, Geneva, Switzerland

P. Mangin · T. Fracasso
University Center of Legal Medicine, Lausanne - Geneva, University of Geneva, Geneva, Switzerland

Introduction

Gunshot injuries are well known and broadly described in forensic medicine. The assessment of entrance and exit wounds, firing distance, intrabody path of a bullet, and differential diagnosis between homicidal and suicidal shooting are classical issues forensic pathologists have to deal with [1–5]. Thus, atypical gunshot wounds after contact with an intermediate target (IT) can be very tricky and may lead to misinterpretation. The present case is an extraordinary example of atypical entrance wound due to a surprising IT in a case of gunshot to the head.

Case history

A 37-year-old drug-addicted man was shot several times by a Smith & Wesson .357 Magnum revolver in a shopping center. He was injured to the head, the right arm, and the left hip. First Aid found him lying on the floor in cardiorespiratory arrest. After successful cardiopulmonary resuscitation, the victim was brought to the hospital, where he died a few minutes later. The public prosecutor ordered medicolegal investigations.

Conventional postmortem X-rays showed two fragmented bullets (in the head and in the right arm). Moreover, an unidentified metallic piece was also observed in the head. Bone fractures were visible at the right humerus and at the lateral wall of the right orbital cavity.

At external examination, the body was that of a 37-year-old Caucasian man, 190 cm in height and 84 kg in weight. A grossly polygonal wound with a central cutaneous defect, measuring 1.8×2.3 cm, was visible at the right temporal region. The edges of the wound were blackened, abraded, and surrounded by a purple bruise associated to slight powder tattooing. On the lateral side of the wound, we observed a linear blackish abrasion measuring 0.9×0.4 cm. A similar lesion measuring 1.1×0.3 cm was visible on the medial side

of the wound 8 mm away (Fig. 1). Other gunshot wounds were noticed at the chin, the right arm, the left hip, and the gluteal area on both sides. Except for very poor hypostasis, no additional relevant findings were observed.

The autopsy was performed 14 h after death by a board-certified forensic pathologist and an experienced resident. At dissection of the scalp, a diffuse hemorrhagic infiltration of the epicranium was observed facing the cutaneous wound of the right temporal region. The anterior part of the right temporal muscle and the underlying galea showed a slight hemorrhagic infiltration. At the outer table of the right temporal bone, we observed an ovoid perforation, extending in larger beveled-out hole in the inner table, associated with an ovoid perforation of the dura mater, and a slight subdural bleeding of the right anterior temporal region. Leptomeninges were perforated at the right temporal pole and associated with a slight subarachnoid hemorrhage. A fragment of the bullet was identified on the cerebral surface at the junction of the right temporobasal region and mesencephalon, together with an ovoid perforation of the ipsilateral skull base at the junction of anterior and middle cranial fossa. A metallic piece was found in the right temporal lobe, with a short emerging part pointing towards the entrance wound.

Furthermore, we observed an entrance wound at the right submental region with a fragmented projectile in the subcutaneous tissue, two entrance wounds and two exit wounds of the right arm with comminuted fracture of the humerus and a fragmented projectile in the subcutaneous and muscular tissues, and two entrance wounds in the pelvis (left hip and left gluteal region) with one exit wound in the right gluteal region and a projectile located in the muscular tissue of the right gluteal region.

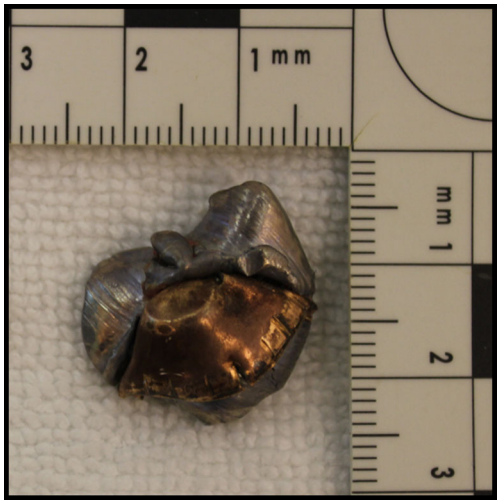

Fig. 2 View of the fragment of projectile found in the brain

Other relevant autopsy findings were a thin fracture of the lateral wall of the right orbital cavity, the presence of gas embolism (ca. 10 ml in the right ventricle), subendocardial hemorrhages at the outflow region of the left ventricle, blood aspiration as well as pale organs, and little blood in the heart and central vessels.

At neuropathological examination, the entrance of the bullet was identified between the right temporal lobe and the right posterior frontobasal region. The trajectory of the bullet was horizontal, leftward, and backward, with dilacerations of the left cerebral peduncle, the mammillary bodies, and the retrochiasmatic area. The end of the tract of the projectile

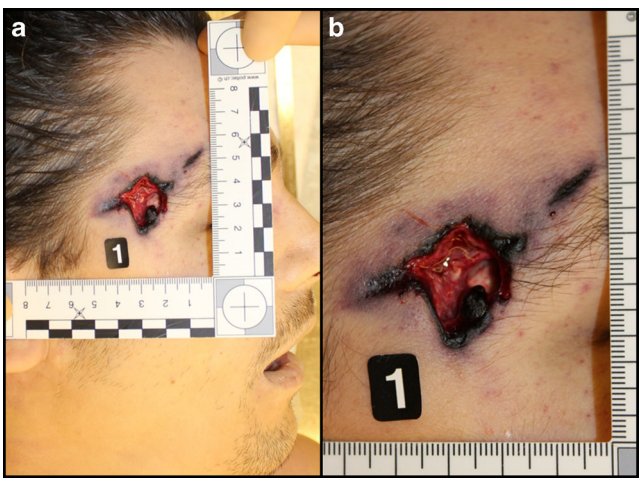

Fig. 1 **a** View of the right temporal region of the head. The picture shows an irregularly shaped wound with blackened and abraded edges and a central cutaneous defect, compatible with an atypical entrance wound. **b** Magnified view of the gunshot entrance wound, with linear blackish abrasions on both sides of the wound and petechial hemorrhages on the forehead and eyelids nearby the wound

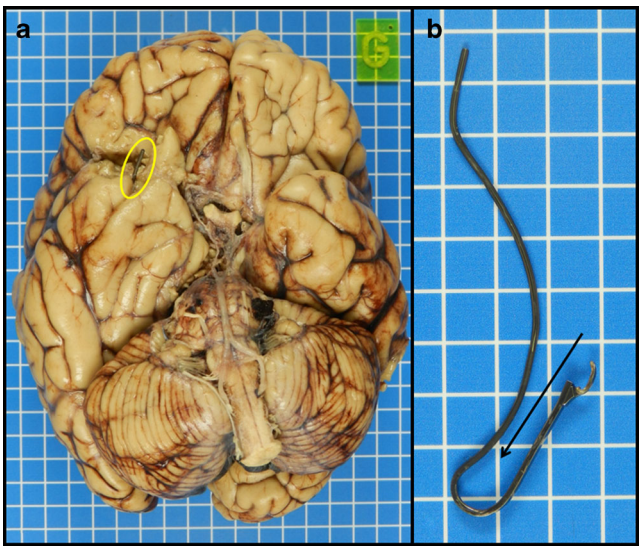

Fig. 3 **a** Ventral view of the brain. This figure shows the presence of a metallic piece emerging from the right temporal lobe (*yellow oval*). **b** Magnified view of the metallic piece after its removal from the brain. Close examination revealed an entire branch of glasses. The *black arrow* shows the trajectory of the bullet making the branch of glasses enter the brain

was identified in the left parasagittal occipitoparietal region, where a fragment of the bullet was found (Fig. 2). Petechial hemorrhages of the cerebral parenchyma were seen near the path of the projectile. A metallic piece was found in the parenchyma of the right temporal lobe (Fig. 3) and after close examination, it turned out to be a deformed eyeglass temple piece.

Microscopic examination of the cutaneous wound located at the right temporal region of the head showed moderate red cells infiltration of the subcutaneous tissue without inflammatory reaction. Similar findings were observed for the other gunshot wounds. Microscopic investigations of the internal organs showed no pathological findings.

Postmortem toxicological analyses were performed on blood and urine samples collected at autopsy. Both substrates were positive for opioids, cocaine, methadone, and oxazepam. Concentrations of opioids and cocaine in blood indicated a nonrecent consumption. Concentrations of methadone and oxazepam were compatible with therapeutic levels. Blood alcohol concentration was 0.27 g/L.

Cause of death was multiple gunshot wounds.

Discussion

Though gunshot injuries are a classical topic in legal medicine whose knowledge is fundamental for the scientific background of the forensic pathologist, IT can make the interpretation of gunshot wounds very tricky, even for experienced professionals. In the simplest scenario, IT stops powder residues so that wounds miss close-range firing characteristics [6].

In more complex cases, the impact of the bullet against the IT can produce secondary missiles from target and/or bullet fragmentation resulting in multiple, mostly atypical entrance wounds [1, 7, 8]. Atypical entrance wounds are also often the consequence of projectile destabilization prior to contact to the body [9]. In such cases, entrance wounds are often larger, irregular in shape with ragged margins, and irregular abrasion rim, due to the decreased kinetic energy resulting in a decreased bullet penetration [10, 11].

In case of short-range shotgun wounds, the pellets reach the IT in a single mass. The initial group of shot striking the target is slowed down so that the following pellets strike one another and then spray out in wide pattern producing the so-called billiard ball ricochet effect: this wide dispersion of the pellets may lead to overestimation of the shot distance [6, 12–14].

Another consequence of the contact with IT can be the contamination of the gunshot wound with foreign material from the target; the most common contaminants are textile fibers from the victim's clothes [15, 16]. Bacterial contamination from contaminated bullet has also been reported [17–20].

The penetration of big fragments of IT or even the whole IT is exceptional. The loss of kinetic energy due to the first impact of the bullet with the IT usually prevents those secondary projectiles to penetrate deeper than the cutaneous or subcutaneous structures. Mallak [21] reported the case of an entire coin discovered in the brain together with a bullet. Based on this case, Thali [22] created a ballistic model of IT simulation and was able to demonstrate the interaction between the bullet and the coin, and also to recreate the wound pattern seen on the body. Murphy [23] draws attention to the subject with reporting a projectile passing through a couch before penetrating into the body, and the bullet carrying with it into the body pieces of cloth and a metal spring, thereby causing an unusual cutaneous entrance wound. Searching for foreign material with the firearm bullet(s) may be of use as evidence. A projectile passing through IT before entering a body may carry on its path fragments of paint, glass, or other material for example. Examination of the traces of foreign material on bullets provides crucial information for the trajectory reconstruction and the possibility to determine the order of impact from the stratification of the foreign material analyzed [11].

The presented case refers to a man who was lethally shot. An atypical entrance wound was found at the right temporal region, but no exit wound was highlighted. A fragment of the bullet was identified in the left parasagittal occipitoparietal region and a curved eyeglass temple piece was found in the right temporal lobe of the brain. The latter seemed to have entered the cranial cavity with the bullet, explaining the two linear blackish abrasions observed on each side of the cutaneous wound at the right temporal region of the head (Fig. 1). Our case is a nice and quite extraordinary example of atypical entry wound after contact of the bullet with an IT which penetrated into the body. The contact with the IT has distorted the entrance wound, which did not show a typically roundish or oval skin defect.

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