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Case report

The importance of computer tomography-imaging in a case of a gunshot wound with an atypical entrance wound

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ABSTRACT

This paper is intended to demonstrate the importance of collaboration between the Radiologist and the Medical Examiner, especially in cases of firearms injuries; Computer Tomography (CT) is the method normally used, thanks to its high anatomical definition and potential for three-dimensional reconstruction and multiplanar visualisation.

The case considered here concerns a shooting victim. Upon his arrival at the emergency ward two injuries were observed, one in the lower back region and a second one in the left front mid axillary line; CT-scans were taken. The entrance wound was identified as the lower back wound, which was surrounded by a margin of abrasion of eccentric shape, with "burr" at the bottom and on the left: this suggested that the path of the projectile was from left to right and from below upwards. The exit wound, however, was located on the left side of the front of the torso: this could be compatible with deviation of the bullet's path within the victim's body caused by having hit bones.

Only analysis of CT images and three-dimensional reconstruction could permit to define the correct path of the bullet and to exclude the possibility of deviation within this path; the atypical nature of the entrance wound was therefore the consequence of a bullet which had been deformed previously.

The case described demonstrates how, in presence of non-typical entrance wounds, external examination of the victim can lead to misleading conclusions, so that, even in apparently simple cases, it is essential to work with a multidisciplinary team.

1. Introduction

The various areas of specialisation the medical examiner must work with include radiology [1]; one case in which this type of partnership is often of essential importance is gunshot wounds.

In cases of a gunshot wound from a single bullet, from the medical examiner's point of view, it is of primary importance to determine which lesion corresponds to the entrance wound and which to the exit wound of the bullet in order to determine the path taken by the projectile.

The key element distinguishing the two lesions is the ecchymotic-excoriative margin [2,3] which is only found in correspondence with the entrance wound. This is defined as typical if it is circular and concentric to the bullet hole or oval in shape, eccentric and more elliptical on the side from which the bullet came. If the morphology does not exhibit these features, it is referred to as an atypical entrance wound. In the first case it is normally easy to determine the trajectory of the projectile by examining the entrance and the exit wound, but this becomes quite complex in the presence of atypical lesions.

The radiologist uses imaging technologies to play a fundamental role assisting the medical examiner, to reconstruct the dynamics of the events in those cases. In particular, Computer Tomography (CT) is the key method for the study of gunshot wounds, thanks to its high anatomical definition, multiplanar viewing levels and possibility of creating three-dimensional (3D) reconstructions [4–11].

The literature describes numerous examples of atypical entrance wounds, many of which are the result of bullets which had been deformed by deflecting off or impacting intermediate targets [12–17]. It is also clear in the literature that in doubtful cases radiological methods [4–11] can provide a valid aid, contributing useful information which

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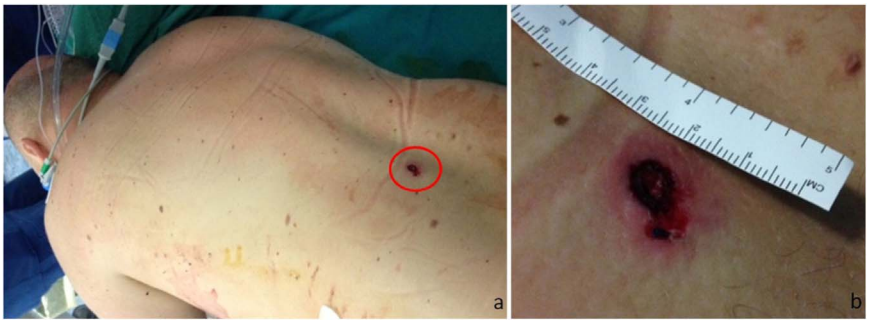

Fig. 1. (a-b): Bullet entrance wound. (a) Bullet entrance wound (circle) located in the lower back region at a height of 110 cm above the ground and 2 cm to the left of the spinal column. (b) Detail of the entrance wound showing the margin of abrasion, which appears to be eccentric, with "burr" on the lower left side in relation to the continuity of the skin.

could not be obtained otherwise and is essential in cases in which circumstantial evidence is deficient and neither the bullet nor the firearm can be found.

2. Case report

The case considered here regards a 42 year old man brought to the emergency ward after suffering a gunshot injury produced by a shot fired in the course of crossfire between a number of robbers and the police. The victim had an injury in the lower back area, 110 cm above the ground and 2 cm to the left of the spinal column (Fig. 1a-b), and another injury at the left front mid axillary line, between the 6th and 7th ribs (Fig. 2a).

Upon arrival at the emergency ward a CT scan was performed using an iodinated contrast agent, revealing a lesion to the upper pole of the left kidney, with expansion of the contrast fluid from the renal pelvis (Fig. 3). It became necessary to perform a nephrectomy on the injured kidney.

At the same time, a legal investigation had begun aimed at reconstructing the dynamics of the shooting; another element of primary

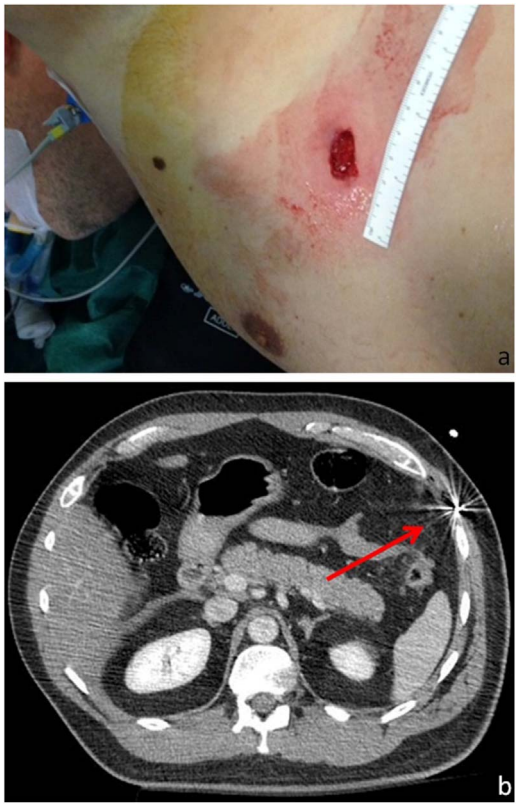

Fig. 2. (a-b): Bullet exit wound. (a) Bullet exit wound located level with the front of the left armpit, between the 6th and 7th ribs. (b) Axial CT image revealing the presence of artefacts of metallic material (arrow) in between the ribs on the front left.

Fig. 3. Axial CT during urographic excretion of contrast medium. It reveals a complex transection type lesion of the left kidney with expansion of contrast medium outside the kidney, affecting the urinary tract, with the contrast medium revealing the path travelled by the projectile from right to left (arrow).

importance in the investigation was determining whether the victim had been shot directly or whether this was a case of a "ricochet shot", in view of the evident differences in terms of criminal liability, which would be very much attenuated in the second case.

The task of assessment of the injuries on the victim's body was assigned to the Forensic Medicine Department of Genoa; the victim was examined, with the aim of obtaining all information that could be of use for answering the questions posed by the legal authorities. During the medical legal examination the victim declared that when he was struck he was standing upright at the roadside, with his back to the site of the gunfight, and was wearing a t-shirt and a bathing costume.

At a later time the police seized and analysed firearms used in the shooting. It was found out that all of them used jacketed bullets: caliber 9 mm Parabellum (Fig. 4).

3. Results

Preliminary analysis of the two skin wounds permitted differentiation of the entrance wound (on the back) from the exit wound (identifiable as the chest injury), as the latter had no margin of abrasion. The margin, which was eccentric in relation to the continuity of the skin, had "burr" on the lower left side, leading to the supposition that the projectile had impacted the victim with a left to right trajectory from below.

If this were a typical bullet hole and the project had hit the victim directly, with a linear trajectory, the exit wound might have been presumed to be situated on the opposite side of the entrance wound, and therefore to the right of the midline of the body. In the case at hand, instead, also the exit wound was located on the front left side of the torso; this would have been compatible with deviation of the bullet's trajectory within the body of the victim, after striking bone (e.g. spinal column).

To confirm this hypothesis, the decision was made to resort to