

## HOMICIDE BY CERVICAL SPINAL CORD GUNSHOT INJURY WITH SHOTGUN FIRE PELLETS: CASE REPORT

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### INTRODUCTION

In the last years, due to increasing violence in urban areas, spinal cord gunshot injuries have become an important cause of morbidity and mortality, especially in the young population<sup>[1]</sup>. The incidence of spinal cord injury caused by gunshot wounds varies considerably depending on the country, with values from 13 to 44%<sup>[2,3]</sup>. Attacks and aggression are the main causes of spinal cord gunshot injuries among civilians, while accidental shootings are rare<sup>[1]</sup>. Patients are generally male<sup>[4,5]</sup> having ages from 15 to 34 years<sup>[6]</sup> and in most cases of spinal cord gunshot wounds, there occurs spinal cord transection with complete neurological deficit<sup>[7]</sup>. Recently, the incidence of shotgun wounds by projectile weapons with high energy has increased (rifles and military weapons)<sup>[8,9]</sup>. Currently, the most common are chest gunshot wounds, and the most devastating are cervical spinal cord gunshot wounds, having a poor prognosis, producing most commonly complete neurological deficit<sup>[7,10,11]</sup>. A report of the Statistical Office of the US Justice Department in 1988 reported that 36% of victims with gunshot wounds were females. The same report states that there are twice more women than men victims of crimes committed by spouses or family members. In 36%

### ABSTRACT

This case presents a rare forensic case of cervical spinal gunshot injury of a female by her husband, a professional hunter, during a family fight with a shotgun fire pellets. The gunshot destroyed completely the cervical spinal cord, without injury to the neck vessels and organs and with the patient survival for seven days. We discuss notions of judicial ballistics, assessment of the patient with spinal cord gunshot injury and therapeutic strategies. Even if cervical spine gunshot injuries are most of the times lethal for majority of patients, the surviving patients need the coordination of a multidisciplinary surgical team to ensure the optimal functional prognostic.

**Keywords:** *cervical spinal cord gunshot injury, shotgun fire pellets, neck gunshot wounds*

of cases of homicide, the crime weapons were pistols and only in 4% of cases shotguns<sup>[12]</sup>.

We present a rare forensic case of cervical spinal gunshot wound with a shotgun fire pellets of a female by her husband, a professional hunter during a family fight. The peculiarity of this case lies in the fact that the cervical spinal cord gunshot injury with a shotgun fire pellets is normally not fatal for a human, but in our case, the gunshot caused the complete destruction of the cervical spinal cord, with no other injuries in the neck vessels and organs, with 7-day survival of the victim.

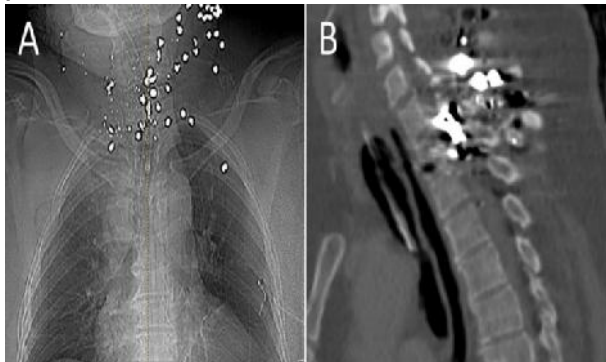
### CASE REPORT

A female patient aged 48 years, from the countryside is admitted to the Emergency Department, having a cervical spinal cord gunshot injury. The patient was in drug-induced superficial coma, tracheally intubated with complete neurological deficit (type A, American Spinal Injury Association classification), hemodynamically stable and with no other injuries in the neck. From further examinations, it was found that she was shot by her husband, a professional hunter, with a shotgun fire pellets in the right supraclavicular region during a family fight. Local examination shows projectile entry wound with irregular edges, involving right latero-cervical deep regions, with no skin, having a size of approximately 4/8

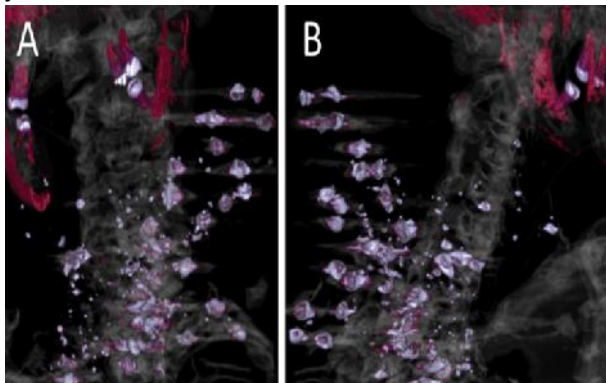
cm (Fig.1.A). The exit wound of the projectile consisting of two contusion wounds of less than 1 cm, located in the left scapular region, accompanied by bruised skin and underlying subcutaneous hematoma (Fig.1.B). Cervical spine computed tomography (CT) scan performed in emergency conditions shows a cervical spinal cord gunshot injury, highlighting several metal foreign bodies (pellets) (Fig.2.A.) in latero-cervical soft tissues located bilaterally and in the right posterolateral spinal canal C6-C7, as well in the C7-T3 spinal canal (Fig.2.A and B, Fig.3.A and B).



**Fig 1:** Intraoperative images: (A) entry wound with plastic wadding of cartridge within (box); (B) the two exit wounds of pellets.



**Fig 2:** CT scan images: (A) foreign metal bodies (pellets); (B) presence of pellets in spinal canal in the cervicothoracic junction.



**Fig 3:** 3D reconstruction of pellets distribution: (A) anterior view of cervical spine showing right-left trajectory; (B) right oblique posterior view showing posterior pellets distribution.

Surgery was performed and during operation there has been observed an oblique path from right to left, top to bottom and inside to outside, rear to right sternocleidomastoid muscle and carotid sheath without involvement of great vessels of the neck and without acute hemorrhage, with a cerebrospinal leak in cervical dural sac. Primary wound toilet and surgical debridement

were performed with the extraction of visible pellets and blocked plastic wadding in wound lane (Fig. 1. box), closure of cerebrospinal fluid leak, and cavity lavage and defect covering with local fasciocutaneous advancement flaps.

## DISCUSSION

For the first time in history, spinal injuries were described in 1700 B.C. by Imhotep in Ancient Egypt [13]. Much later, Galen made the first clinical correlations and showed that transverse spinal cord lesions are associated with paraplegia and they are much more serious than longitudinal lesions [14]. In the 16<sup>th</sup>-century, Ambroise Pare first describes spinal cord injuries caused by firearms, while in the Second World War, front line surgeons discover first steps of treatment, namely, that debridement of necrotic tissue, use of antibiotics and surgery greatly reduce early mortality and morbidity in patients with spinal cord gunshot wounds [15].

In spinal cord gunshot injuries are involved two mechanisms: ballistic and non-ballistic, that underlay the understanding of gunshot wounds pathophysiology.

These mechanisms differ among them by the speed of the projectile at the time of impact. Tissue destruction by bullet is produced by three mechanisms: direct impact of the bullet, its shock waves pressure and temporary cavitation [3, 16]. The factors that influence the severity of spinal cord gunshot injury are: the type of speed, projectile nature (shape, design, fragmentation), point of entry, projectile angulation, as well as the features of tissues involved (bone, muscle, mucosa) anatomical and neurovascular structures destroyed by the projectile in its trajectory [3, 17].

Shotgun fire pellets are made of a cartridge containing pellets. After shooting, plastic wadding of cartridge opens and pellets are dispersed in a truncated cone, the top starting from the barrel of a gun and forms in space a circular field, which is intended to cover the target. The projectile with pellets is used mainly in hunting weapons and pellets are lead spheres or lead alloy of different sizes between 1 and 5 mm [13, 18].

Spinal cord gunshot injuries are classified as transfixing injuries (when small fragments of projectile are found in the spinal canal), intra-canal (when the entire projectile is found in the spinal canal) and intervertebral (when the cartridge is inside the intervertebral disc space) [13]. In most cases, the wounds are transfixing and only small fragments (<50% of the projectile) are found in the spinal canal [19].

In the presented clinical case, the hole entrance was produced only by shotgun fire cartridge because it was positioned in the supraclavicular region close to skin. Cartridge exploded in right deep supraclavicular region, with the creation of a field of dispersion of pellets, oriented obliquely and down towards the root of the neck, with the distribution of pellets throughout the right laterocervical region, the junction region of the cervico-thoracic spine, laterocervical and left scapular region with the exit of two pellets through two holes with a diameter of less than 1 cm, located in the left scapular region. Most pellets (about 40) were stuck in the soft tissues located latero-cervically

bilaterally and in right posterolateral spinal C6-C7 canal and in C7-T3 spinal canal.

For the survival of patients with spinal cord gunshot injuries, it is crucial that the overall assessment started with basic life support techniques. After life support is ensured, spinal lesion assessment follows [6]. It is recommended that excessive mobilization be avoided due to risk of aggravation. Therefore, the cervical spine is immobilized with a cervical collar [17]. In case of patients who are victims of murder, reconstruction and history are extremely important, accurate information from witnesses should be collected related to the type of shotgun used, the proximity of gunshot, number of cartridges and the direction of shoot. These notions of judicial ballistics can help the first assessment of injury and could further guide the treatment decision [20].

Also, the entry and exit wound should be evaluated and it is recommended that bullet trajectory should not be explored by finger but only after the patient has reached a hospital. Cervical spine radiography is performed to assess fractures and locate cartridges. Once their positions are identified, a thin section CT is done to allow a better view of cartridges, as well as the extent of bone destruction. Magnetic resonance imaging permits a better visualization of the nerve roots and spinal cord, but is controversial because of the risk of potential migration of cartridges or pellets [21].

In the case of our patient, ABCDE (airway, breathing, circulation, disability, exposure) protocol was accomplished, cervical spine was immobilized by a collar and gunshot wound was not explored, leaving the cartridge in its place. The cervical and thoracic spine CT scan was performed in emergency which showed complete destruction of spinal cord of cervico thoracic junction.

Cervical spinal cord gunshot injuries are usually associated with damage to the airways that may require emergency tracheal intubation [22] and the main cause of instant death in case of gunshot wounds is hemorrhage due to damage of vascular structures in the neck, which is most often fatal [23,24].

Generally, shotgun fire pellets do not cause death injuries. In the presented case, the lesion was fatal, since the gunshot distance was less than 0.5 m from the victim, which caused major spinal cord injury that later caused death. Although the cone of dispersion of pellets was very close to the neck neurovascular bundle and other organs of the neck, these were not damaged, the patient survived another seven days after the aggression and died of complications of spinal cord injury.

Cervical spinal cord gunshot injury are in most cases fatal [23], and patients who survive require guidance of a multidisciplinary surgical team to optimize the functional prognosis, still a surgical treatment for complete neurological deficit remains controversial [24].

The only indication for surgical treatment is the dural leak or progression of neurological deficit associated with compression of the spinal cord/nerve roots confirmed by imaging [17], the occurrence of spine instability [25], installation of toxicity - poisoning (in case of lead bullets) and the likelihood of migration of an intracanal cartridge or

pellets. Indications for surgical treatment of spinal cord decompression are for the first 24-48 hours [3].

In this case, emergency surgery consisted of primary surgical wound toilet with the extraction of visible pellets and blocked cartridge in the wound lane, cerebrospinal leak closure, cavity lavage and coverage of defect of substance with fasciocutaneous advancement flaps.

In spinal cord gunshot injuries, the most important prognostic factor is the initial neurological examination of the patient [5, 16]. Functional recovery of spinal cord gunshot injuries with incomplete neurological deficit is more difficult than in the case of stab wounds or wounds caused by road accidents [5, 26]. In case of cervical spinal cord gunshot wounds, the neurological deficit is complete in about 70% of cases [27, 28], lesions are completely in approximately 30% of cases in the lumbosacral region [29, 30]. In our case, the patient's prognosis was unfavorable due to initial important cervical spinal injury that lead to respiratory insufficiency, patient's death occurring seven days after hospitalization.

## CONCLUSIONS

Therapeutic management of patients with spinal cord gunshot injuries is an emergency and requires an interdisciplinary team. Surgical treatment in case of spinal gunshot wounds with complete neurological deficit is not recommended in most cases and remains controversial because there are no therapeutic resources.

Spinal cord gunshot wounds are important forensic events and it is essential in such cases to know few notions of judicial ballistics, such as type of weapon used in the murder, understanding the mechanism of spinal cord injury and the correct classification of the offense under the law in force as provided by Criminal Law.

**Conflict of interest: Nil**

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