

CASE REPORT

Dual spinal cord injury caused by a firearm projectile migrated into the spinal canal: A case report

Doble lesión de la médula espinal por proyectil de arma de fuego con migración en el canal medular: reporte de un caso

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Abstract

Introduction: Surgical treatment of spinal gunshot wounds is controversial, however, neurological deficit is one of the criteria for its indication.

Case presentation: A 21-year-old man was admitted to the emergency department of a tertiary care hospital in Bogotá, Colombia, due to multiple gunshot wounds, paraplegia, hypoesthesia in the lower limbs and saddle area, and inability to move, for which thoracotomy and laparotomy were performed. Given the absence of muscle strength and reflexes, a grade A spinal cord injury was diagnosed according to the American Spinal Injury Association Impairment Scale (ASIA). Twelve hours after admission, the patient was taken to surgery for the removal of a firearm projectile (laminectomy and longitudinal durotomy) without achieving the extraction, so a fluoroscopy was carried out, in which it was observed that the bullet had migrated cephalad to the L4-L5 intervertebral space. L4-L5 laminectomy, dural sac exposure, and longitudinal durotomy were performed, leading to the removal of the projectile. After 20 days, improvement of motor function and muscle strength, voluntary contraction of quadriceps, and grade C in ASIA were reported.

Conclusion: Projectile removal in spinal cord injuries is recommended when the projectile migrates into the spinal canal. Fluoroscopy is recommended before and after surgery.

Keywords: Wounds, Gunshot; Spinal Cord Injuries; Neurologic Manifestations, Spine; Surgery (MeSH).

Resumen

Introducción: El tratamiento quirúrgico de las lesiones por proyectil de arma de fuego en la columna es controversial; sin embargo, el déficit neurológico es uno de los criterios para su indicación.

Presentación del caso. Hombre de 21 años que ingresó al servicio de urgencias de un hospital de tercer nivel en Bogotá, Colombia, por múltiples heridas de arma de fuego, paraplejía, hipoestesia en miembros inferiores y silla de montar, e incapacidad para moverse, por lo que se realizó toracotomía y laparotomía. Ante la ausencia de fuerza muscular y reflejos, se diagnosticó lesión de la médula espinal de grado A según la American Spinal Injury Association Impairment Scale (ASIA). A las 12 horas del ingreso, se llevó al paciente a extracción quirúrgica de un proyectil (laminectomía y durotomía longitudinal) sin lograr la extracción, por lo que se utilizó fluoroscopia, en la que se observó que la bala había migrado cefálicamente al espacio intervertebral L4-L5. Se realizó laminectomía de L4-L5, exposición del saco dural y durotomía longitudinal, logrando la extracción del proyectil. A los 20 días se observó mejoría de la función motora y la fuerza muscular, contracción voluntaria de cuádriceps y grado C en ASIA.

Conclusión. La extracción del proyectil en lesiones de la médula espinal se recomienda cuando hay migración de este en el canal medular. Se sugiere usar fluoroscopia antes y después de la cirugía.

Palabras clave: Heridas por arma de fuego; Traumatismos de la médula espinal; Manifestaciones neurológicas; Columna vertebral; Cirugía (DeCS).

Introduction

Due to the increase in urban violence, gunshot wounds have become a major cause of morbidity and mortality, especially among young men. The incidence of penetrating spinal cord injuries due to firearm projectiles varies depending on the region, but it has been reported that the thoracic region is the most frequently involved area, followed by the lumbosacral and cervical regions.¹⁻³

Some studies have established that the location of the lesion determines the occurrence of neurological deficit, with 70% of cervical lesions resulting in complete deficits and 70% of lesions in the lumbosacral region and cauda equina resulting in incomplete deficits. The main prognostic factor for recovery of patients with spinal cord injury is their initial neurological status, and the functional outcome is usually worse in patients with injuries caused by firearm projectiles. On the other hand, the follow-up period necessary to consider the functional status as definitive varies in the literature, ranging from 2 weeks to 6 months.¹⁻⁵

Treatment of patients with gunshot wounds is based on advanced trauma life support (ATLS), administration of broad-spectrum intravenous antibiotics, and tetanus prophylaxis.¹⁻¹² Surgical management remains controversial and factors for its indication include the presence of cerebrospinal fluid fistula, progression of neurological deficit, and vertebral instability due to associated fractures. Currently, biomedical literature supports spinal decompression and projectile removal in patients with incomplete spinal cord injury. Moreover, other factors used to determine surgical treatment are the location of the projectile with evidence of migration (within the disc or spinal canal) and heavy metal toxicity in joints or within the disc.^{1,3-10,12-20}

In this context, the following is the clinical case of a patient with a dual spinal cord injury caused by a firearm projectile lodged in the dural sac at the level of the cauda equina and incomplete neurological deficit, in whom the projectile was surgically removed.

Case presentation

A 21-year-old man was admitted to the emergency department of a tertiary care hospital in Bogotá (Colombia) due to multiple gunshot wounds (Figure 1), paraplegia, hypoesthesia in the lower limbs and saddle area, paresthesia in legs, and inability to move. Imaging studies identified the first entry orifice of the projectile in the right posterior thorax at the level of T5-T6, which caused pneumothorax; the second entry orifice in the right paravertebral region with fracture of L1 involving the pedicle and the right facet joint, with presence of small free bone fragments inside the medullary canal (Figure 2); and the third orifice in the midline spine at the level of S1-S2, with the projectile lodged in the dural sac and in contact with the cauda equina (Figure 3).

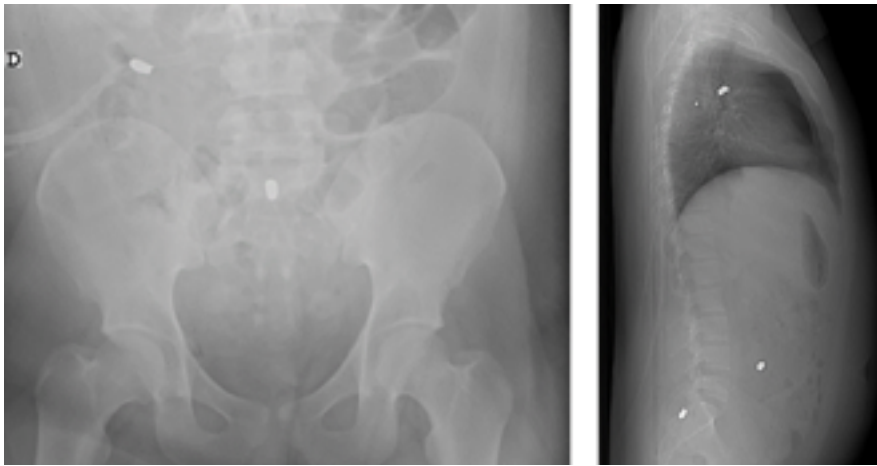


Figure 1. A): Anteroposterior pelvic radiograph. B) X-ray of the lateral spine showing multiple firearm projectiles.

Source: Image obtained while conducting the study.

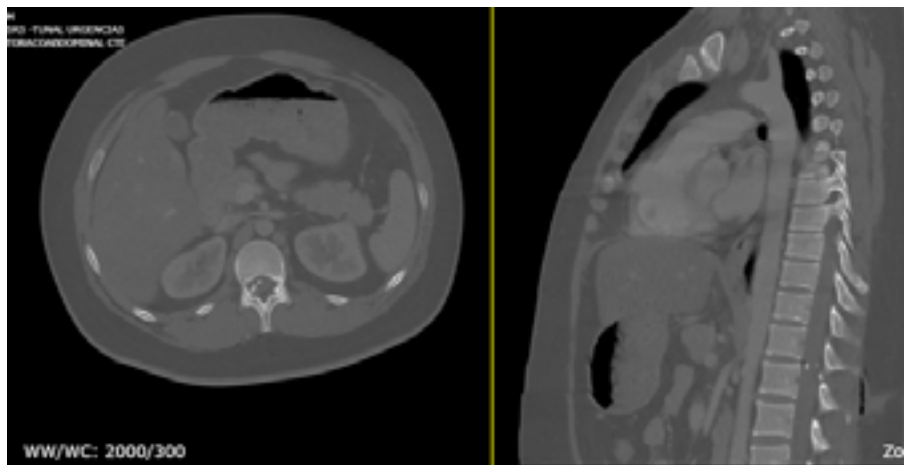


Figure 2. Computed tomography of thoracic spine showing L1 fracture and vertebral fragments within the spinal canal. A) Axial view. B) Sagittal view.

Source: Image obtained while conducting the study.

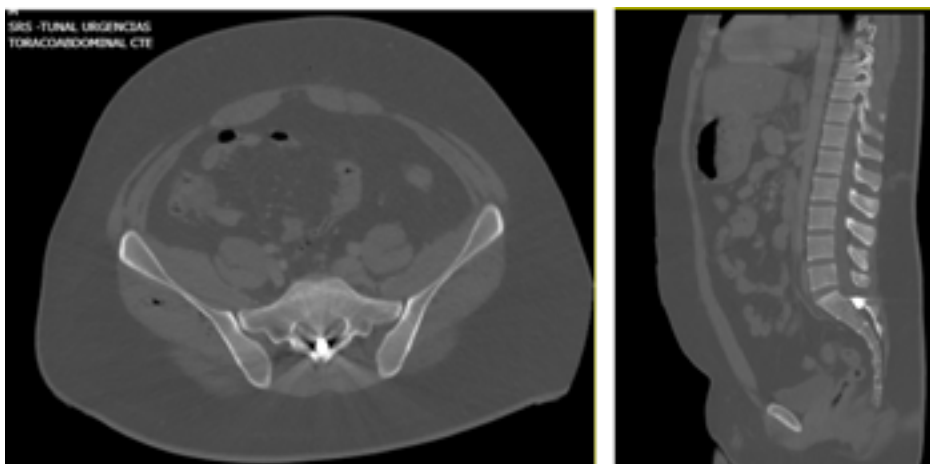


Figure 3. Computed tomography of the lumbosacral spine showing a projectile lodged in the vertebral canal at S1-S2. A) Axial view B) Sagittal view.

Source: Image obtained while conducting the study.

Three hours after admission, the general surgery service performed a thoracostomy and an exploratory laparotomy, finding a small lesion in the ascending colon without perforation, as well as the third projectile which was apparently in the abdominal wall and did not require removal. Nine hours after admission, the patient was assessed by the orthopedic spine service, finding no evidence of cerebrospinal fluid leakage. In addition, the assessment revealed strength in both lower limbs of 0/5 according to the Daniels muscle strength scale, areflexia, hypoesthesia in saddle area and lower limbs up to S1, and absence of cremasteric and bulbocavernosus reflex. Consequently, grade A spinal cord injury according to the American Spinal Injury Association Impairment Scale (ASIA) was determined between T12-L1.

Surgical procedure and postoperative evolution

In view of the foregoing, 12 hours after admission, the patient was taken to surgery to remove the projectile. The patient was positioned in prone position and a posterior approach was used in the lumbosacral midline. Dissection by anatomical planes until exposing the posterior arches of S1-S2 was performed, as well as laminectomy and longitudinal durotomy. However, the projectile could not be removed because it could not be located, so fluoroscopy was immediately performed, observing that the projectile had migrated cephalad to the L4-L5 intervertebral space (Figure 4), without evidence of projectile movement due to manipulation of the patient's position, which included reverse Trendelenburg position. This was followed by laminectomy of L4-L5, exposure of the dural sac, and longitudinal durotomy. The projectile was located in the dural sac, anterior to the cauda equina, had no sharp edges, and floated freely in the cerebrospinal fluid, generating a bulging of the dural sac (Figure 5) that allowed predicting its location using a blunt dissector to avoid its cranial migration and achieve its removal. Finally, the projectile was extracted using a curved Kelly forceps and the roots of the cauda equina were found to be intact (Figures 3- 5). The dura was sutured, and the Valsalva maneuver was performed without evidence of cerebrospinal fluid leakage. Lastly, the wound was closed in the standard way.



Figure 4. Fluoroscopy performed during surgery showing the location of the projectile at the level of L4-L5. Source: Image obtained while conducting the study.

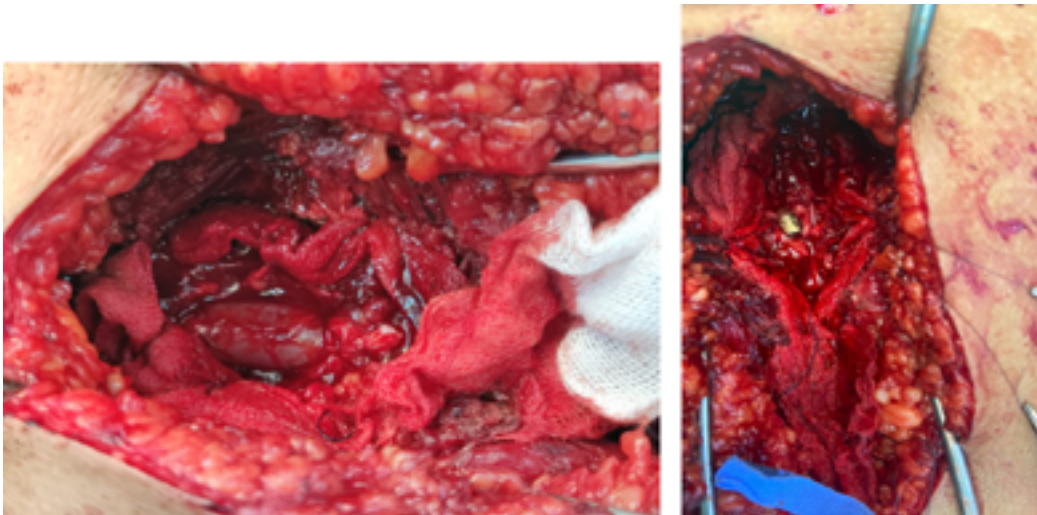


Figure 5. Surgical intervention performed to remove the projectile. A) Bulging of the dural sac. B) Projectile inside the dural sac at the level of L4-L5.

Source: Image obtained while conducting the study.

Fifteen days after the surgery, the patient presented dehiscence of the abdominal and lumbosacral wound and infection of the operative site, so the general surgery service performed surgical lavage and wound closure and, subsequently, the spine surgery service implemented intravenous antibiotic therapy. During the follow-up visit that took place 20 days after surgery, there was evidence of improvement in the motor function of the lower limbs, voluntary contraction of the quadriceps muscles, muscle strength 1/5 on the Daniels scale in both legs, no sensory changes, and grade C ASIA. However, the patient still required bladder catheterization.

Discussion

Surgical management of gunshot wounds to the spine, although controversial, aims to maintain spinal stability, reduce neurological deficit, and prevent complications such as cerebrospinal fluid fistula and migration of the projectile.^{2,3,4} Physicians who favor conservative treatment of these wounds have reported cases of neurological recovery without projectile removal,⁵⁻⁸ while those who propose surgical management recommend early removal (within the first 24 to 48 hours) if the patient is stable,^{2,3,9-13} in order to prevent worsening of the health status and the appearance of new neurological symptoms and signs due to projectile migration, as well as meningitis, epidural fibrosis, intramedullary dystrophic calcification, and long-term effects of lead poisoning.^{12,14,15}

It has been reported that patients in whom surgical removal of the projectile has been performed had partial or complete recovery of neurological symptoms.^{10,16-18} Furthermore, some authors have pointed out that early removal of the projectile from the spinal canal facilitates the neurological recovery of the patient since the axons in this region have the capacity to regenerate.^{2,12} It should be noted that only one of the studies found during the preparation of this article reported that the patient did not recover from the neurological deficit after removing the bullet.¹⁶

It has been described that projectiles that migrate usually lead to deterioration of neurological function and, therefore, migration is a criterion for surgery.²⁰ Also, in patients with migration and intradural location of the projectile, it is recommended to perform surgery as soon as possible to prevent further damage to the patient, considering that

Ghori *et al.*¹⁸ reported that a patient presented cauda equina syndrome 15 months after the bullet impact due to the migration of the bullet through the spinal canal.

The displacement of these migrating intradural projectiles during surgery was reported in the articles found and reviewed, but that event is expected in these cases. In the present case report, laminectomy was performed in the sacral region based on the results of preoperative imaging tests since the projectile was not found during this procedure. Consequently, fluoroscopy was used, which allowed observing cephalic migration of the bullet, making it necessary to extend the laminectomy to L4-L5; this is in line with the reports by Baldawa *et al.*¹⁹ In this sense, fluoroscopy should be performed before and during surgery to accurately locate the projectile and guide the laminectomy adequately.²⁰ In addition, changes in patient position may help remove the projectile; in fact, the use of the reverse Trendelenburg position has been described to avoid further cephalic migration of the bullet.^{13,20}

The present case has the particularity of involving the spinal cord in two sites, since the projectile that was extracted was initially lodged in the dural sac in the cauda equina and the second projectile was located in the abdomen, although it entered through the right paravertebral region at the level of L1, causing fracture of the pedicle and the right facet joint, with small vertebral fragments inside the spinal canal that were not susceptible to surgery. The incomplete spinal cord injury caused by the second projectile explains the initial grade A ASIA classification between T12-L1. Another relevant aspect is the improvement of motor function 20 days after surgery, achieving a grade A to C transition in ASIA.

Conclusions

Surgical treatment of gunshot wounds to the spine remains controversial. Migration of intrathecal projectiles may worsen neurological deficits and cause other short- or long-term complications, so surgical removal is recommended in these cases. The migration of these projectiles during surgery is common, and fluoroscopy should be used before and during the procedure. Moreover, proper positioning of the patient may facilitate the surgery.

Informed consent

The patient's participation was voluntary, and his parents signed the informed consent form endorsing this case report. The confidentiality of the data obtained, as well as the identity of the subjects, was preserved at all times.

Conflicts of interest

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