



Clinical Case of the Month

Gunshot wound to the spine

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Introduction

Violence in some countries is considered to be endemic and the number of patients with gunshot wounds has been increasing. When the spine is affected usually there is a consequent spinal cord injury.

In USA¹ and Brazil² gunshot wounds are the second commonest cause of spinal cord injury (SCI), after motor vehicle accidents.

As many of the papers published are related to wartime experience, we present a case of gunshot wound to the spine caused by a low-velocity weapon, as observed in urban areas.

Case presentation

TEP Barros

The patient, a 25-year-old man, had a gunshot wound (posterior entrance) to the spine 5 h previously.

He is paraplegic (Frankel A), without any other associated injury. The initial X-ray images (AP and lateral views) are shown in Figure 1a,b.

Questions

- (1) Do you think the bullet has to be removed? When? Are there any special recommendations during the surgical procedure?
- (2) How would you deal with the dural laceration?

First opinion

J Zigler

This case of a 25-year-old with Frankel A paraplegia following gunshot wound (GSW) to the spine is very typical of these civilian injuries. In a review of the

Rancho experience with civilian GSW's published in 1991, we found demographically that 31% of our Spinal Injury Center admissions were secondary to GSW, that the mean age of these patients was 25.9 years, 91.5% were male, and 75.3% were paraplegic. The majority of the GSW's causing paraplegia were at the T7–L2 levels.³

This patient's entry wound was posterior, so it is unlikely that there will be associated intra-abdominal or intra-thoracic injuries, although these may occur in 60% of these patients. These injuries are almost universally stable; the only unstable lumbar GSW's encountered in the large series at Rancho were flank entry wounds where a disruption of the pedicles bilaterally allowed for a progressive spondylolisthesis.³

This patient's wound would be expected to be at the level of the cauda equina. While it is possible that there has been some cavitation or concussive injury that may secondarily effect the conus, there should be relative sparing of the conus tissue. Neurologically, this represents a peripheral nerve-type injury, rather than central nervous system injury, with a better prognosis for recovery.

Interestingly, in a review by Waters and Adkins⁴ of 32 bullet removals in 90 patients with GSW and SCI, they were able to conclude that statistically significant neurologic motor improvement occurred after bullet removal from the spinal canal at the T12–L5 levels. In more proximal thoracic spine GSW's at the T1–T11 levels, no statistical difference was seen following bullet removal, whether the patient was neurologically complete or incomplete.⁴

In this case, I would advise bullet removal. In late removals, several months post-GSW, the bullet is usually walled-off by reactive scar tissue, so it is usually possible to remove the bullet without encountering a direct connection to the subarachnoid space. CSF leakage is generally not a problem in these late cases. In this case, several days after injury, there is a high probability that lacerated dura and an active

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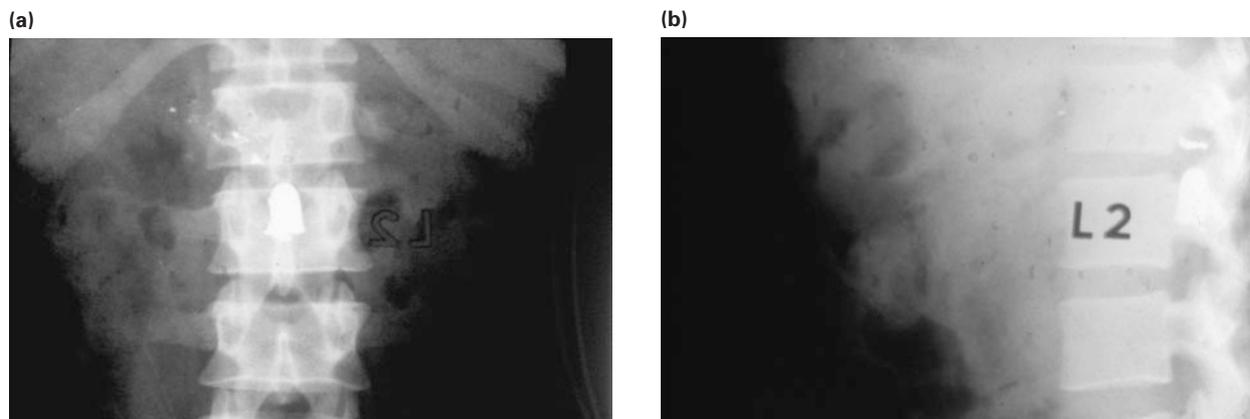


Figure 1 (a) AP and (b) lateral view of the spine at the thoracolumbar junction showing a bullet inside the vertebral canal at the upper part of the body of L2

CSF leak will be encountered. Additionally, there may be evidence of directly injured and lacerated nerve roots, and the remaining intradural contents must be handled carefully to prevent further damage to the cauda equina. The dura may be unreparable at the entry site of the bullet.

I would recommend a careful exposure, being careful not to sacrifice the facet joints and cause iatrogenic instability. The bullet should be gently dissected from the cauda equina roots, and an attempt made at primary closure. If the defect is too large, or the dura is too shredded, a dural patch may be necessary. This can be made from the patient's fascia, from freeze-dried allograft, or even from a synthetic substance now available. Attempts should be made to render this watertight.

If a watertight closure cannot be obtained, and there is active leaking in the field, a closed subarachnoid drain should be considered. This can be placed cephalad intradurally under direct vision, and the catheter woven through several layers of tissue on the way to the skin. Use of thrombin glue or commercially available sealers would be encouraged, as well as a watertight fascial closure.

Second opinion

S Aito and N Di Lorenzo

In Europe SCI caused by gunshot wounds are very rare compared to other geographical areas such as USA^{1,3} and Brazil.² The exception is represented by those regions where there is a high level of violence (eg war in the Balkan countries) and where guns are easily available.

In Italy, according to the latest epidemiological researches, their incidence does not exceed 1% of all traumatic causes of spinal cord injuries.

In our centre we have treated 17 persons affected by gunshot wounds of the spine out of 1400 patients admitted over 20 years. Such limited experience does

not allow us to state absolute indications on surgical management.

In the literature there are no unequivocal indications about this issue. Waters and Adkins reviewed 90 patients, in which 32 had bullet removal and 58 had conservative treatment. They concluded that at the T12–L5 levels, significant neurologic motor improvement occurred following bullet removal.⁴

Other authors advise not to explore the spinal canal unless it is required as part of wound toilet. As to other issues such as infections, CSF leak, pain, spinal instability, lead toxicity, there are different opinions among authors. With regard to treating spinal gunshot wound victims with high doses of intravenous methylprednisolone, recent papers have denied any neurological benefit.⁵

We think that in the case of an incomplete neurological lesion a surgical procedure (laminectomy and removal of bullet) is mandatory, in order to avoid further damage due to the presence of the foreign body.

Our subjective opinion, regarding this specific case, is as follows:

- (1) More accurate investigations should be done in the first hours post lesion, such as CT scan and Magnetic Resonance of the injured spine, in order to better understand the condition of the vertebrae involved and identify the spinal damage. With regard to the use of MRI, we confirm that it is possible to perform it without any problem, as stated by other authors,⁶ both concerning the risk of movement of the bullet or the risk of overheating (within 24 h).
- (2) To perform a surgical procedure as soon as possible in order to achieve these aims:
 - Enlarge the space for the conus medullaris and cauda equina by laminectomy;
 - Wound toilet, removal of the bullet and, possibly, small fragments, in order to avoid

future infections and/or local toxicity due to the presence of lead in the cerebrospinal fluid;

- Exploration and replacement of the cauda equina into the dural sac;
- Repair of the dural laceration by autologous graft (fascia).

This course of action is also justified in order to limit late sequelae of arachnoiditis and reactive scars that can account for pain syndromes and spasticity (progressive post-traumatic myelopathy).

These indications cannot be interpreted as mandatory. In fact, if the conditions do not permit it (unavailability of an expert surgeon or other), the surgical procedure could be, of course, delayed.

Third opinion

P Wing

The imaging of this 25-year-old man who sustained a posterior penetrating gunshot wound showed a small largely intact missile situated within the upper part of the body of L2. The AP view shows some damage to one of the pedicles of L1, with a small amount of fragmented metal to suggest that this was the entry point. Thus, the patient is likely to show no neurologic recovery.

Without seeing CT scans of this area, it nonetheless appears that there has been little bony damage that will destabilize the spine, and I would disregard stability as an issue in this patient.

A bullet retained in the spinal canal can lead to a number of late complications including bullet migration, lead poisoning, neurotoxicity and inflammatory foreign body reaction.⁷⁻⁹ They suggest that unless the patient's neurologic status is incomplete and deteriorating, spinal decompression to improve neurology is not indicated. Waters and Adkins,⁴ and Yoshida *et al*,¹ have suggested that bullet removal made no significant difference with respect to pain reduction or sensory improvement but may influence motor recovery in the upper lumbar region.⁹ I suggest the bullet be left alone, and minimal cleansing and debridement of the entry wound be undertaken. If over time this improves to an incomplete lesion with some cauda equina escape, removal of the bullet could be considered. I do not believe there is a significant risk of later lead toxicity with this bullet.

If deep infection supervened (this would be unusual) deep debridement might be required and bullet removal could be undertaken in conjunction with that. In our jurisdiction, a representative of the police force must be at hand and a rubber-clad forceps must be used for handling the bullet. If dural repair is necessary, lumbar fascia could be used. Tekavcic and Smrkolj¹⁰ describe the use of lyophilized dura.

The last situation in which the bullet should be removed is if it migrates within the spinal canal and there is late neurologic deterioration.²

Fourth opinion (proposed classification and protocol of treatment)

TEP Barros

As recognized by Yoshida *et al*,¹ the theoretic reasons for bullet removal are improved neurologic recovery and prevention of complications, cerebrospinal fluid leak, lead toxicity, pain and late neurologic decline.

With the increasing number of patients with gunshot wounds to the spine in our country, we have developed a classification and a protocol of treatment for this type of injury.

Classification

Group 1: Gunshot wound to the spine without bullet or fragments inside the vertebral canal;

(A) without associated abdominal viscera perforation;

(B) associated with perforated abdominal viscera.

Group 2: Gunshot wound to the spine with bullet or fragments inside the vertebral canal;

Subtypes A and B.

Group 3: Gunshot wound with the bullet into the intervertebral space;

Subtypes A and B.

Protocol of treatment

In patients of subgroup B (associated with perforated abdominal viscera) special precautions should be taken due to the higher risk of infection, and therefore broad-spectrum intravenous antibiotics should be maintained for 2 weeks with special attention to the risk of vertebral infection, especially if there is perforation of the colon.

In patients of Group 1 there is no indication for surgical treatment of the spine injury, unless there is a progressive neurologic deterioration.

In patients of Group 2 we recommend removal of the bullet to avoid complications and to improve the possibility of neurologic recovery, specially when the injury is at T12–L5 levels.

In patients of Group 3 it is important to pay special attention to the risk of lead poisoning. Blood tests are done every 3 months. If there is an increase in the lead blood level the bullet has to be removed and chelation therapy should be initiated.

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