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ABSTRACT

Retention of all or part of the weapon following a non-missile penetrating spinal injury is a rare occurrence. The authors report a case of thoracic spinal cord stab injury in a young man. The patient presented with a knife blade lodged in his back and with Brown-Sequard-plus syndrome. At surgery, the wound with the knife in situ was explored and the knife was removed. Although the wound healed without evidence of cerebrospinal fluid leakage or infection, he developed a complete neurologic deficit post-operatively. This was an unlikely outcome for incomplete spinal cord injury resulting from non-missile penetrating spinal injury, historically known to have a favourable outcome. Pre-operatively, patients with incomplete neurological injury following penetrating spine injury with the retained foreign body should be specifically counselled on the possibility of a worsened neurological outcome after surgical intervention.

INTRODUCTION

Spinal cord injury is associated with long-term disability and substantial economic burden; disproportionately affecting younger populations mainly in their third decade. (1,2) While blunt trauma accounts for most traumatic spinal injuries, penetrating injuries represent higher rates of morbidity, disability, and financial burden.(1) Furthermore, non-missile-penetrating spinal cord injuries are rare and account for less than 1.5% of the total penetrating injuries.(2) Most of the weapons are already withdrawn by the attacker in spinal stab injuries, but rarely may get impacted into the bone and is retained either as a whole or as fragments requiring surgery.(3,4) Spinal cord injury resulting from stab

Keywords

non-missile penetrating spinal injury (NMPSI), impaled knife, Brown-Sequard-plus syndrome, complete spinal cord injury



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wounds are usually incomplete with most cases appearing typically as the Brown-Sequard-plus syndrome – a term reserved for the less pure forms of the original description of cord hemisection.(5) Neurologic recovery overall fares well generally for these injuries – with up to 97% significant recovery in a series.(6) On the other hand, Lipschitz opined that

if spinal injury due to stab wound is neurologically complete over 24 hours after injury neurological recovery was rare, and if present, negligible.(7) Literature on outcome specifically for penetrating spinal cord injury with retained weapon is unsurprisingly rare, due to the uncommon nature of these injuries.

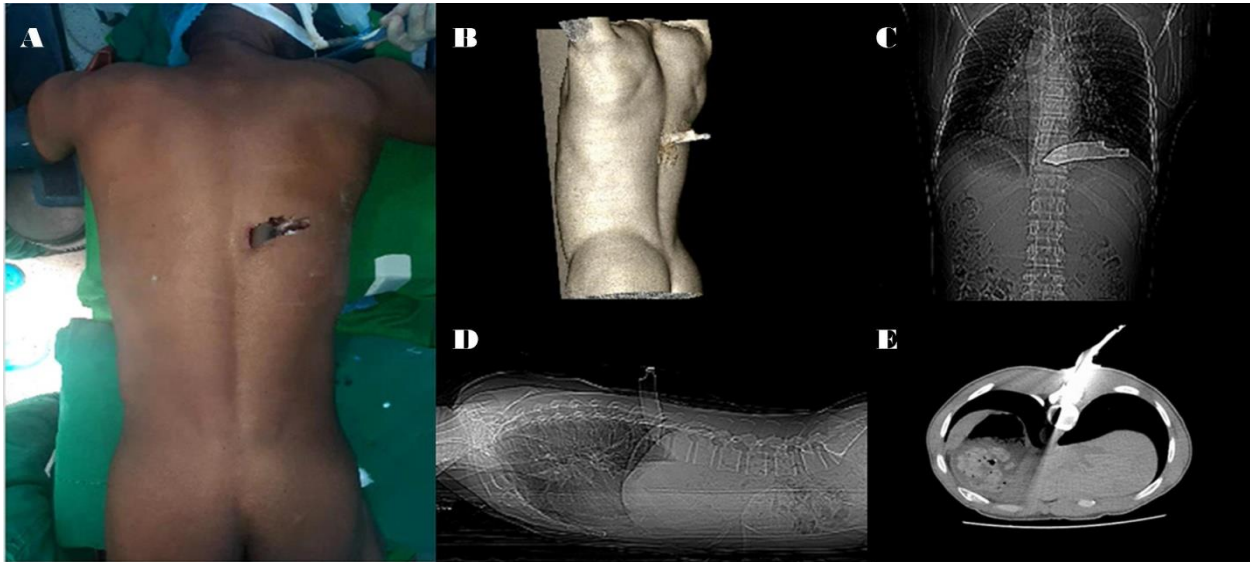


Figure 1. Non-missile Penetrating Spinal Injury. A: Patient in prone position showing the point of entry; B-E: Reconstructed images showing direction and depth of entry.



Figure 2. Intraoperative images of non-missile penetrating spinal injury. A-B: Surgical exposure and extraction; C: Impaled knife after extraction.

CASE REPORT

A 40-year-old man was stabbed in the back with a knife by unknown assailants who also hit his waist

with a block, four hours prior to presentation. He sustained a single stab wound which bled minimally. He perceived immediate paraesthesia in the left

lower limb but no weakness or sphincteric compromise. There were no significant injuries involving other regions of the body.

On examination he was a young man, fully conscious and lying prone. His heart rate was 90 beats per minute, respiratory rate of 23 cycles per minute and arterial blood pressure was 100/65mmHg. His Glasgow coma score was 15 and he had intact higher mental function. There was normal sensation to light touch and pin prick on the right side of the body and sensation up to L2 on the left, as well as hypoesthesia down to L5. (Motor examination was made difficult by the prone positioning) but power in the lower limb muscle groups were at least 3 in the left lower limb and at most 2 in the right lower limb. There was no evidence of acute urinary retention prior to urethral catheterization and rectal tone was normal.

A knife blade was seen stuck in the T10/T11 interspace to the right of the midline, with clotted blood surrounding it. (Figure 1A) A diagnosis of penetrating thoracic spinal injury with Brown-Sequard-plus syndrome – grade C on the ASIA scale – was made.

A thoracic spine CT was performed considering the obvious risk of an MRI in the presence of a ferromagnetic object; this showed a 6 cm hyperdense foreign body, consistent with a knife, entering the right T11 lamina. A radiograph improved on the poor visualization of the path of the foreign body, occasioned by ferromagnetic streak artefact on the CT, and clearly showed the downward and medial trajectory of the knife. (Fig. 1B-E)

He was worked up for planned extraction of the retained knife.

In the operating room, pre-oxygenation before anaesthetic induction, and tracheal intubation with the aid of a laryngeal mask airway, were done in lateral position as patient could not lie supine. At surgery, under intraoperative magnification, the stab wound was extended and the underlying paravertebral muscle was dissected along the tract of the knife down to the vertebral lamina. The knife's entry point was found entirely in to the lamina lateral to the spinous of T11 on the right. Although rigidly held in position, attention was paid to avoid moving with knife while dissecting, to avoid spinal cord damage. Right-sided T10 hemi-laminectomy was done using Kerrison punches. Following adequate exposure, the stuck tip of the knife piece was easily

extracted with minimal additional bleeding that was readily controlled. The estimated entire retained length deep to the skin was 6cm (Figure.2 A-C). Inspection of thecal sac showed a small longitudinal split with minimal cerebrospinal fluid leak, which was sealed with Surgicel. Copious irrigation, and then meticulous soft tissue closure was done in layers after a closed passive drain was left in situ.

Immediate and subsequent postoperative neurological examination revealed a sensory level of T10 and power in both lower limbs was 0 in all muscle groups respectively. Wound drain was minimal, and no evidence of post-operative cerebrospinal fluid leak or wound infection was present.

A post-operative magnetic resonance scan could not be done due to financial constraint. He has been followed up for two months post-injury during which the neurological injury was yet to evolve from the E rating on the ASIA scale, while his bladder remains neurogenic.

DISCUSSION

Apart from the longest case series on penetrating spinal cord injury which was published by Peacock *et al* from South Africa, the global literature contains only rare case reports and small case series on NMPSI.(8)

Spinal cord injury resulting from stab wounds are usually incomplete.(9) In the South African study earlier referred to, Peacock and colleagues found out that half of the 450 patients from a total of 1,600 patients had Brown-Sequard syndrome. Most of the injuries occurred in the thoracic region, and knives were found to be the mostly used object, both in this series and in the next most impactful series on this subject matter. (10, 11)

Usually, the weapon enters the spinal canal via the interlaminar region between the spinous process and collide with the bony elements of the spine, and is compelled through a trajectory that guides the knife to only one side of the spinal cord, thereby resulting in Brown-Sequard syndrome.(9,12) Our patient's injury was most likely through this mechanism.

The proposed mechanisms of injury to the cord include direct damage by the weapon or in-driven bone fragments, damage of the vascular supply of the cord or coup-counter-coup spinal contusions.(3) The first is an immediate mechanism and the second

is a delayed mechanism.(12) The occurrence of neurologic deficit immediately after the assault suggested a direct cord injury in our patient, and the subsequent deterioration was likely of a vascular cause or secondarily from cord oedema.

While there is significant variability in penetrating spinal trauma management practices due to paucity of data on penetrating spine trauma generally, existing literature provides some guidance on surgical indication, reserving surgical intervention for progressive neurological deficit, spinal instability, or infection control.(1) Additionally, for foreign bodies lodged in the spinal canal the need for surgery is obvious to prevent infection, myelopathy and delayed neurological deficit.(3) The objectives of the surgical treatment are therefore to decompress the spinal cord, remove the foreign body, control infection and prevent cerebrospinal fluid leakage.(13)

Generally, in the management of retained foreign bodies, the manipulation or blind removal of a retained weapon before a careful evaluation can cause a significant bleeding, because of the theoretical plugging effect of the weapon over adjacent vessels.(14) Therefore, the standard of care in retained foreign body injuries to the spine remains extraction performed on the operating table.(3) The options for removal of the foreign body were summarised by Sobnach to include simple extraction, wound exploration and extraction, or open operation and extraction.

Arguments in favour of simple extraction hold the position that open surgical explorations will add little benefits if any, and have surgical risks in neurologically intact spinal stab wound patients, but added that during simple extraction the operation team must be ready for urgent exploration of the wound in the event of brisk bleeding or CSF leakage after withdrawal.(3)

One of the challenges with patients with the perioperative management of a penetrating spinal injury with an impaled knife is that of positioning for endotracheal intubation. Tracheal intubation in the lateral position is difficult because the laryngeal view is compromised during direct laryngoscopy.(15) There are several reports of successful ventilation with the laryngeal mask airway (LMA).(16) The left lateral position is favoured because of the relative difficulty in the right lateral position was attributed to the positioning of the tongue, which has a tendency

to slip off the laryngoscope blade while the blade is inserted from the right side of the tongue.(17)

At surgery, identification and repair of dural tears is done to prevent the formation of CSF fistulas, pseudomeningoceles, and intradural infections.(18) In the case we presented oxidized regenerated cellulose and meticulous soft tissue closure was sufficient to prevent CSF leakage post-operatively. The neurological outcomes from penetrating spine injury other than those presenting with Brown Sequard syndrome, are worse than those of blunt injuries.(9) In Peacock's series, about half of the patients had Brown-Sequard syndrome, and two-thirds of them had a positive functional recovery.(10) This promising neurological recovery has been attributed to the neuronal plasticity of the spinal cord.(9)

In illustrating both the favourable outcome in incomplete penetrating spinal cord injuries as well as beneficial role of surgery in their management, the report by Manzone and colleagues comes to mind. They reported a 22-year old man who sustained a thoracic spinal cord stab injury with a concealed broken knife tip which was retained for several months before surgery; neurologic improvement was noted to be rapid after operative removal of the retained object. (19)

Nasser et al. reported a unique case in a 34-year old male, whose neurological status essentially improved post-operatively to ASIA E, from a pre-operative status of C, in spite of injuries caused by the ice pick fragment penetrating posteriorly through the spinal canal into the aorta.(20)

Rabiu and colleagues reported a case of C4 Brown-Sequard syndrome with the impaling object – a screw driver – in situ, who had some neurologic improvement post-surgery, but later died from unrelated causes.(8)

The absence of a similar favourable outcome in our patient was envisaged during the process of acquiring informed consent for surgery, and he was so counselled.

An understanding of the pathophysiological mechanism underlying this uncommon outcome was partly made difficult by the patient's failure to carry out post-operative spine MRI. Possibilities may include firstly, the mass effect from an intraspinal haematoma following release of the theoretical plugging effect by the weapon over vessels within the cord. Another possible mechanism probably

involved the artery of Adamkiewicz, considering the proximity of the injury to artery.(20) Indeed the artery of Adamkiewicz and the aorta are the most commonly injured vascular structures from NMPST.(12) It must be stated however that the loss of sacral root functions in the patient post-operatively did not support the second consideration because injury to the artery of Adamkiewicz usually presents with signs of thoracic watershed ischemia — paraplegia with relative sparing of the sacral roots.(21) .

CONCLUSION

This case reflects some of the difficulties encountered in an attempt to describe an unlikely outcome in a rare entity in a resource-poor setting. The reality of a worsened outcome following operative retrieval of a retained foreign body in the spine should be specifically brought to the fore in counselling patients needing intervention.

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