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EVALUATION OF OUTCOME OF PENETRATING SPINE INJURY, TERTIARY CARE CENTER

Neurosurgery

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ABSTRACT

Penetrating spine injuries are second most common spine injury after blunt trauma. Stab wounds and, gunshot wounds are two common types of penetrating injuries. Surgery has a significant role in penetrating spine injury in cases of cord transection, cord compression by foreign body/ bony and soft tissue fragment, bony instability and in CSF leak. Stab wounds have comparatively better prognosis. Moreover, surgery plays a much larger role. Retained foreign objects should be removed after a stab injury, whereas bullet fragments may be left in place if it is not causing any role in neurological compression. Penetrating spine injuries are the second leading cause of spinal cord injuries. There is high rate of complications in surgical intervention for penetrating spine injuries to the spine. Very few literatures are available showing data on Penetrating spine injuries to the spine in India. Approximately 38 cases over the last 3 years have been recorded, with unusual presentation and neurological recovery. We tried to fill this gap in data, by reviewing cases of Penetrating spine injuries to spine presenting at a tertiary care hospital. **Methods** A Retrospective cohort study, in which Patients of all ages who presented to the emergency department of IMS BHU, with Penetrating spine injuries between October 2019 and April 2022 were included in the study. Neurological examinations were done and data were collected. American Spinal Injury Association score (ASIA) was used for the initial and follow-up neurological assessment. Extent of cord transection, motor and sensory deficits were also recorded. The patients were grouped into patients with cord transaction and those with cord contusion with cord compression by foreign body or by bony and soft tissue fragment, CSF leak, and intact spinal cord and having fractures with bony instability. All patients were then followed and the outcomes were recorded. **Results** A total of 38 patients were identified. The mean ± SD of patients age was (30.9 ± 9.5) years. Of the 38patients with Penetrating spine injuries 36 were gunshot wounds, 2 had sharp weapon penetrating spinal cord injury.35 patients were managed surgically and conservative management done in 3 patients. The mean ± SD of follow-up was (8.7 ± 7.2) months. In our study, dorsal spine was the most commonly injured region. Of the 38 patients with medical imaging performed at our institute, 27 (71.05%) having cord contusion, 6(15.78%) were having cord compression by foreign body, 3(7.89%) were having bony instability without cord contusion and 2(5.26%) having CSF leak. **Conclusion** The prognosis of Penetrating spine injuries to the spine depends on whether the spinal cord is intact or transected and on presence of bony instability. Above inference will help healthcare providers to plan the further management of the patient and counsel them accordingly.

KEYWORDS

Hospital management, Cord transection, Prognostic predictors, Gunshot injury, Spinal trauma.

INTRODUCTION

After blunt trauma, Penetrating spinal injuries are second most common spine injury all over world. Gunshot wounds and stab wounds are two common types of penetrating injuries. Gunshot injury, which was previously predominant in military population, is now increasingly seen in civilian population [1]. According to de Barros Filho TE et al[2], The incidence of penetrating injuries to the spine has increased lately, and caused 13%–17% of all spine injuries. Although thoracic injuries are the most common following gunshot, cervical spine injuries may be the most destructive. The main prognostic factor considered for recovery is the initial neurological status [2, 3, 4, and 5]. Penetrating spine injuries are commonly stable in dorsal and lumber region. Instability may be present if bullet or sharp weapon passes transversely causing fractures of pedicles and facets along with damage to the spinal canal. The anatomical distribution of Penetrating spine injury shows that there is a predominant injury to the thoracic region contributing to 55.26% of all the cases followed by cervical spine in 36.84% and lumbosacral wounds in 15.78% (the least likely place in the observed patients). Injuries in the cervical spinal cord present with quadriparesis, Dorsal and lumbosacral group with Paraparesis. Bladder and Bowel involvement were present in 81.57% cases.

There is a wide spectrum of pathologies associated with Penetrating spine injury in the spinal cord which include complete myelopathy, incomplete injury, and bony instability and CSF leak. The complete myelopathy incurs a total loss of motor and sensory functions to the victim, whereas an incomplete spinal cord injury occurs when an injury survivor retains some motor and sensory functions below the site of the injury. In Spinal contusions there is bruise over spinal cord, often causing inflammation and bleeding from blood vessels near the site of injury. Marked variance in outcomes of spinal cord injuries was witnessed as a transition from World War I to World War II. Owing to the advancement in treatment of spinal trauma and better neurosurgical approaches, the mortality rate significantly declined [5, 6, and 7].

Firearm injury causes both direct or an indirect tissue injury as bullet traverses through tissue planes. The direct injury is the formation of a wound track which results in a tissue damage by edge of the advancing bullet. The injury may range from incomplete cord injury, complete cord injury. The wound track is a permanent cavitation with areas of irreversible tissue damage causing necrosis and sloughing, contributing to the formation of wound track. As opposed to direct injuries, indirect injuries are due to the cavitation wave effect and shock wave energies [3]. The authors were interested in understanding the prognostic factors and recovery outcomes in patients of Penetrating injury with Incomplete and Complete spinal cord injury. Are there any differences between the two cohorts? We aimed to evaluate the spectrum of presentation in patients who report to the IMS BHU Hospital with penetrating spine injury to the spinal cord and to assess the outcomes based on the type of intervention provided. The study also aimed to judge the consequences of complete cord transection *vs*. a partial or intact spinal cord.

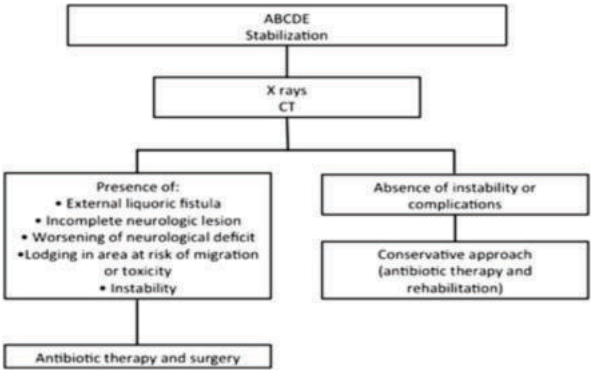
METHODS

This is an institutional retrospective study conducted at IMS BHU HOSPITAL VARANASI. A well set format was used to address the objectives of the study, including patient demographics such as the age, sex, the spinal level of gunshot injury, presentation in the emergency department, the emergency and definitive intervention provided and the outcomes were assessed. X ray and CT were used to assess bony injury. MRI was used only in few cases to assess the integrity of the spinal cord in cases of Spinal cord injury with no retained foreign body on Xray/CT. Furthermore, follow-up clinical notes were used to assess the therapeutic success or failure of the treatment provided. Data were analyzed and results were made showing neurological outcomes in patients with complete and incomplete spinal cord injury. Patients of all ages with gunshot injuries to spine presenting to the emergency department between OCTOBER 2019 and APRIL 2022 were included. Patients with incomplete records and unavailable radiological data were excluded. We used American Spinal Injury Association score for the assessment of neurological

status. Consequently, patients were divided into five subsets depending upon neurological status, respectively (A) Complete cord injury; (B) Intact sensory but impaired motor function; (C) More than half of key muscles below injury level have a power strength less than 3; (D) More than half of key muscles below injury level have a power strength more than 3, and (E) Normal motor and sensory function [12]. A second method based on X-Ray and computed tomography and imaging patients were classified into two groups: those with cord transection and intact spinal cord with bony injury.

Literature regarding penetrating spinal wound presents analysis of orthopedic military and neurosurgical experiences. The Literature concerning missile injury of spine reported better outcome in world war 2, as compared to world war 1 and thereafter. [8, 9, 10] This was possible because of Advance trauma support, proper understanding of Pathophysiology and biomechanics of the GSW, use of antibiotic and early surgery with advancement of micro-neurosurgical techniques.

Mortality in patients suffering from GSW increases with the severity of neurological deficit. [11] Management algorithm of penetrating spinal cord injury



Algorithm for the initial treatment of a patient with a gunshot wound in the spine, following the techniques of basic life support known as the 'ABCDE' (airway, breathing, circulation, disability and exposure).

RESULTS

Thirty Eight patients were involved in the study. The mean ± SD of patients age was (38.08 ± 9.09) years. In hospital, 3 of the patients were treated conservatively while 35 received surgical intervention. The most pertinent indication for surgery was to eliminate the risk of cord compression 31 (88.57%), followed by bony instability 3 (8.57%) and CSF leak 1 (2.85%). The in-patient stay, presented as mean ± SD was (16.4 ± 5.29) days in surgical group and 8 days in nonsurgical group. Both groups were followed upupto6 months. Most prevalent complications were bedsores of 10 patients (28.57%), chest infection in 6 (17.14%) followed by CSF leak of 1(2.85%). Among the patients who were treated conservatively, all of them were discharged without any mortality, whereas those who underwent surgical treatment, 3(8.57%) died primarily due to chest infection and Meningitis. A detail characteristic of all patients can be visualized in Table1.

Table 1 Demographic characteristic of patients in the study. (n = 38).

Variables	n (%)
Gender	
Male	28(73.68)
Female	10(26.31)
Region of gunshot	
Cervical	14 (36.84)
Thoracic	18(47.36)
Lumbosacral	6(15.78)
ASIA scoring	
A	20 (52.63)
B	9 (23.68)
C	6 (15.78)
D	0 (0)
E	3(7.89)
Sensory deficits	
Absent	20(52.63)
Present	18 (47.36)
Bowel impairment	
Present	31 (81.57)
Absent	7(18.42)
Bladder impairment	
Present	31 (81.57)
Absent	7 (18.42)

ASIA: American Spinal Injury Association.

A total of 20 (52.63%) patients were presented with complete cord injury. Of these 20 patients, 8 were quadriplegic and 12 (60%) were paraplegic.Patients of ASIA-A &B group 3 patients died during hospital stay. 20(76.92%) did not recovered during 6 month follow up, Only 6(23.07%)patients recovered upto power 2/5. Patients of ASIA-C group 5 (83.33%) patients recovered during 6 month follow up and 1 (16.66%) patient did not got improvement in power. Cervical spine has worst prognosis with 21.42% mortality. Cervical injury patients with complete cord injury only 1 (12.5%) got improvement in power up to 2/5. Cervical injury patients with incomplete cord injury only 1 (16.66%) got improvement in power up to 2/5 and rest 83.33% did not got improvement. Dorsal spine injury all patients were having complete cord injury only 22.22 % got improvement in power up to 2/5. Patients of Lumbar spine injury with 50% were presented with complete cord injury among whom 33.33% got improvement up to antigravity power.

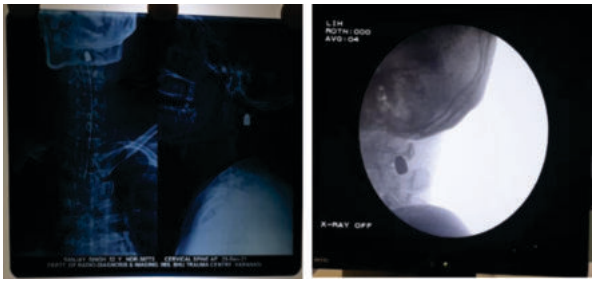


Fig.1: The Cervical spine injury within tradural bullet in situ showing cord compression at C1C2 level.

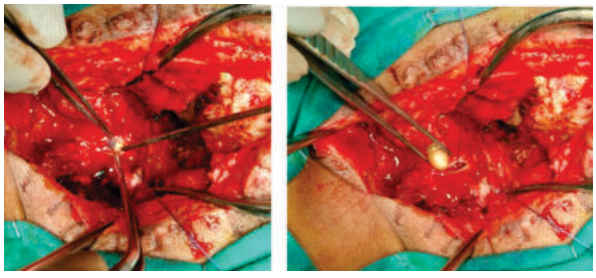


Fig.2: Intraoperative picture of Intradural Bullet extraction from C1C2 level

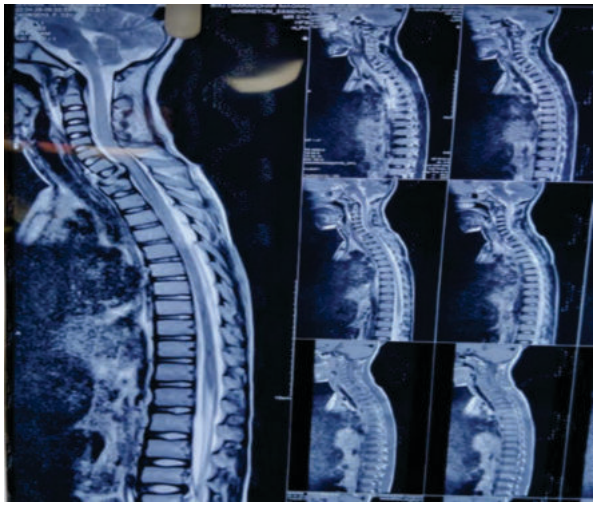


Fig.3: MRI showing Dorsal spinal cord injury with collapse of D1 vertebrae due to passage of bullet

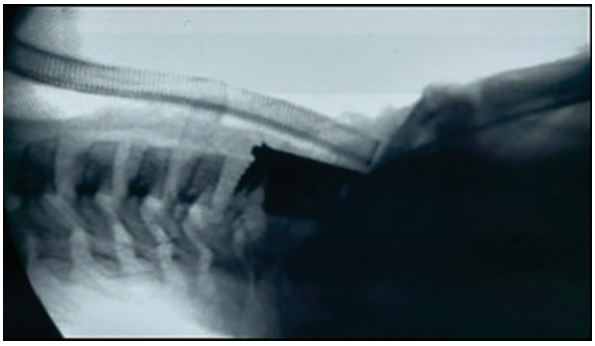


Fig. 4: Postop picture after D1 corpectomy and fixation with expandable cage and plate

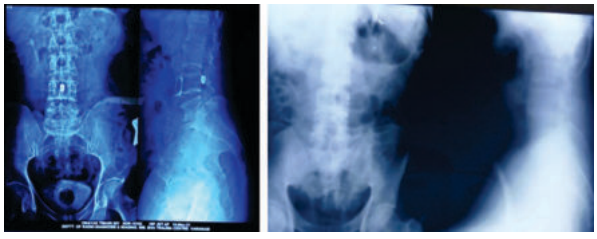


Fig.5: Preoperative Spinal cord injury with Bullet in situ and postoperative Xray after extraction of bullet

DISCUSSION

The management of penetrating spine injury is categorized into acute or initial treatment and definitive treatment. In the acute phase, the aim is mainly to provide advanced trauma life support.2 Neurological impairments of SCI can be precisely assessed after recovery from spinal shock (after 72hr of injury). Accordingly outcomes in patients of SCI are generally determined using ASIA scoring system at 72 hour after injury .Functional recovery depends upon whether the injury was complete or incomplete. Most of the Neurological recovery occurs during the first 3 months and it reaches a plateau by 6 months after injury. However, very marginal additional recovery can occur up to18 months post-SCIin selective cases. Predictors of Long term outcome in SCI are level of the injury, the severity of the primary injury and progression of secondary injury.

A cervical cord injury patient usually presents with Quadriplegia. Dorsal and Lumbar spine injury presents with paraplegia. Paraplegia is defined as the loss of sensory or motor function in lower extremities.Patients of Dorsal spine injury with complete paraplegia (ASIA A&B) only 22.22% developed power up to antigravity while patients of Lumbar spine injury with complete paraplegia 33.33 % recovered power up to antigravity. Patients of incomplete paraplegia have recovery of lower limb function up to level of 4/5, occurred in almost all patients and about half of patients regain their Bladder Bowel functions. Patients of Complete paraplegia, 76.19 % patients did not show recovery in their locomotor and Bladder Bowel function.Quadriplegia is defined as partial or total loss of sensory or motor function in all four limbs. Patients with incomplete quadriplegia will gain better recovery than complete quadri- and paraplegia). Patients generally reach a plateau of recovery within 9–12 months after injury. Recovery of some motor function within the 3 to 4 weeks after the injury is associated with a better neurological function. Moreover, appearance of muscle flicker (a series of local involuntary muscle contractions) in the lower extremities is highly associated with recovery of function. 27.58% of Quadriplegic patients regain function at one level below the injury. Initial Muscle power is an important predictor of functional recovery in these patients. Complete Quadriplegic patients with cervical SCI can regain antigravity muscle function in 27.58%. However, recovery of power to antigravity muscle strength at one caudal level below the injury increases to 66.66% in patients with incomplete cord injury.

An association between sensory and motor recovery has been demonstrated in SCI where spontaneous sensory recovery usually follows the pattern of motor recovery. Patients of incomplete spine injury with preserved pain temperature sensory function found to have better recovery of motor functions 62.5% as compared to patients with lost pain temperature sensation 37.5%. There is no difference in recovery of patients with complete spinal cord injury having lost or preserved pain temperature sensations. Maintenance of pinprick sensation at the zone of partial preservation or in sacral segments has been shown as a reliable predictor of motor recovery One proposed reason for this association is that pinprick fibers in lateral spinothalamic tract travel in proximity of motor fibers in the lateral corticospinal tract, and thus, preservation of sensory fibers can be an indicator of the integrity of motor fiber. Diagnosis of an incomplete injury is of great importance and failure to detect sensory preservation at sacral segments results in an inaccurate assessment of prognosis.

CONCLUSION

Penetrating spine injuries are second most common spine injury after blunt trauma. Stab wounds and, gunshot wounds are two common types of penetrating injuries. Surgery has a significant role in penetrating spine injury in cases of cord transection, cord compression by foreign body/ bony and soft tissue fragment, bony instability and in CSF leak. Stab wounds have comparatively better prognosis. Preoperative neurological status is the most valuable predictor of patients outcome. Patients with incomplete cord injury with preserved sensory functions have better postoperative recovery as compared to complete spinal cord injury.

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