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Gunshot Injury with Intraspinal Intradural Location of a Bullet

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Abstract: ***Gunshot injury to the spine which was earlier common in the military population is now being increasingly noted in civilians due to either license or illegal firearms with an increased rate of violence in the society. Gunshot wound (GSW) to the spine contributing to 13% to 17% of all spinal injuries, the management still complex and controversial. Surgery indicated in progressive neurological deterioration with complete/incomplete spinal cord injury and with associated other major organ injuries requiring immediate surgery. We represent a case of a 34 yr old man with a gunshot injury in the abdomen without an exit wound. He was paraplegic with right haemothorax and penetrating gunshot injury with a bullet at the level of l3 l4 lumbar spine on radiological examination. Patient underwent surgical removal of bullet and is in follow up since then.***

Keywords: gunshot injury, deficit, spinal injury, complications

1. Introduction

Spinal gunshot wound (GSW) is a devastating event with severe morbidity and sometimes mortality. Spinal gunshot wound was once common in the military population but now increasingly prevalent in civilians due to easy availability of firearms that are either licensed or illegal. It contributes to 13% to 17% of spinal injuries [1]. GSW spine is the third most common cause of spine injuries after road traffic accidents (38.6%) and falls (22.9%) [2]. This injury is commonly related to criminal or violent activities and predominantly among the young male population [3]. The thoracic spine is the most commonly involved level (51.8%), followed by lumbar spine (28.9%) & the cervical spine (19.3%) [4]. The location of the lesion determines the neurological deficit, with complete spinal cord injury most prevalent in the thoracic spine (70%) [4, 5]. Bullet trajectory is also closely related to neurological outcomes, with paralysis higher in patients with retained intraspinal bullet fragments [6]. Patients may be also present years later with the development of neurological deficit as the result of bullet migration in the spinal canal. A penetrating bullet generally follows a straight trajectory in the body. It may either exit the body or trap inside a tissue. The incidence of gunshot injury that perforates and traps within the spinal canal is quite low and rarely reported in the literature [7, 8]. Spinal cord injury caused by GSWs remains a controversial topic. The most recent literature on the subject advocates conservative management because of the lack of evidence showing that surgical intervention improves outcomes and associates with higher complication rate. Herein we present a case of a patient with Gunshot Injury causing cauda equina symptoms at L3 L4 spinal vertebra level with abdominal and thoracic injury.

2. Case Report

Pre - op course:
A 34 yr male presented to the emergency department with h/o assault injury with firearm. On admission he had chest pain, shortness of breathing with the entrance wound of bullet at rt side upper quadrant region, without exit wound. He was in altered sensorium with BP 100/70 mmHg, heart rate 110/min, saturation 94%. Vital signs were consistent with hypovolemic shock. The neurological examination could not be assessed correctly because of his low level of consciousness (GCS 8/15). Due to his poor general medical condition and unstable vital signs, radiological examination (x- ray/ CT scans) was not done. So, after primary resuscitation, he underwent an emergent exploratory laparotomy. After the operation he was intubated and kept on mechanical ventilation for 2 days. During this period, the ICU team was not aware of spinal trauma.

After extubation and stabilization of the patient, clinical examination was done & found that he was paraplegic with complete loss of sensation below the T6 spinal segment. On lumbar x - ray (fig. - 1), the bullet was seen lodged at the level of L5 level. A CT Scan spine (axial & sagittal cut) showed a bullet was retained in the spinal canal at the level of L5 (fig - 2). A decision was made to proceed with operative management.

Figure 1: Plain x - ray of L - S spine

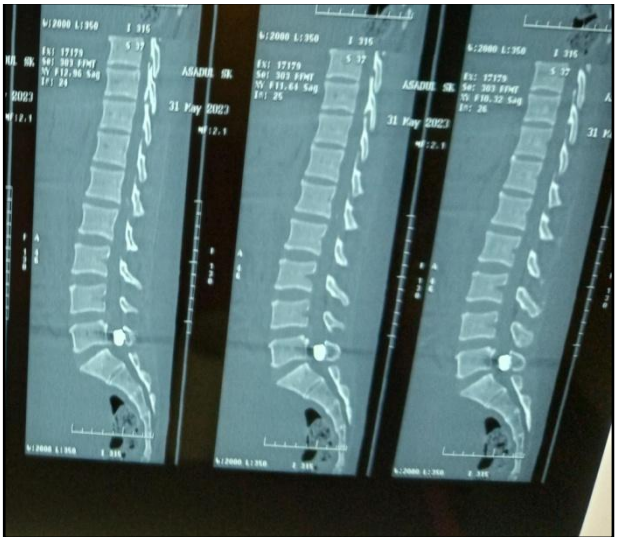

Figure 2 (a): Ct section showing bullet at l5 level shows location of the bullet

Figure 2 (b): CT Scan of L - S Spine

Operative Course:
Post midline incision made from L3 to S1 done. Subperiosteal dissertation was done to expose lamina of L5. Bullet was found to be Intradural. So, the durotomy was done but after the durotomy the bullet was not found. The position of the bullet was confirmed at L4 with lateral fluoroscopy (fig - 3), suggesting migration of the bullet in cranial direction. So, L4 laminectomy was also done and durotomy was also extended. And the bullet was found Intradural (fig - 4). And removed and the area was irrigated with saline. Dural closure done by non - absorbable (silk 4 - 0) (fig - 5). The dural repair was subsequently reinforced with DuraGen. Further irrigation was given and closure done in standard fashion with sub muscular plane drain placed.

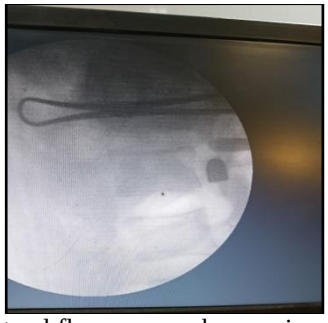

Figure 3: Lateral fluoroscopy shows migration of bullet

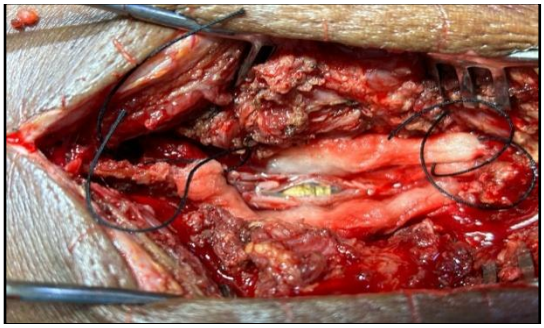

Figure 4: Intradural Location of bullet

Post - op course
After 2 days the drain was removed as no CSF was found in the drain and no soakage from the operative site. After 3 days of post OP, the patient noted improvement in sensory but not in power. However, bladder symptoms did not improve so the catheter was kept in situ. Gradually the patient developed a bedsore which was managed conservatively. Patient has been discharged and is in close follow up.

3. Discussion

Gunshot injuries to the spine are associated with an incidence of paralysis with complete sensory motor loss of function in 73% of cases [9]. The prognosis for subsequent improvement in neurological function is worse following gunshot injuries than for motor vehicle accidents or stab victims [10]. In the thoracic spine, the canal/cord ratio is less than that of the lumbar spine and cervical spine so the bullet is more destructive in the thoracic region than in other spine levels [11]. It can result in varying degrees of severe and structural neurological deficit including radiculopathy, paralysis, infection depending on the site of the bullet impact [8]. Bullet can cause significant damage to the surrounding tissue along the trajectory due to dispersion of both thermal and kinetic injury which include laceration, penetration, crushing, contusion and a temporary cavity for a shorter term.

Gunshot injuries to the spine can cause temporary or permanent damage to the spinal cord, in the literature, 49 - 83% had a complete injury, 12 - 43% had an incomplete injury & 17 - 20% had cauda equina injury due to gunshot injury to spine [12 - 14]. The prognostic factors can broadly be classified as mechanical and biological [8]. There is a major difference between military and civilian population gunshot injury to the spine as firearm used in this two population group are categorized according to energy and velocity [15] & the type of projectile are also vary with the type of fire varying, from multiple palettes from a shotgun bullet to a single bullet from a rifle. The weapons with velocity lower than 457.2 m/s called low - energy bullets cause direct injuries, whereas those with a velocity higher than 609.6 m/s called high - energy bullets cause both direct & indirect injuries (due to shock wave & cavitation wave). The size of the bullet also matters in the amount of kinetic energy and momentum that it is carrying and in the degree of tissue loss it can produce at the target site. Gunshot injuries in the spine are generally biomechanically stable [16]. If a bullet breaks pedicle or facet while traversing, it

can cause acute or chronic instability [15]. If the pedicle or facet is intact, no spinal instability is observed. The thoracic vertebra has a stable mechanical structure maintained by the costo - vertebral joints and the thoracic cage. However, the cervical and lumbar spine are more prone to biomechanical instability. Gunshot injury to the spine is also associated with hollow viscus and lung injury which increases mortality and morbidity of the patients [7].

Acute infective complication of gunshot injury to spine due to spinal abscess, empyema, subcutaneous & psoas abscess, bullet tract infection, CSF leak due to dural tear & impending risk of meningitis that determines the prognosis following surgery and morbidity of patients [17]. While arachnoiditis, a pain syndrome in lower limb, delayed neurological deficit due to retained intraspinal bullets, long - term copper and lead toxicity of bullets are chronic complications seen in gunshot injury to spine. Septic complications are also common in gunshot injury to spine & lumbar spine is a common site followed by the thoracic and the cervical spines [18]. The incidence of septic complications in lumbar spine injuries is highest because bullets often pass through the gastrointestinal tract [19]. Such contaminated bullets increase the risk of osteomyelitis when it is associated with vertebral body injury. Romanick et al. [20], in a study of 20 patients, urged early removal of the bullet to prevent complications particularly associated with abdominal penetrating injury to the abdomen.

Intraspinal gunshot injury and consequently damage are difficult to assess only with symptoms. Further radiological techniques should be employed to better identify the damage. The radiological examination, usually with direct x - ray (ap, lateral view) and non contrast ct scan, is used to locate the bullet and detect bone fractures or fragments [23]. Use of MRI to evaluate spinal cord injury with soft tissue damage in gunshot injury to the spine is stated as a relatively contraindicated due to the possibility of bullet migration with a strong magnetic attraction, which may cause more soft tissue or neurological damage in GSIs [24]. Todnem et al. [13] used MRI for an intra spinal bullet and showed that the MRI could be safely used in GSIs with bullets from low - speed firearms where the bullet was coated with non - ferromagnetic metals such as copper. However, this does not apply to high - speed firearm bullet injury.

Management & treatment of gunshot injury to the spine, continue to be a controversial topic. Some authors advocate conservative management while others advocate surgery. Despite the absence of clear guidance for surgery, there are some indications like presence of persistent CSF fistula and infection, progressive neurological deterioration with intraspinal blood bullet or bone fragments, bullet migration, vertebral instability and cauda equina syndrome [25 - 29]. Even if GSI is asymptomatic initially, it causes a robust fibrotic reaction and becomes symptomatic within a few years. On the other hand, many authors recommended surgical removal of a bullet due to risk of lead intoxication or contact of a copper - jacketed bullet destroying the axons and myelin, and causing a significant amount of gliosis in the spinal cord tissue [30]. Spinal cord necrosis around copper fragments implanted within the dura was shown in animal studies [31]. It is also reported that effects of metal corrosion in CSF may be the same in the brain due to migration through this spinal canal [32].

Surgical removal of an intraspinal bullet may be further complicated by positional migration, is most frequently caudal in nature because of gravity as well as CSF recirculation and respiration mechanics [28]. Cephalad migration from the lumbosacral spine is limited because of conus medullaris and anatomical narrowing of the spinal canal at the level of T10 [33]. However increased lumbar lordosis may allow cranial migration, which can occur during patient positioning or intraoperatively [28]. Therefore, preoperative and intraoperative imaging is essential to ensure the correct spinal level [33, 34]. Bullet migration can be used to the advantage of the surgeon by, during surgery placing patient in upright or in the reverse Trendelenburg's position [34] can encourage caudal migration of the bullet, permitting relatively safer surgical excision. Since the bullet is moving inside the dural sac, a strategy has to be used in order to trap it first than remove it; otherwise, minimal manipulation with instruments might cause cranial migration of the bullet and unnecessary extension of laminectomy and/or durotomy.

4. Conclusion

A GSI to the spine is a complex injury, can cause complete to incomplete spinal cord damage and its treatment remains a controversial topic from conservative to surgery. Management of GSI to the spine includes thorough neurological examination and diagnostic imaging to identify exact location of bullet, neural injury and associate hollow viscus and lung injury. However, the decision to perform surgery depends on: neurologic status, spinal instability, bullet location and injury level along with other damage. Decompression and removal of the bullet at L1 and below may improve symptoms. Regardless of injury level, new onset or progressive neurological deterioration due to retained or migration of bullet is an indication for urgent decompression. However there is a continued need for well studied protocols that are specific to spinal GSIs to simplify treatment decisions and further improve the standard of care.

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