

CASE REPORT



# Dual lesion spinal cord injury in a polytrauma patient: a case report

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**INTRODUCTION:** Dual lesion spinal cord injury (SCI) is the presence of two distinct regions of injury to the spinal cord, which can occur simultaneously or as a sequela of initial injury. Dual lesion SCI appears to be a rather rare occurrence with a paucity of cases described. As such, there is limited information available regarding presentation, evaluation, long-term rehabilitation management, and prognostication of these patients.

**CASE PRESENTATION:** Presented is a case of a 25-year-old woman with a gunshot wound injury to the T5 vertebra with associated cord damage, initially classified as T6 ASIA Impairment Scale (AIS) B. A subsequent cervical spinal stroke, in the setting of cord edema, resulted in a motor incomplete cervical SCI. As such, she underwent additional functional decline.

**DISCUSSION:** Patients with dual lesion SCI present with unique challenges in evaluation and management. This case highlights key factors for the acute care and rehabilitation teams to consider when addressing these challenges.

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## INTRODUCTION

Motor vehicle collisions (MVC), falls, and gunshot wounds (GSW) represent the most common etiologies of traumatic SCI (TSCI) [1]. In general, the acute assessment of TSCI patients is performed by emergency medicine and trauma surgery teams, and often leads to consultation of neurosurgery or orthopedic spine teams. These teams evaluate for operative versus nonoperative management. The spinal cord injury (SCI) rehabilitation team is often consulted in the acute setting for medical management recommendations and functional prognostication. As per SCI guidelines, repeated American Spinal Injury Association (ASIA) examinations are performed to designate a neurologic level of injury and ASIA Impairment Scale (AIS).

This case report details the hospital course of a patient with a dual lesion SCI, found on repeat ASIA examination, who initially presented with a single SCI. Dual lesion, “double-crush”, or double SCI is the presence of two distinct regions of injury to the spinal cord. This appears to be rare, with only a handful of published case reports [2–8]. Dual lesion SCI is thought to occur at time of initial injury or as an acute sequela of the initial injury and can involve both traumatic and nontraumatic etiologies. Dual lesion SCI presents unique challenges compared to single level SCI, as subsequently discussed.

## CASE PRESENTATION

A 25-year-old female was admitted to the intensive care unit (ICU) of a level one trauma, tertiary care hospital after sustaining a GSW passing from the right shoulder into the thorax and spine. She sustained a right proximal humeral fracture, right coracoid process fracture, multiple rib fractures, a lung injury, and a pneumothorax.

Additionally, she was 33 weeks pregnant, resulting in the obstetrics team performing an emergent caesarian section in conjunction with the trauma surgery team performing a right-sided thoracotomy and exploratory laparotomy. During her ICU stay she further underwent (at varying times) placement of chest tubes, right upper lobe lung resection, and open reduction, internal fixation (ORIF) of her right humerus.

During the initial evaluation she was only able to move her upper extremities and had diminished sensation below the mid-thorax. Imaging showed the bullet had lodged near the fifth thoracic vertebra (Fig. 1). Neurosurgery advised against surgical intervention. Initial ASIA examination designated a T5 AIS A paraplegia. Specifically, she had 0 out of 5 strength on manual muscle testing of key muscles at L2, L3, L4, L5, and S1. Sensation was absent below T5. Voluntary anal contraction was absent. Repeat examination 2 days later demonstrated T6 AIS B paraplegia. Light touch was 1 out of 2 from T6 down through the left lower extremity but was completely absent in the right lower extremity. There was some sensory preservation in the most caudal segments.

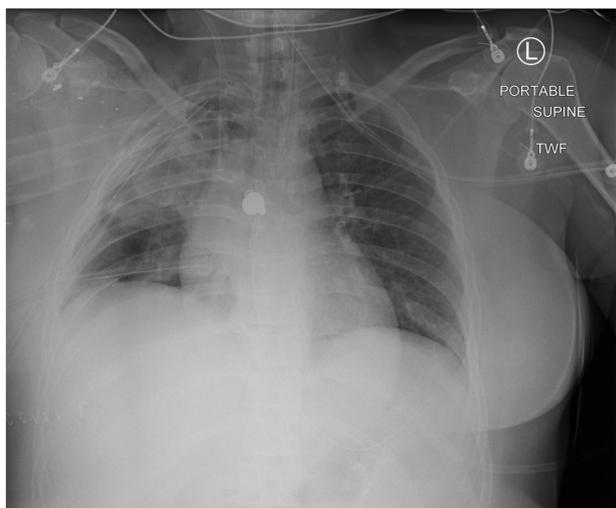
Three days after admission, the patient developed fevers, leukocytosis, and new (right greater than left) upper extremity weakness and paresthesias. The patient was empirically started on antibiotics for suspected infectious meningitis. A lumbar puncture was performed, and the consulting neurology team indicated the differential included infectious meningitis as well as a noninfectious inflammatory process. During this period repeat ASIA examination revealed C4 AIS A tetraplegia.

Cervical magnetic resonance imaging (MRI) detected diffuse cord edema from the base of the skull to the C7 vertebral level. Further, there was evidence of posterior spinal cord core infarct at

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**Fig. 1 Lodged bullet on chest x-ray.** Initial radiographs demonstrating bullet lodged adjacent to T5 vertebra.



**Fig. 2 Cord edema and infarct.** Cervical MRI demonstrating cervical cord edema and C1–C2 core infarct.

C1–C2 (Fig. 2). Subsequent spinal arteriogram demonstrated an occlusion of the right T5 radicular artery, without findings of any traumatic dural arteriovenous fistulae or other vascular malformation. It was concluded that the post-traumatic spinal cord edema was the etiology of the spinal stroke and the patient was started on aspirin.

The patient's upper extremity weakness and paresthesias stabilized and slight functional improvement was noted over time. The patient was transferred to the SCI rehabilitation unit given the non-weight bearing status of the right upper extremity (status post ORIF) in the setting of an incomplete C4 upper extremity paresis and the complete paraplegia now noted below T2. An interdisciplinary team recommended short-term goals to provide relevant SCI education, initiate family training, improve function in activities of daily living, and provide durable medical equipment. After a short inpatient rehabilitation stay, she was discharged home with home health, skilled nursing, physical therapy, and occupational therapy, with plans for future

readmission for intensive inpatient SCI rehabilitation once her right upper extremity weight bearing status was advanced with Orthopedics. She was seen in a post discharge SCI outpatient visit, where this plan was further solidified.

## DISCUSSION

Polytraumatic injuries to the nervous system are not uncommon. Physiatrists treat patients with dual traumatic brain injury and SCI, double-crush syndrome of a peripheral nerve, and SCI with an associated root avulsion. Cases of dual lesion SCI, however, are scarce based upon review of rehabilitation literature. One of the few cases in American literature documents the hospital course of a polytrauma patient with complete T5 injury, in which it was subsequently discovered that the patient also had an incomplete C7 injury, with upper extremity weakness initially attributed to wrist fractures [2].

Other literature notes a patient with ankylosing spondylitis who presented with cauda equina syndrome after a fall leading to L2, L3 vertebral fractures. This patient then developed complete T9 paraplegia after hypotension and subsequent cardiac arrest upon arrival to the emergency room. Ischemic changes around T9 and traumatic changes around L2–L3 were ultimately found on MRI [3]. Another case reports a SCI without radiographic abnormality (SCIWORA) in a young child after a presumed MVC. The MRI demonstrated near complete and complete transection at the level of the T3–4 and T6–7 vertebrae, respectively [4]. Additional literature notes cases of double noncontiguous three-column vertebral injuries (leading to “floating spine” segments) that were likely associated with dual lesion SCI given the mechanism of injury [5–8]. For example, one of these patients developed an incomplete SCI at C7 and a complete SCI at T4 with three-column injuries at each level [6].

## Take away points

The importance of frequent and thorough neurologic examinations, specifically the ASIA examination, cannot be overlooked in acute TSCI patients. In general, ASIA examinations are key in establishing a neurologic baseline in the acute setting, monitoring for improvement during rehabilitation, and prognosticating neurological and functional outcomes. In acute TSCI patients, however, worsening on the ASIA examination can suggest an undiscovered or evolving SCI.

Further, it is critical to maintain a high suspicion for missed or worsening processes. Acute polytrauma patients can have several life-threatening injuries that may mask or supersede examination and evaluation of other injuries. Frequent reexamination may demonstrate acute neurologic decline. In TSCI patients, vascular insufficiency, infection, cord edema, and unaddressed spinal instability are proposed as some possible etiologies of ongoing or subsequent evolution of TSCI. Based on existing case reports, it may be reasonable to consider a lower threshold of suspicion for patients who are potentially at greater risk for dual lesion SCI, such as polytrauma patients who are children, elderly, and those with special disease states impairing spinal biomechanics (such as ankylosing spondylitis [3], Klippel-Feil syndrome [9], or trauma patients with double three-column vertebral injury [5–8]) that would be implicated in promoting spinal instability [10].

Next, there are limited dual SCI cases and consequently limited evaluation and management guidelines. For example, the classification of such patients is not standardized—does the AIS classification simply change (such as from T6 AIS B to C4 AIS A for the patient presented) with an evolving injury? For patients with two clear sites of SCI on initial presentation, need one mention the more caudal site of injury or only use the more cephalad injury for classification? Kirschblum et al. tackled these questions by proposing a more descriptive characterization of the patient's neurologic status instead of a single unifying AIS designation [11].

In the case presented, C4 AIS A tetraplegia does not accurately describe the existence of an “incomplete” cervical upper extremity paresis and the “complete” thoracic lower extremity paraplegia. Based on precedence from Kirschblum et al. subsequent rehabilitation documentation described this patient as having both an incomplete C4 level injury and a complete T2 injury, instead of a single AIS designation, to provide a more accurate assessment of the patient’s neurologic function [11].

Lastly, management of these patients presents unique challenges. Two distinct neurological levels of injury could lead to different potentials for neurological and functional outcomes. Some patients, such as the patient presented, may have other ongoing impairments given the devastating nature of the mechanism of injury that make it infeasible to immediately transition to acute rehabilitation after an acute stay. Instead, a uniquely crafted long-term rehabilitation plan that may require outpatient or home rehabilitation initially, followed by an inpatient rehabilitation admission, may be more feasible for some.

## CONCLUSIONS

While rare, dual lesion SCI can occur, at the time of initial injury as well as later in the acute course as a sequela of the initial injury. With acute TSCI patients, repeated examinations and a low threshold for repeat diagnostic workup is critical to detect new or evolving processes. Evaluation and management of dual lesion SCI patients pose unique challenges to the physiatrist, however proper planning with the interdisciplinary team can lead to appropriate functional goals and gains as with any other SCI patient.

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## AUTHOR CONTRIBUTIONS

Each of the named authors contributed significantly to the production of this report.

## COMPETING INTERESTS

The authors declare no competing interests.

## ADDITIONAL INFORMATION

**Supplementary information** The online version contains supplementary material available at <https://doi.org/10.1038/s41394-021-00455-w>.

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