


Spinal Cord Injury in the Geriatric Population: Risk Factors, Treatment Options, and Long-Term Management

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Abstract

Spinal cord injuries (SCIs) are sustained by more than 12 500 patients per year in the United States and more globally. The SCIs disproportionately affect the elderly, especially men. Approximately 60% of these injuries are sustained traumatically through falls, but nontraumatic causes including infections, tumors, and medication-related epidural bleeding have also been documented. Preexisting conditions such as ankylosing spondylitis and diffuse idiopathic skeletal hyperostosis can render the spine stiff and are risk factors as well as cervical spondylosis and ensuing cervical stenosis. Treatment options vary depending on the severity, location, and complexity of the injury. Surgical management has been growing in popularity over the years and remains an option as it helps reduce spinal cord compression and alleviate pain. Elevating mean arterial pressures to prevent spinal cord ischemia and avoiding the second hit of SCI have become more common as opposed to high dose steroids. Ongoing clinical trials with pharmacological agents such as minocycline and riluzole have shown early, promising results in their ability to reduce cellular damage and facilitate recovery. Though SCI can be life changing, the available treatment options have aimed to reduce pain and minimize complications and maintain quality of life alongside rehabilitative services.

Keywords

geriatric medicine, geriatric trauma, physical therapy, spine surgery, spinal cord injury

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Introduction

In industrialized nations, the increase in life span over the last 50 years underscores the advancements in medicine, technology, and health care. Concurrently, longer life spans are associated with an increased prevalence of both chronic and acute illnesses and subsequently increased health-care costs.¹ Spinal cord injuries (SCIs) contribute to age-related functional decline and normally exacerbate preexisting conditions.² Individuals belonging to 65 years and older population have shown increased susceptibility to SCIs, adding to the list of complications commonly seen with this age group such as osteoporosis, diabetes, heart disease, and pulmonary disease.^{2,3} Currently, over 200 000 people live with SCIs in the United States.

In the geriatric population, the majority of SCIs are of traumatic origin.⁴ The most common cause of trauma-related SCIs is falls, accounting for 60% of all cases. The second leading cause is transportation accidents, seen in 24% of injuries. Finally, 12% of SCIs are attributed to medically or surgery-related complications.^{4,5} The overall age-related decline in muscle mass and musculoskeletal strength is an important risk

factor and contributor to falls, which increases the risk of sustaining debilitating injuries.⁵

Although most SCIs in the elderly patients are sustained traumatically, nontraumatic SCI can be precipitated by tumors, infections,⁶ genetic predisposition (ossification of the posterior longitudinal ligament),⁶ and medications (blood thinners causing epidural hematoma).^{6,7} Preexisting hyperostotic conditions such as ankylosing spondylitis and diffuse idiopathic skeletal hyperostosis (DISH) can render the spine highly unstable following a minor fall.⁸ Treating SCIs can be complicated by the presence of comorbid conditions. However, traumatic injuries are typically treated surgically.⁹ Often times, decompression is

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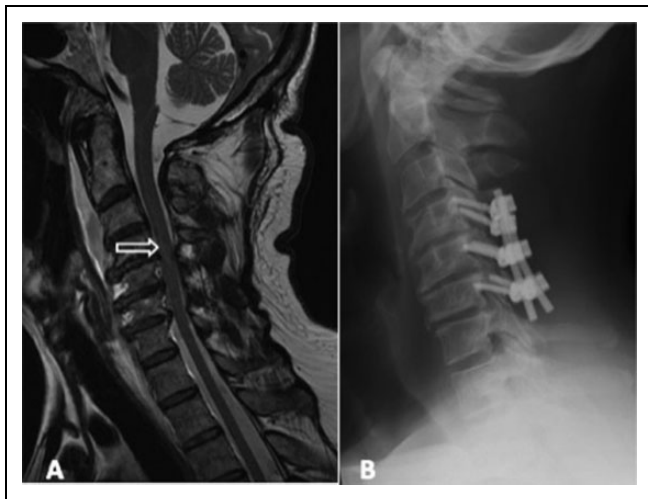


Figure 1. A 65-year-old male who fell down from a flight of stairs sustained a central cord syndrome. A, Sagittal T2 weight magnetic resonance imaging (MRI) demonstrating cervical stenosis and cord signal change (arrow). B, Lateral radiograph demonstrating the C4 to C6 posterior spinal fusion and laminectomy. The patient underwent for the management of his incomplete spinal cord injuries (SCI).

performed followed by stabilization with instrumentation. A recent multicenter study has clearly demonstrated the role of early decompression (<24 hours) and subsequent improvement in motor function following cervical SCI.¹⁰ Nonoperative management is reserved for patients with medical comorbidities that can lead to intraoperative mortality. Mild central cord syndrome may also be treated nonoperatively with either corticosteroids or elevating the patient's mean arterial pressure (MAP) to 85 mm Hg and higher. However, nationally there is an increasing trend for surgical management of central cord syndrome (Figure 1).¹¹

Long-term management of SCIs involves rehabilitation and exercise with the goal of improving functionality and reducing pain. The extent of SCI, complete versus incomplete, and American Spinal Injury Association grade is also a determinant of how much motor or sensory improvement the patient can expect.¹² However, the literature regarding the efficacy of rehabilitation following an SCI is inconclusive regarding functional outcomes.¹³

Risk Factors for SCIs

There are certain risk factors that predispose some individuals to SCIs more than others. Gender, age, risky behavior, and preexisting conditions are risk factors that increase the chances of sustaining an injury.⁵ Men, disproportionately more than women, sustain SCIs 80% of the time.¹⁴ Regarding age, there is a bimodal distribution. Males aged between 16 and 30 years, and older than 65 years, are at a high risk of sustaining SCIs although for different reasons.^{4,14} In the 16- to 30-year age group, individuals are more likely to suffer from motor vehicle accidents. Falling is the second leading cause of sustaining SCIs overall (22%), but it is the leading cause in the 65 and older group (60%).¹⁴

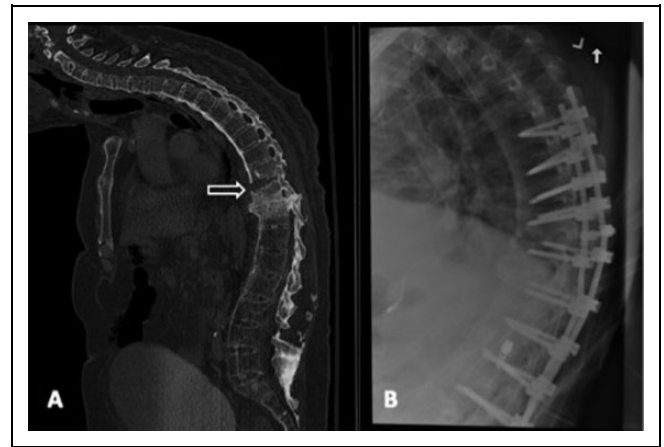


Figure 2. A 71-year-old male with ankylosing spondylitis who sustained a ground-level fall resulting in T9 to T10 hyperextension fracture and complete spinal cord injury. A, Sagittal computed tomography demonstrating the T9 to T10 hyperextension fracture (arrow). B, Lateral thoracic radiograph demonstrating the operative management consisting of T6 to L2 posterior spinal fusion.

Risky behavior includes not using the right equipment for certain activities, engaging in dangerous habits (ie, driving without seatbelts, drinking and driving), and use of illicit substances.^{4,8,14} Sports and recreation account for nearly 8% of SCIs.^{8,14} For example, elderly cyclists who ride without helmets have an increased risk of sustaining debilitating injuries, including SCIs. Acts of violence account for almost 15% of SCIs.^{8,14}

Preexisting musculoskeletal anomalies can contribute to the development of SCIs especially in elderly individuals. Degenerative changes can result in stenosis of the spinal canal, which in some cases can be superimposed on preexisting congenital stenosis. The narrowing of the spinal canal minimizes space for the spinal cord making it susceptible to injury following a fall or car accident especially if the neck is hyperextended.¹⁵ Hyperostotic spine conditions including ankylosing spondylitis and DISH render the spine highly unstable after minor and often lead to a complete or incomplete SCI (Figure 2).

Treatment Options and Current Treatment Trends

The lack of "specific" treatment for SCI adds to the growing list of frustrations experienced by affected patients. However, this continues to remain an active area of research. In 2016, the National Institute of Health allocated US\$86 million toward SCI research, an increase of US\$2 million over the past 2 years.¹⁶ Spinal cord injury can be classified as either complete or incomplete.^{1-7,9-13} Complete SCI involves loss of control of motor, sensory, bowel, and bladder functions below site of injury. Incomplete is albeit less severe encompasses a wide spectrum ranging from sensation in the bowel region only to motor function to the point of ambulating with an assistive device.^{4-7,9-15} The most important goal of the treatment is to take pressure off the spinal cord and avoid the second hit that can ensue following SCI. High-dose corticosteroids for SCI are

less commonly used and elevation of the MAP (≥ 85 mm Hg) is becoming more common for up to 5 to 7 days postoperative.¹⁷

Treatment therefore is patient specific and needs to account for the nature of injury. For example, some injuries may involve the stretching of a single nerve, multiple nerves, or the complete transection of the spinal cord.¹⁸ Polytrauma whereby the patient has sustained multiorgan injuries including an SCI need to be addressed in a multidisciplinary manner. Rehabilitative, pharmacologic, and surgical interventions are used, often times combined to obtain optimal patient outcomes.^{18,19}

Prompt surgical management of SCI (within 24 hours) has increased significantly in the past few years and has been shown to be both beneficial and effective in alleviating pain and reducing spinal cord compression.^{10,11} Decompression and fusion techniques, among other techniques, are used to treat SCI based on the location of injury.¹¹ In elderly patients with significant comorbidities, however, the benefit of surgical intervention must be weighed against the risk of mortality or prolonged intubation.¹¹

In addition to these conventional approaches, current research in SCI treatment include stem cell therapies—though controversial—which helps regenerate nerves and restores functionality. Polyunsaturated fatty acids have been shown to protect the spinal cord during acute phase injury, which in turn facilitates restoration.¹⁸ Nonbiological approaches include the use of functional electrical stimulation, which utilizes electrical stimulation to control arms and legs.¹⁸ Furthermore, there are ongoing clinical trials that include the use of minocycline—a tetracycline antibiotic shown to decrease pro-inflammatory cytokines in a phase II clinical study, thereby decreasing lesion sizes and neuronal loss.²⁰ Riluzole (a sodium channel blocker) has also shown promising results in reducing motor neuron loss in SCI injuries and improving recovery. It is currently in phase III clinical trials.^{20,21} There is also ongoing research on therapeutic hypothermia for the management of acute SCI.²²

Long-Term Complications of SCI

Long-term complications of SCI depend on the nature of the injury. Traumatic injuries usually have worse complications and outcomes.^{23,24} Long-term (chronic) complications often develop from acute problems, which include neurogenic shock, cardiovascular problems (stroke and heart disease), dysphagia, respiratory complications, autonomic dysfunction, and thromboembolism.^{23,24} These acute problems often translate into chronic issues and often require longer hospital admissions to better stabilize the patient. Chronic problems include bladder and bowel dysfunction, pain syndrome, pressure ulcers, osteoporosis and bone fractures, musculoskeletal and metabolic complications, and thromboembolic disease (ie, deep vein thrombosis and pulmonary embolism).^{23,24}

Rehabilitation

Rehabilitation is an important component of the treatment approach for patients with SCI. Acute inpatient rehabilitation

in a center with experience with SCI is ideal. Having a dedicated psychologist or psychiatrist who can assist with depression and coping is critical.²⁵ On the outpatient basis, a multidisciplinary approach including physical and occupational therapy, physical medicine and rehabilitation, urology, wound care, spine surgeon, and primary care is critical. Usually an SCI clinic is operated by specialists trained in spinal cord medicine. Patients with incomplete SCIs benefit most from rehabilitation as they retain some level of motor functionality.²⁶ The process can take months and even years to help patients regain strength. Concurrently, the medical cost for treatment is proportionately high as well.²⁷

Conclusion

Spinal cord injury is devastating to the geriatric patient and associated with high health-care costs. Patients who sustain SCIs can benefit from surgical intervention depending on the nature of injury as well as acute and long-term rehabilitation and pharmacological intervention. The goal of surgical treatment is to decompress the spinal cord, provide stability, and reduce pain. In addition to prompt surgical decompression, a concurrent strategy is to monitor hemodynamic factors such as the MAP and to avoid hypotension. Current pharmacological trials such as minocycline and riluzole have shown early, promising results may eventually contribute to better treatment outcomes for patients with SCI in the future.

Declaration of Conflicting Interests

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