Part X: Trauma

Chapter 70: Spinal Injuries

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Introduction

The human spine is an engineering masterpiece designed to allow movement, maintain stability, and protect the spinal cord. Major trauma to the spine, especially when the underlying spinal cord is damaged, produces devastating injuries leading to economic, personal, and social tragedies. This situation is compounded by the development of paramedic services, which have lead to better survival of patients with high spinal injuries who in the past would not have reached hospital alive. The incidence of spinal injuries in Australia is 20-25 per million population per annum.

While significant advances have lead to improvements in both the rate and quality of survival of paraplegic and quadriplegic patients, the major thrust is in prevention and education - the use of appropriate safety helmets and car restraints; adequate preparation for contact sports, ie, football; and teaching of safety in water sports.

Aetiology

Motor vehicle (both car and motor cycle) trauma provide the major source of spinal injuries in Australia. The next commonest causes are football injuries and water accidents, especially those caused by diving into shallow water. Accidents related to hang gliding and ultralight aircrafts, falls and gunshot wounds comprise other common causes.

Spinal injuries are therefore likely to be associated with other injuries, particularly head and abdominal injuries, and aspiration of salt or fresh water. A careful check for other injuries should be mandatory in the patient with spinal injuries. Conversely, the multiple trauma patient should be assumed to have spinal injuries until proven otherwise.

Mechanism of Injury

The magnitude and type of injury depends of the ability of the spine to withstand and absorb various forces. Flexion injuries usually compress the vertebral bodies and disrupt the posterior longitudinal ligaments, leading to herniation of the intervertebral disc. Extension injuries disrupt the anterior ligaments and fracture posterior segments of the vertebral column. Compression injuries produce explosive fractures of the bodies and ligamentous rupture. Rotational injuries either cause fracture dislocations of the facets, which damage the midsection of the bodies, or disrupt the ligaments producing fractures. The combined rotation flexion and rotation extension injuries in the cervical region severely damage ligaments, bone and the underlying spinal cord.

Injury to the cord leads to the bruising or mechanical destruction of nerve, haemorrhage, reduced perfusion, oedema and necrosis. An element of the cord damage can be reversible, and up to 4 weeks may be required to assess the final degree of damage.

Initial Treatment

The initial management is rapid immobilization of the fracture area and evacuation to a centre dealing in spinal injuries. Paramedic and ambulance services usually have devices such as backboards, scoop stretchers (eg, a Jordan frame) and extricators which permit safe movement of the patient. The traditional "log rolling" technique is used, but movement of unstable thoracolumbar segments is possible. Nevertheless, it is still necessary in many first aid situations. Hard and soft cervical collars are inadequate to stabilize patients with suspected spinal injury who are awaiting radiological examination. The classic technique of sandbags at each side of the head should be used. As movement of either neck or body may extent the spinal injury, the body should be immobilized on the bed/trolley as well, by means of straps or sheets. Suction equipment should be immediately available at all times.

In high spinal injuries, intubation may be necessary to provide ventilation. The preferred method of stabilizing the neck during intubation is controversial. In one recommended technique, the patient is intubated after administration of IV thiopentine and muscle relaxants, with cervical traction applied longitudinally by means of skull tongs. Care is taken not to extend the neck, although a small degree of flexion is permissible. However, in a study performed on dead patients with cervical cord injuries, longitudinal traction during orotracheal intubation may produce subluxation at C6-C7 fracture dislocations. In practice, extreme care must be used. An array of accessories for difficult intubation should be ready prior to intubation. Consideration is given to intubating with a fibreoptic laryngoscope/bronchoscope or carrying out a cricothyrotomy in very unstable high spinal injuries.

During transport, regular assessment of ventilation and level of neurological deficit is essential, as both may deteriorate. The patients are vulnerable to hypothermia, becoming poikilothermic after high spinal injury. A transient hypertension and bradycardia may occur, but the usual cardiovascular feature is hypotension, which is difficult to treat. Patients are unusually sensitive to both volume loading and drugs because of loss of vascular tone, muscle activity and thoracic effects of breathing on venous return. Treatment should be cautious and titrated with repeated assessments.

Hospital Management

1. Initial Assessment

Upon arrival in hospital or ICU, the neck should be initially stabilized as described above. The next priority is radiological diagnosis/assessment, especially PA, lateral and through-the-mouth oblique x-rays, and CT scanning where possible. At the same time, ventilation is assessed and other injuries treated. Following neurological and radiological assessments, more definitive (surgical) stabilization is considered, which usually involves the use of skull tongs, halopelvic traction or anterior or posterior spinal fusion.

2. Circulation

Haemodynamic stability may be extremely difficult to achieve. Sympathetic outflow disturbances lead to hypotension, and the spinal injury associated injuries may both produce

significant hypovolaemia. The radiological appearance of a widened mediastinum in thoracic spine injuries often leads to concern about aortic damage, and if associated signs are present angiography may be required. (See Chapter 69, Chest Injuries.) In high spinal injuries, a low blood pressure is tolerated in the early period provided that urine output, peripheral perfusion and acid base states are maintained.

3. Respiratory

Fractures above C5 lead to the loss of diaphragmatic function and those above C8, loss of intercostal function. Initial and repeated assessment of lung volumes is mandatory. Patients with forced vital capacities of less than 2 L will usually require mechanical ventilatory support. Atelectasis, particularly of the upper lobes, is common and bronchoscopic clearance may be necessary. Sitting patients more upright will increase functional residual capacity. Abdominal binding may assist ventilation. In patients who will require tracheostomy, it is good policy to perform tracheostomy early, and to use a speaking tube which provides obvious advantages especially in improving morale.

4. Nursing

Patients should be nursed supine on a bed capable of lateral tilting and allowing them to be lifted for skin care. Suprapubic catheterization or ureteric catheterization are necessary, and are replaced in males with uridome drainage after urodynamic assessment at 4-6 weeks. Prophylactic antibiotics are not indicated in early treatment.

5. Social Consideration

In injuries such as C1-C2 total quadriplegics, the wishes of the patient and family regarding continuation of treatment should be sought when the complete nature of the lesion is established.

Specific Treatment

Various modalities of treatment have been tried experimentally in animals and humans. Such treatments have included use of hyperbaric oxygen, direct cord hypothermia, osmotic agents, steroids and naloxone. The clinical evaluation of these therapies is extremely difficult and none have any proven value from controlled trials. An isolated case of a dramatic response to local hypothermia, and anecdotal responses to hyperbaric oxygen have been reported.

Complications of Spinal Cord Injury

1. Cardiovascular

Postural hypotension is common during rehabilitation. The cardiovascular system may be unstable for periods of up to a week, particularly during anaesthesia. Thromboembolic disease is also common. Although there is no controlled study on the prophylaxis of thromboembolism in spinal injured patients, available studies suggest that venous thrombosis

occurs early, and that conventional prophylactic measures such as low dose subcutaneous heparin may reduce the incidence.

2. Skin

Pressure sores are a major problem and meticulous attention to turning, lifting and pressure areas is mandatory. Such areas may be complicated by soft tissue infections and osteomyelities which require surgical debridement.

3. Alimentary System

In the early stages, paralytic ileus and gastric distention are common, making enteral feeding difficult and predisposing to aspiration. Although with nasogastric decompression, the ileus usually improves, it may recur or become protracted. Abdominal pain may be a feature and pancreatitis should be excluded. Non specific changes in liver function tests occur in 50%. After neurological and cardiovascular stabilization, faecal impaction is a common problem requiring regular enemas and evacuation. Spinal injured patients are at risk from stress ulceration. Control of gastric pH is difficult in quadriplegics due to the loss of sympathetic stimulation of the stomach. H_2 blockers and antacids should be used and gastric pH monitored 4 hourly. Higher doses than usual of antacids and H_2 blockers may be necessary to maintain a pH less than 4.0.

4. Metabolic

Although the metabolic rate is low, muscle wasting and hypoalbuminaemia rapidly occur. Calcium excretion is increased and glucose intolerance may occur.

5. Genitourinary

Infection of the urinary tract is a major problem. In the early phase of spinal injury, a paralysed overdistended bladder is a danger and drainage is necessary. Reflex activity returns in 2-8 weeks and retraining, often with the help of self-catheterization can occur. Regular monitoring of renal function is mandatory in the early stages.

6. Neuromuscular

In the early phase, autonomic dysreflexa occurs in 50% of patients with lesions above T6. Symptoms include hypotension, sweating, blanching, headache, bradycardia and fever, and the episodes are often triggered by bowel or bladder distension. If prevention of the latter does not control the autonomic dysreflexia, alpha-adrenergic blockers may be necessary.

7. Other Complications

Causalgic pain and reactive depression are common. Non infective fevers frequently occur in the early phase of injury, but the majority of fevers are harbingers of infection.