Acute Spinal Cord Injury: Managing at the Site of Impact and Addressing Reality Gap

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Introduction

Acute spinal cord injuries are common medical emergencies that occur due to direct injury to the spinal cord. The common causes of injury to the spinal cord in India are road traffic accidents, fall from trees, buildings or at the construction sites, railway accidents, sports injuries, gun shot wounds, etc.

The damage to the spinal cord results in loss of function of the parts of the body below the site of spinal cord injury. It could result in either total paralysis or partial paralysis. If the injury is at the level of the cervical spine, it may lead to quadriplegia, or also known as tetraplegia, and if the impact is below the level of dorsal or lumbar, then it may lead to paraplegia.

In general, acute spinal cord injuries can be divided into two types: complete and incomplete injuries.

- In complete acute spinal cord injuries, the cord cannot relay impulses below the level of the injury. As a result, patients are totally paralyzed below the level of injury with loss of function in all modalities including motor, sensory and autonomic functions.
- An incomplete injury is a partial injury to the spinal cord, where partial functioning below the level of injury is observed, which could be either in the movement of the limbs or in sensation of bladder/bowel control with intact autonomic reflexes.

Lowering the Burden of Spinal Cord Injury

Identifying and Preventing the Risk Factors

It is very important to know the epidemiology of spinal cord injury in India. Understanding the preventable risk factors of traumatic spinal cord injury can help to reduce the frequency and morbidity of spinal cord injury. Highlights of the epidemiological study on traumatic spinal cord injury conducted in Rohtak are as follows:

- The most common cause of spinal cord injury was falling from height including roof, trees, electricity pole (44.5%) followed by motor vehicle accidents (34.7%).
- Dorsolumbar spine injury was the commonest followed by cervical spine injury.
- Seasonal variation was observed.
- There is an increased frequency of spinal cord injury during summer followed by rainy season.
- Incidence was significantly higher in young, active and productive population of the society.

Prehospital Management

Management of acute spinal cord injury at the site of impact is a very crucial step in treating accident victims. Immediate treatment can reduce long-term effects; later treatment usually includes medicine and rehabilitation therapy.

Following practices should be incorporated as a part of management of all acute spinal cord injury patients:

- The importance of recognition and early treatment.
- The need for adequate first aid, like cervical collar or spinal board.
- Proper modes of transportation used to shift the patient to the medical center.
- Time taken to shift the patients from the accident site to the treatment centers and the delay in reaching these treatment centers.
- Administration of a steroid at appropriate time, choice of the steroid and the feasibility of administering steroid at the site of accident.
- Timing of surgery.
- Financial burden and steps to overcome this burden.
- Logistics involved in transportation, training and implementation.

Early Recognition and Treatment of Acute Spinal Cord Injuries

Early recognition and treatment of acute spinal cord injury are very important to prevent further injury. Acute spinal cord injury can be due to accidents like road traffic accident, railway accidents, fall from a height, etc. In such cases, the general public should recognize the injury early and shift the patient to the nearby treatment center. All trauma patients should be considered to have suffered polytrauma, especially if the patient is in coma or has altered sensorium. They should be immobilized and transported in a spinal board or at least after putting a cervical collar. The major concern here is that neurologic function may be further impaired due to pathologic motion of the injured vertebrae causing second insult to the spinal cord during transportation. General public must be made aware in this regard.

Modes of Transportation

There are various modes of transporting patients to the treatment center. In some cities (like Chennai and Coimbatore), there are ambulance networks with trained and semi-trained staff who aid in transporting these accident victims; whereas in rural areas, autos and bullock carts are used to transport these patients with the help of untrained public. Accordingly, the patients in cities are shifted to either government hospital, medical college attached hospital, private sector or corporate hospital with improved treatment options.

The patients in rural areas are transported to nearby primary healthcare center, from where they may be sent to a government or private hospital in the city for advanced treatment options. The shift from primary healthcare center to tertiary center is a major reason for the delay in giving appropriate and timely treatment to the patients with acute spinal cord injury. It happens mainly to the patients who are shifted from rural areas. This delay can range between 12 and 72 h.

In Indian scenario, policemen are the first to reach the accident...
sites. Therefore, policemen should be well-trained in stabilizing the spine and maintaining the airway. This can definitely bring down the mortality and morbidity during patient transfers. This practice of training policemen was successfully implemented in Mumbai. A training handbook was published in local language and was appreciated a lot by policemen.

Rohtak study had shown that only 1.86% of patients were accompanied by trained personnel during transfer. About 23% of patients were transported by ambulance, whereas 77% of patients were transported by vehicles unsuitable for a spinal patient such as car, jeep or maxi cabs.

**Time Taken to Reach the Hospital**

Early treatment of patients with acute spinal cord injury is very important to prevent secondary spinal cord injury. A study conducted by Prasad et al. from NIMS, Hyderabad, analyzed 133 patients with acute spinal cord injury. The data obtained from the study showed that out of total number of patients:
- Only 7 (5.2%) patients reached the hospital within 8 h.
- Another 23% patients reached within 24 h.
- 42% patients reached between 24 and 72 h.

Similar results were reported by Ramani and Laud from Mumbai regarding the time taken by the spinal cord injury patients to reach the hospital. On the other hand, reports obtained from USA showed that almost 50.2% of patients were admitted within the first 1 h of the accident. Data obtained from the study conducted between April 2005 and March 2007 at MIOT Hospitals, Chennai, showed that out of 81 patients with spinal cord injury, only 4 (4.9%) were admitted within <8 h. Moreover, two of these patients had sustained injury at a site 3–4 km from the hospital, signifying that timely treatment could be administered only if they were within the vicinity of the hospital.

**First Aid Given at the Site of the Accident**

Timely first aid intervention is essential. Reports from a study have shown that of the total number of accident cases, <10–15% of patients are given adequate first aid treatment. Another report has shown that <15% of patients were given a cervical collar at the time of shifting them to the hospital and <4% of patients were transported in spinal board by trained personnel. Therefore, it is essential that every treatment center has well-equipped ambulances. Also, in a country like India where ambulances are used for various other purposes, one needs to be strict and make sure that ambulance is used for the right purposes with trained paramedical staff employed to handle the accident victims.

Issues like unequipped ambulances and delay in transporting the patients to the treatment centers should be handled by public–private sector cooperation by improving patient transportation strategy.

**Spinal Cord Injury Grading System**

Several grading systems are available for spinal cord injury:
- Frankel’s grading.
- American Spinal Injury Association Impairment Scale (now called the International Spinal Cord Injury classification system).
- Syndromes of spinal cord trauma: complete/Brown-Sequard/anterior spinal artery/central cord/incomplete.

The Frankel’s grading is the most common grading system.

**Spinal Cord Edema**

In case of posttraumatic spinal cord edema, majority of clinicians agree that steroids are the treatment of choice for many years till now. But the following aspects need to be addressed regarding this therapy:
- Choice of the steroid to be given.
- Dosage of the steroid used.
- Timing of steroids.
- Duration of the treatment.
- Use of steroids post surgery.

**Timing of Steroids**

Timing of steroids has been discussed a lot. According to the National Acute Spinal Cord Injury Studies (NASCIS) I–III, the time factor in the treatment of acute spinal cord injury, is the most crucial aspect. The NASCIS III states the following:
- If a patient is reported within <3 h, then the therapy with steroids should be given for 24 h.
- In case the patient is reported between 3 and 8 h, then the therapy should be given for 48 h.
- In case the patient is reported within <8 h, a high dose of methylprednisolone 30 mg/kg bolus over 15 min followed by a gap of 45 min and then by 5.4 mg/kg/h for 23 or 47 h is advocated.

An Indian study that was conducted in Jammu and Kashmir can also be taken into account. Following are the results obtained from the study:
- Methylprednisolone given within 8 h of injury had more motor recovery (p<0.001) than those who were not given the drug.
- Improvement in the pinprick scores and light touch scores was also greater at 6 weeks (p<0.001). Similar effect was also seen after 6 months.

This study has concluded that methylprednisolone prevents secondary cord injury to a great extent and hence its administration in the immediate post-injury period results in a better functional (motor and sensory) outcome.

**Timing of Surgery and Management**

Delay in surgical timing, especially in the Indian context, could occur due to delay in the patient reaching the hospital.

A study published by Ramani and Laud from Mumbai showed the number of patients operated at different time intervals after the accident were as follows:
- In <12 h of the accident, approximately 9 patients (20%).
- Between 12 and 24 h, about 8 (17.7%).
- Between 1 day and 1 week, 14 (31%).
- Between 1 and 3 weeks, 9 (20%).
- After 3 weeks, 5 patients (11.3%).

Again, there is a concept that surgery has to be deferred between 48 h and 5 days if the patient presents with cord edema. During this waiting period, complications like bedsores, aspiration pneumonia can occur, leading to a further delay in the management. Another important factor leading to the delay is the availability of surgical team in a government hospital, whereas in a private hospital, it could be the financial aspect of the patient that could possibly cause the delay.
Analytical data about spinal cord injury patients obtained from MIOT Hospitals at Chennai between 2005 April and 2006 March showed the following:

- Of the total 41 acute spinal cord injury patients treated, 37 acute spinal cord injury cases were operated and the remaining 4 patients were referred to other hospitals.
- Among 37 operated cases, 12 cases had cervical spine injury and 25 cases had dorsolumbar spine injuries.
- Number of cases reported within <8 h were two, but none were operated within this time period.
- In-hospital mortality was 8.1% (3/37).
- Similar results were observed in the next 40 acute spinal cord injury cases treated at MIOT Hospitals, Chennai, during April 2006 to March 2007.

**Positive Measures for Better Management of Spinal Cord Injuries: Indian Scenario**

**Need for a Central Organization**
- Establishment of a core spinal society comprising of spine and neurospinal surgeons of India that can give valuable insights and help in creating blueprint regarding the complete management of acute spinal cord injuries.
- Obtaining required knowledge regarding prevention strategies from already established foundations like “THINK FIRST,” which is a National Injury Prevention Foundation of USA and then applying the same for Indian ground reality.

**Addressing the Training Needs**
- Proper and adequate training of policemen and field force in terms of stabilizing and maintaining airway of injured person.
- Educating general practitioners, paramedical persons and physiotherapists.
- The paramedical personnel should be trained at regular intervals (either directly or through Red Cross), region-wise using a definite timeframe so that within 2 years, the whole country is covered. This should again be followed by reinforcement programs.
- Running regular training reinforcement and CME programs for doctors, paramedicals and field force.
- NGOs like Rotary club, Lions club should come up with programs like ‘Project Spinal Cord Injury Prevention’ to educate public like bus drivers, school and college students. For example, a program called ‘Project Helmet’ supported by Rotary Combmatorre Manchester successfully educated over 5000 school students, 200 police personnel and 250 bus/auto drivers using a 30-min module.

**Adequate Infrastructure**
- Provide air ambulances for the timely intervention of the accident victims all over the country similar to that in Mumbai and Chennai.

**Financial Support from MNCs and Pharma Companies**
- Pharmaceutical and implant manufacturing companies, which deal with relevant spine products, can be approached for financial support.
- Multinational companies can form various teams including spinal surgeons, who in turn can educate the smaller nursing home doctors through a short video film.
- These companies can help in propagating and advertising the need for adequate management of spinal cord injuries. Financial support from these companies can be used to carry out multiple activities like.
- Making video films of experts and key opinion leaders and then using those videos for educating general practitioners, paramedical persons and physiotherapists.
- Educating general public via advertisements: Media like television can be used to educate the public by giving 30-second advertisements sponsored by pharmaceutical and other companies.
- Developing CME programs and then running regular training reinforcement for doctors, paramedicals and field force.

**Key Messages**
- Acute spinal cord injury patients should be given adequate prehospital care, which can reduce mortality as well as morbidity of these patients.
- Evidence from the studies has shown that a dose of methylprednisolone during immediate post injury period gives better functional outcome. Hence, this can be very useful particularly in Indian setting, where delay in transportation is an important cause of delay in surgery.
- Adequate training of policemen and paramedicals in stabilizing the spine and maintaining the airway can definitely improve prehospital management in Indian setting.

**References**