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Research Paper

Emergency Management of Injury to the Spinal Cord

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Highlight
This piece of write up is a contribution toward the emergency handbook for FMC Owerri. The aim is to help improve the identification and care of spinal cord injury patients presenting to the emergency. It is not an all-encompassing knowledge for a neurosurgeon managing injury to the spinal cord. A neurosurgeon or any other doctor interested in detail may further consult other literatures or texts.

LEARNING OBJECTIVE
By the end of this chapter readers should:
- Be able to identify Spinal Cord Injury **(**SCI)
- Understand the gravity of SCI
- Resuscitate and keep a patient with SCI alive – ATLS protocol
- Maintain or improve patients neurology
- Make a quick referral to the neurosurgery units
- Identify and make appropriate consultation or referral for other associated critical pathologies/injuries

Introduction/Definition
Spinal cord injury is the disruption or loss of functional and anatomic integrity of the spinal cord. It results in disturbances to normal sensory, motor, or autonomic function[1] and ultimately affects a patient's physical, psychological, and social well-being.

Epidemiology
This is commoner in the youths (peak age < 30 years) and in males. Sekhon and Fehlings reported an annual global incidence of acute SCI of 14 to 40 per million.[2]

Causes - RTA, Falls, Assaults, Contact Sports, etc[3]
Risk Factors -Male, youth age, athletes, high attitude jumpers or workers.

Pathogenesis
Following trauma to the spines, the impact of the force in transmitted to the spinal cord. This may lead to injury to the cord parenchyma – with inflammation, free radical release, vasoconstriction. This leads to dysfunction which may be functional (spinal shock) or anatomical (actual spinal structural dysruption). This dysfunction cause loss of transmition of nerve impulses distally; presenting as paralysis of the supplied muscles. Disconnection between the distal spinal segment causes loss of cerebral control leading to hyperreflexia.

The initiating trauma may affect blood vessel suppling the cord leading to ischemia of the cord and further neurologic deficit. With an initial trauma, there is onset of inflammation with associated tissue edema cranially and caudally. They present with functional loss depending on the involved segments and may progress secondarily to myelomalacia or irreversible scare tissues like formation around the segments of the cord injury.

Details of spinal bony or soft tissue injuries without spinal cord injury is beyond the scope of this material. However, bony injuries may compromise the spinal canal spaces available for the cord at various levels thus resulting in canal stenoses, direct injury to the cord or cord edema due to compromise of spinal cord vasculature.

Classification.
- It may be Complete or Incomplete based on the anatomical site of the involved cord segments
- Primary or Secondary based on the pathological sequely
- According to spinal level based on the anatomical location of the cord segments
- ASIA Classification based on level of severity and the clinico- pathophysiological manifestations.

- **Complete or Incomplete**

For the incomplete injury, various cord syndromes are seen.
Transversely, injury may also involve any part of the cord causing anterior cord syndrome, posterior cord syndrome, central cord syndrome or lateral cord syndrome (Brown Sequard Syndrome).

- **Primary or Secondary**

Primary injuries are mainly due to direct injury to the cord at the time of the initial impact. Ranging from cord contussion, transection, cord haematoma and ischaemia
Secondary cord injuries are those that result from failure to mitigate the progress of (or attenuate the effects of) primary injury to the cord. Examples are cord edema, compression from listhesis of a bony segment other inflammatory responses following the primary injury.
Frequently, there may be injury to the bony spine without injury to the spinal cord. This may involve either the anterior, middle, or posterior spinal columns but are outside of the scope of this material.

- **By Spinal level**

Depending on the level of injury it may be cervical, thoracic cord injury or conus medullaris injury. Below the conus medullaris, the injury affects the canda equina.

- **By severity**

ASIA Neurologic Grading[4]
- Complete loss of motor and sensory functions below the level of injury
- Preserved sensation but absent motor function below level of injury
- Presence of motor function with greater than 50% of muscle groups having power of less than grade 3 below the injury level
- Presence of power with greater than 50% of muscle groups having at least grade 3 power below the injury level
- Normal Sensory and motor function

Rarely (especially in children) there may be spinal cord injury without bony injury. This usually shows as SCIWORA (spinal cord injury without radiologic abnormality), a form of functional disruption to the spinal cord.

Clinical Presentation- including other associated features/injuries.
May show symptoms and signs of motor and sensory dysfunction below the level of injury. There may also be features suggestive of other injuries such as head, chest, abdominal, pelvic or limb injuries.

MANAGEMENT – depends on mode of presentation and attention given to the patient from the scene of the incident.
- Prehospital care
- Emergency
- Elective (non emergent).

Prehospital care.
-Recovery
-Resuscitation
-Relocation/transportation

Emergency Presentation – airway compromise, breathing difficulty, hypotension or cardiovascular instability.

Goal of care in this mode of presentation.
- Stabilize patient by correcting life threatening situations.
- Prevent worsening of spinal cord injury.

Modalities:
- ATLS protocol
- Stabilization of the spinal fracture/injury
- Consultation of other specialists in relation to the associated injuries

1. ATLS PROTOCOL
Primary Survey
MIST- history
ABC of resuscitation

- Airway maintenance with stabilization of the c-spine
- Breathing optimization
- Circulation optimization
- Disability Assessment / Drug Administration (Normal saline 1L/8hrly, analgesics)
- Exposure of other injuries – Log-roll during examination

Secondary Survey
-AMPLE history

- Allergy
- Medication
- Past medical History
- Last meal
- Event leading to presentation

2. Stabilization of spinal fracture/injury site
.

- Cervical Spine – neck collar
- Thoracic – Thoracolumbar corset
- Lumbar – lumbar corset

Transportation – hard board with supporting sandbags on the side if not stabilized.

3. Consultation of Neurosurgery team and other specialists in relation to the associated injuries

Emergency Treatment
While awaiting the neurosurgery team, the following should be done by the emergency team.
- Maintain spinal stability - Corsets, Neck collar or hard board
- Commence proper rehydration: 3-4L/day in an adult.
- Give a shot of steroid with proton pump inhibition preferred option is intravenous bolus of methylprednisolone (30 mg/kg) then methylprednisolone infusion of 5.4 mg/kg per hour for 48 hours, preferably started within 8 hours of injury plus IV Omeprazole 40mg 12 hrly.[5,6]
- Give analgesics: Paracetamol, DF118, Tramal, etc
- . Control blood loss.
- . Continue to maintain "Airway, Breathing and Circulation".
- Invite other relevant specialties of need.

DVT Care: mainly non pharmacologic

Superficial Wound Care: clean and dress wounds

Baseline Investigations:
- Urgent FBC, EUCr, Urinalysis, RBS.
- Chest, Pelvic X-rays and Abdominal USS to excluding blunt injuries to these regions.

Non Emergent (Elective) Care

Elective/Stabilized Patients
Detailed History
After stabilizing the patient, the detailed history of the event is noted.
Note the presenting complain which many include neck, midback or waist pain following trauma. There may by associated difficulty in moving upper and / or lower limbs. There may be incontinence or retention of urine or

feces. These features should raise suspicion of spinal cord injury and prompt consideration for the invitation of or referral to the neurosurgery team.
History suggestive of head injury should also be considered e.g transient or prolonged loss of consciousness, headache, personality changes or hemiparesis. Other components of history are noted as they are relevant. Other histories such as breathing difficulties, abdominal pain or swelling, pelvic pain or limb deformities may suggest injuries to these regions.

Examination
In a spinal cord injury patient general examination finding may depend on other injuries sustained.
Glasgow coma - depended on the intracranial condition or systemic state. Spinal examination should access for motor level, sensory level and neurologic level to determine the likely level of injury. This will determine the highest level of neurological injury. Note that there may be multiple levels of injuries.
Areas of sharp differences in neurological status should be stabilized ahead of invitation of the neurosurgeons.
Spine examination could be done by logrolling the patient to the side. Presence of gibus or step deformity may suggest a possible level of spinal injury.
Once suspicion of spinal/ spinal cord injury is noted, the neurosurgery team should be invited immediately even before neuroimaging studies.

Grading Of Neurologic Deficit: American Spinal Injury Association (ASIA) grade A to E

Investigations
Diagnostic investigations are neuroimaging studies.
- Spinal MRI – shows state of cord and soft tissues clearly.
- Spinal CT – shows the bones clearly.
- Spinal X-ray shows bony injuries and deformities. It is fast, available, and affordable.

NB: The level and type of investigation is best determined by the neurosurgery team after appropriate review. Thus, for best outcome, absence of these investigations should not delay neurosurgical review. In fact, the neurosurgical team should be invited to review and commence preliminary management and request for relevant neuroimaging investigation as they consider best.

Treatment
Details of treatment of SCI is beyond the scope of this book. But for emergency treatment of SCI, see the relevant section above in this chapter.

Conclusion
Emergency management of injury to the spinal cord if promptly and properly done helps to prevent worsening of neurological injury. ATLS protocol, stabilization of the spine, and early commencement of steroid and prompt invitation of the neurosurgery team should be practiced by the emergency team to improve outcome.

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