Chapter 20

Wounds and Injuries of the Spinal Column and Cord

Introduction

Combat injuries of the spinal column, with or without associated spinal cord injury, differ from those encountered in civilian practice. These injuries are often open, contaminated, and usually associated with other organ injuries.

Following the ABCs of advanced trauma life support (ATLS), management principles include:

- Initial spine stabilization to prevent neurologic deterioration.
- Diagnosis.
- Definitive spinal stabilization.
- Functional recovery.

In complete injuries, the likelihood of neurological recovery is minimal and is not influenced by emergent surgical intervention. However, incomplete injuries with neurological deterioration may benefit from emergent surgical decompression. Emergent, life-saving, soft tissue exploration, and debridement may still be required, particularly with colorectal involvement.

Classification

Four discriminators must be considered in the classification and treatment of spinal injuries.

- Is injury open or closed?
- Neurologic status: complete vs incomplete vs intact.
  - o Complete injury demonstrates no neurologic function **below the level of injury** after the period of spinal shock

(usually 24–48 h, evidenced by return of the bulbocavernosus reflex).
- Location of the injury: cervical, thoracic, lumbar, or sacral.
- Degree of bony and ligamentous disruption: stable vs unstable.

Pathophysiology of the Injury to the Spinal Cord
- Injury to the spinal cord is the result of both primary and secondary mechanisms.
  - Primary: the initial mechanical injury due to local deformation and energy transmission.
    - High-velocity missile wounds in the paravertebral area can cause injuries even without direct trauma. Stretching of the tissue around the missile's path during formation of the temporary cavity, or fragmentation of the projectile and bone resulting in secondary missiles, cause injury without any direct destruction of the spinal column.

The destructive nature of high-velocity wounds explains the futility of decompressive laminectomy in the management of these wounds.

  - Secondary: the cascade of biochemical and cellular processes initiated by the primary process that causes cellular damage and even cell death.

The critical care of spinal cord injury patients includes attempts to minimize secondary injury from hypoxia, hypotension, hyperthermia, and edema.

Mechanical integrity of the vertebral column
The vertebral column is composed of three structural columns (Table 20-1).

Table 20-1. Support of the Spinal Column.

Column	Bony Elements	Soft-Tissue Elements
Anterior	Anterior two-thirds of vertebral body	Anterior longitudinal ligament Anterior annulus fibrosus
Middle	Posterior one-third of vertebral body Pedicles	Posterior longitudinal ligament Posterior annulus fibrosus
Posterior	Lamina Spinous processes Facet joints	Ligamentum flavum Interspinous ligaments

- Injuries occur by either direct penetrating forces or a combination of flexion, axial loading, rotation, and distraction forces.
- Loss of integrity of two of the three columns results in instability of the spine.
- **Instability is common following blunt injury of the vertebral column, but is not usually the case with gunshot or fragment wounds of the vertebral column.**
- Cervical instability by lateral radiograph (must include C-7/T-1 junction) is defined by:
  - 3.5 mm or greater sagittal displacement or translation.
  - Angulation of 11° or more on the lateral view.
  - Should questions exist regarding cervical stability, flexion and extension lateral radiographs can be obtained in the awake, cooperative patient.
- Thoracic and lumbar spine instability:
  - 5 mm of sagittal translation.
  - 20°–30° of sagittal angulation.
  - 50% loss of vertebral body height.
  - Widened pedicles on anterior-posterior (AP) radiographs.

Computed tomography (CT) is very effective in demonstrating spinal instability and has become available in some field environments.

Instability must be presumed (and the spine stabilized) in any patient with:

- **Complaints of a sense of instability (holds his head in his hands).**
- **Vertebral column pain.**
- **Tenderness in the midline over the spinous processes.**
- **Neurologic deficit.**
- **Altered mental status.**
- **SUSPECTED, but NOT PROVEN injury.**

Patient Transport

On the battlefield, preservation of the life of the casualty and medic are of paramount importance. In these circumstances, EVACUATION TO A MORE SECURE AREA TAKES PRECEDENCE OVER SPINE IMMOBILIZATION. Data do not support the use of cervical collars and spine boards for PENETRATING spine injuries on the battlefield.

Extrication

- Cervical spine.
  - **The neck should never be hyperextended.**
  - If an airway is needed.
    - If appropriate, attempt endotracheal intubation with in-line neck stabilization.
    - Cricothyroidotomy is necessary if intubation fails.
  - The head should be maintained in alignment with the body.
    - Requires several people, including one just to stabilize the neck.
    - Log roll with the most experienced person stabilizing the neck.
  - A stiff cervical collar and sandbags provide stabilization of the neck during the transport. The head and body should be secured to the extrication device.
- Thoracic and lumbar spine.

- o Use log roll or two-man carry as demonstrated in Fig. 20-1.
  - ♦ The two-man carry alone does not protect the cervical spine.
  - ♦ The cradle-drop drag may also be used.
- o In the absence of a spine board, makeshift litters can be fashioned from local materials.

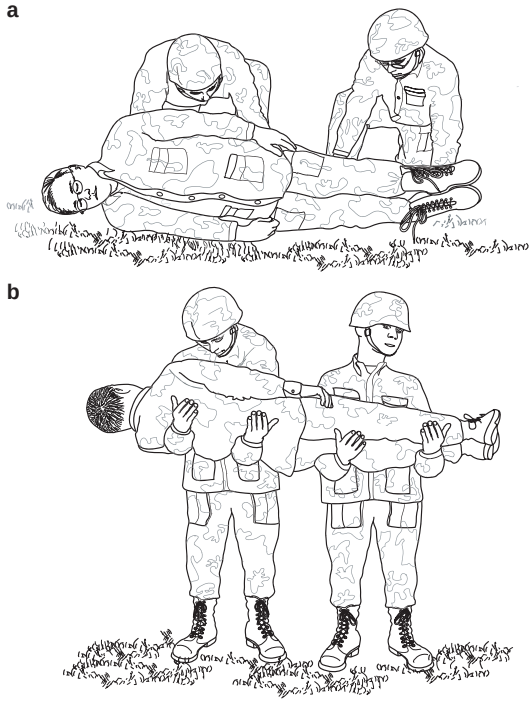

Fig. 20-1. (**a**) Log roll (**b**) two-man carry.

Anatomical Considerations

Cervical Spine

All potentially unstable cervical spine injuries should be immobilized in a rigid collar, unless halo immobilization is required.

- ● Indications for halo use:

- The role of halo immobilization in the acute combat setting is quite limited. In nonpenetrating trauma to the cervical spine, immobilization with a cervical hard collar or sand bags is preferable until arrival at a definitive treatment site.
- Should traction be indicated for cervical spine injuries (eg, facet joint dislocations or burst fractures with a tenuous neurologic status), the Gardner-Wells tongs should be applied and sufficient weight (generally 2–10 kg) placed in line of the spine (Fig. 20-2, Table 20-2). It is paramount to remember that injuries to occipitocervical articulation should not be treated with traction-in effect, putting these injuries in traction "pulls the head off". If traction is applied, radiographs must be obtained to be certain that no undiagnosed ligamentous injury has been exacerbated by the weight.
- The role of collar immobilization in penetrating injuries to the cervical spine is less well established. Soft-tissue care is compromised by the collar's position and, in general, penetrating injuries coupled with osseous instability should be managed in Gardner-Wells traction.

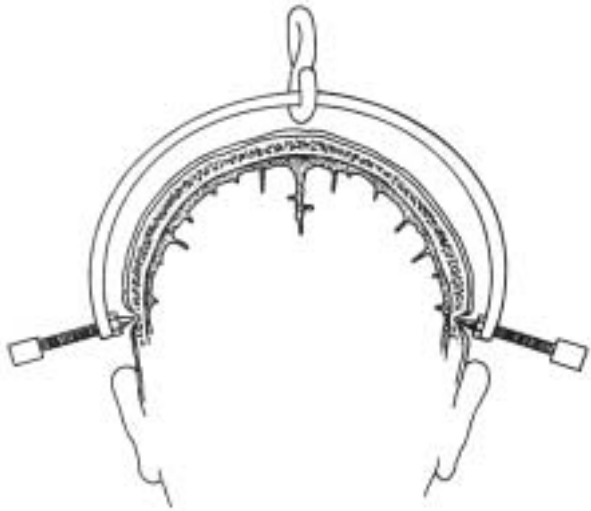

Fig. 20-2. Gardner-Wells tongs.

Table 20-2. Application of Gardner-Wells Tongs.

Step	Procedure	Comment
1	**Inspect Insertion Site:** Select a point just above apex of each ear.	Rule out depressed skull fracture in this area.
2	**Shave and Prep Pin Insertion Site.**	
3	**Inject Local Anesthetic:** Inject 2–3 cc of 1% Xylocaine or equivalent agent 1 cm above each ear in line with the external auditory meatus.	May omit if patient is unconscious.
4	**Advance Gardner-Wells Tong Pins:** Insert pins into skull by symmetrically tightening the knobs.	A spring-loaded device in one of the two pins will protrude when the pins are appropriately seated. (A data plate on the tongs provides additional information.)
5	**Apply Skeletal Traction:** Use a pulley fixed to the head of the litter or frame to direct horizontal traction to the tongs.	Use 5 lb rule (ie, 5 lb of weight for each level of injury). High cervical fractures usually require minimal traction to reduce. Monitor with series radiographs. The tong-pin site requires anterior or posterior positioning to adjust for cervical spine flexing or extension as indicated.
6	**Elevate Head of Litter:** Use blocks in order to provide body-weight counter traction.	The knot in the cord should not be permitted to drift up against the pulley. Should this occur, traction is no longer being applied.
7	**Decrease Traction Weight:** When radiographs confirm that reduction is adequate, decrease traction to 5–15 lb.	Unreducible or unstable fractures should be maintained in moderate traction until surgical intervention. If neurological deterioration occurs, immediate surgical intervention must be considered.
8	**Daily Pin Care.**	Cleanse tracts with saline and apply antibiotic ointment to the pin sites. Maintain pin force (see Step 4) by tightening as necessary to keep spring-loaded device in the protruded position.

9	**Turn Patient Appropriately:** Use Stryker, Foster, or similar frame and turn patient every 4 h.	When initially proned, obtain radiographs to ensure that the reduction is maintained. If reduction is not maintained when the patient is proned, rotate the patient only between the 30° right and left quarter positions. The use of a circle electric bed is contraindicated with injuries of the spinal cord or column.
10	**If Satisfactory Alignment Cannot Be Obtained, Further Workup Is Necessary.**	Consider myelogram, CT scan, tomograms, and neurosurgical/orthopedic consultations.

Thoracic and Lumbar Spine

- Although the thoracic rib cage contributes considerable rotatory stability, it does not protect completely against injuries.
- The vascular supply of the spinal cord is most vulnerable between T-4 and T-6 where the canal is most narrow. Even minor deformity may result in cord injury.
- The most common place for compression injuries is at the thoracolumbar junction between T-10 and L-2.
- Most burst fractures result from an axial load, and occur at the thoracolumbar junction. These fractures are associated with compromise of the spinal canal and progressive angular deformity. They are often associated with significant neurologic injury.
- Evaluation for surgical stabilization and spinal cord decompression should be done with advanced imaging such as CT and/or magnetic resonance imaging (MRI).

When complex wounds involving the head, thorax, abdomen, or extremities coexist with vertebral column injuries, lifesaving measures take precedence over the definitive diagnosis and management of spinal column and cord problems. During these interventions, further injury to the unstable spine must be prevented by appropriate protective measures.

Emergent Surgery

Emergent spine surgery for penetrating or closed injuries of the spinal cord is indicated only in the presence of neurological deterioration.

- Penetrating Spine Injuries.
  - o Injuries associated with a hollow-viscus should undergo appropriate treatment of the viscus injury without **extensive** debridement of the spinal injury, followed by appropriate broad-spectrum antibiotics for 1–2 weeks. Inadequate debridement and irrigation may lead to meningitis.
  - o Removal of a fragment from the spinal canal is indicated for patients with neurologic deterioration.
  - o In neurologically stable patients with fragments in the cervical canal, delaying surgery for 7–10 days reduces problems with dural leak and makes dural repair considerably easier.
  - o Casualties not requiring immediate surgery may be observed with spine immobilization and treated with 3 days of IV antibiotics. Surgical stabilization can be performed following evacuation.

Pharmacologic Treatment

- **Penetrating injuries of the spine should NOT receive corticosteroid treatment.**
- **Closed** spinal cord injuries may be treated with an IV corticosteroid if started within 8 hours of injury.
  - o 30 mg/kg bolus of methylprednisolone initially.
  - o 5.4 mg/kg/h of methylprednisolone for the next 24–48 hours.
    - ♦ If therapy is started within 3 hours of injury, continue treatment for 24 hours.
    - ♦ If therapy is started within 3–8 hours after injury, then treat for 48 hours.

General Management Considerations

Neurogenic shock

- Traumatically induced sympathectomy with spinal cord injury.
- Symptoms include bradycardia and hypotension.
- Treatment:
  - Volume resuscitation to maintain systolic BP > 90 mm Hg.
  - May use phenylephrine (50–300 μg/min) or dopamine (2–10 μg/kg/min) to maintain BP.

Gastrointestinal tract

- Ileus is common and requires use of a nasogastric tube.
- Stress ulcer prevention using medical prophylaxis.
- Bowel training includes a schedule of suppositories and may be initiated within one week of injury.

Deep vein thrombosis

- Start mechanical prophylaxis immediately.
- Initiate chemical prophylaxis after acute bleeding has stopped (See Chapter 11, ICU Care).

Bladder Dysfunction

- Failure to decompress the bladder may lead to autonomic dysreflexia and a hypertensive crisis.
- The bladder is emptied by intermittent or indwelling catheterization.
- Antibiotic prophylaxis for the urinary tract is not advised.

Decubitus ulcers

- Skin breakdown begins within 30 minutes in the immobilized hypotensive patient.
- **For prolonged transport, the casualty should be removed from the hard spine board and placed on a litter.**
- Frequent turning and padding of prominences and diligence on the part of caretakers are essential to protect the insensate limbs.
- All bony prominences are inspected daily.
- Physical therapy is started early to maintain range of motion in all joints to make seating and perineal care easier.