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.

• After initial Advanced Trauma Life Support (ATLS) which are the A, B,C’s (Airway, Breathing, Circulation) management principles include:
  • Initial spine stabilization to prevent neurological deterioration.
  • Diagnosis.
  • Definitive spinal stabilization.
  • Functional recovery.
INTRODUCTION:

• In COMPLETE injuries, the likelihood of neurological recovery is minimal and is NOT influenced by emergent surgical intervention. Incomplete injuries with neurological deterioration, however MAY benefit from emergent surgical decompression.

• One must assume, until spinal shock has abated, that patients with a significant spinal column injury have the potential for a concomitant neurological deficit, and should be treated and transported accordingly. (*Assume the worst*)
ASSESSMENT:

• There are four discriminators that must be considered in the classification and treatment of spinal injuries:
  • Is the injury open or closed? (Skin broken)
  • Neurological status: Complete vs. Incomplete vs. Intact?
  • Location of injury: Cervical (7), Thoracic (12), Lumbar (5), or Sacral (5)?
  • Degree of bony and ligamentous disruption: Stable vs Unstable?
• Injury to the spinal cord is the result of both primary and secondary mechanisms.

• Primary mechanism:
  • The initial mechanical injury due to local deformation and energy transmission (Primary injury cascade). This phase of the injury is most often unpreventable.

• Secondary mechanism:
  • The cascade of biochemical and cellular processes initiated by the primary process that causes cellular damage and even death (Secondary injury cascade).

• Example: A Sailor in a fire-fight with the enemy, a bullet from AK-47 moving at 2104 feet/second or faster, grazes the neck of the Sailor. No significant spinal injury noted, Sailor able to evacuate self to be treated by the Corpsman. But within 48 hours patient is no longer breathing independently due to the edema putting pressure on the phrenic nerve.
PATHOPHYSIOLOGY:
• Mechanical Integrity of the Vertebral Column:
• The vertebral column is composed of 3 structural columns:
  • Posterior
  • Middle
  • Anterior
PATHOPHYSIOLOGY:

• Injuries of the Vertebral Column:
• Injuries occur from either direct penetrating forces [gunshot or shrapnel] or a combination of flexion, axial loading [crush], rotation, and distraction forces [dislocation without dermis interruption, break in the skin].
• Instability may occur from either blunt injury of the vertebral column or gunshot/fragmentation wounds. The incidence of instability is significantly higher in explosion-related injuries.
PATHOPHYSIOLOGY:

- Instability must be presumed (and the spine stabilized) in any patient with complaints of:
  - Complaints of a sense of instability (holds head in hands).
  - Vertebral column pain.
  - Tenderness in the midline over the spinous processes.
  - Neurological deficit.
  - Altered mental status.

Know This

SUSPECTED, but NOT PROVEN, injury.
DIAGNOSTIC:

• Cervical instability by lateral radiograph (must include the C7/T1 junction) is suggested by:
  • 3.5mm or greater sagittal displacement or translation.
  • Angulation of 11 degrees or more on the lateral view.
  • The accuracy and, therefore, the role of flexion and extension lateral radiographs to assess for cervical stability are limited in the acute injury setting.
  • If cervical stability remains in question following initial assessment, the safest course of action is to provide external cervical immobilization [C-collar] until stability can be definitively established.

• Computer Tomography (CT) is very effective in demonstrating spinal morphology and has become available in some field environments.
ANATOMICAL CONSIDERATIONS:

- 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. [I.E. Jaw Thrust maneuver vs Head-Tilt Chin-Lift to obtain airway.]
ANATOMICAL CONSIDERATIONS – CERVICAL SPINE:

• All potentially unstable cervical spine injuries should be immobilized in a cervical collar [C-Collar], unless a halo immobilization is required. However, halo devices should not be placed until the patient is evacuated to a theater asset where a neurosurgeon or orthopaedic spine surgeon is available for halo placement and reduction of these injuries.
HALO USAGE:

• The role of a halo in an acute combat setting is very limited. In non penetrating trauma use cervical collar and/or sandbag until arrival to a definitive treatment site.

• **Do not treat injuries to the occipitocervical articulation with traction because this could result in disarticulation of the head from the cervical spine.**

• The use of cervical collar with penetrating injuries to the cervical spine is less well established, frequently making soft-tissue injury care compromised. Penetrating injuries coupled with osseous instability should be managed in Gardner-Wells traction.
GARDNER-WELLS TONGS:

- Should traction be indicated for cervical spine injuries (I.E. facet joint dislocations or burst fractures with tenuous neurological status), the Garden-Wells tongs should be applied and sufficient weight (generally 10-20 pounds) placed in line with the spine. If traction is applied radiographs must be obtained to be certain that no undiagnosed ligamentous injury has been exacerbated by the weight.
GARDNER-WELLS TONGS:

1. Inspect insertion site – rule out depressed skull fractures.
2. Shave and prep pin insertion site.
3. Inject local anesthetic – 2-3ml of 1% Lidocaine.
5. Apply skeletal traction – Use the 5 pound rule, 5 pounds for each level of injury.
7. Decrease traction weight – Unstable, unreducible fractures should be maintained until surgical intervention. If neurological deterioration occurs immediate surgical intervention is needed.
9. Turn patient – every four hours, use Stryker, Foster, or similar frame.
ANATOMICAL CONSIDERATIONS – THORACIC AND LUMBAR SPINE:

• Although the thoracic rib cage contributes considerable rotary stability, it does not protect completely against injuries.

• The vascular supply of the spinal cord is most vulnerable between T4 and T6, where the canal is most narrow. Even a minor deformity may result in cord injury.

• The most common place for compression injuries is between T10 and L2 in the civilian population. However, there is a very high preponderance of low lumbar burst fractures (L3 and below) in the military population. These injuries are quite distinct in that the pelvic brim connotes “inherent” stability for these fractures.

• Most burst fractures result from axial load and occur at the thorocolumnar junction. They are often associated with significant neurological injury.

• Evaluation for surgical stabilization and spinal cord decompression should be done with advanced imaging, such as CT and/or MRI.
TRANSPORT:

• On the battlefield, preservation of life of the casualty and corpsman is 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:
    • Endotracheal Tube with in-line neck stabilization.
    • Cricothyroidotomy may be necessary if intubation fails.
  • Head should be maintained in alignment with the body:
    • May require multiple people to assist, one person for the head.
    • Log roll with the most experienced person on the head leading the roll.
  • A stiff cervical collar and sandbags (stabilization pads) provide stabilization of the neck during transport. The head and body should be secured to the extrication device.
EXTRICATION:

- Thoracic and Lumbar Spine:
  - Use log roll or two-person carries. Two-person carries do not protect the C-Spine, ensure the C-Spine is protected prior to movement when possible.
  - In absence of spine board, makeshift litters [stretchers] may be fashioned from local materials.
EMERGENT SURGERY:

- Indicated ONLY if penetrating or closed injuries of the spinal column in the presence of neurological deterioration.

- Neurological deterioration is decreasing mental acuity. I.E. Was able to say name, date, location, etc. and now can not or gets the answers incorrect. Also could be increasing loss of sensation or purposeful movement.
EMERGENT SURGERY:

- Penetrating spinal injuries:
  - 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.
  - Removal of a fragment from the spinal canal is indicated for patients with neurological deterioration.
  - If no neurological deterioration from fragments in the cervical canal, delay surgery 7-10 days reduces problems with dural leak and make dural repair more straightforward.
  - Casualties not requiring immediate surgery may be observed with spinal immobilization and treated with 3 days of IV antibiotics. Surgical stabilization can be performed following evacuation.
GENERAL MANAGEMENT CONSIDERATIONS:

• Neurogenic Shock:
  • Traumatically induced sympathectomy with spinal cord injury.
  • Symptoms include bradycardia and hypotension.
  • Treatment
    1. Volume resuscitation to maintain systolic blood pressure >90mmHg.
    2. May use Phenylephrine (50-300 ng [MICROgrams]/minute) or dopamine (2-10 ng [MICROgrams]/kg/minute) to maintain blood pressure. Do number 1 first with supplemental oxygen support before starting pressor support.
GENERAL MANAGEMENT CONSIDERATIONS:

• Gastrointestinal Tract:
  • Ileus is common and requires use of nasogastric tube.
  • Stress ulcer prevention using medical prophylaxis. **Ranitidine/Zantac, Cimetidine/Tagament**
  • Bowel training including a schedule of suppositories and may be initiated within 1 week of injury. **Bisacodyl/Dulcolax**

• Deep Vein Thrombosis (DVT):
  • Start mechanical prophylaxis immediately (Sequential Compression Devices [SCDs]).
  • Initiate chemical prophylaxis after acute bleeding has stopped. **Coumadin/Warfarin, Heparin**
GENERAL MANAGEMENT CONSIDERATIONS:

• Bladder Dysfunction:
  • Failure to decompress the bladder may lead to autonomic dysreflexia and a hypertensive crisis.
  • The bladder is emptied by intermittent or indwelling urinary catheterization. [Suprapubic catheter]
  • Antibiotic prophylaxis for urinary tract infection is NOT advised.
GENERAL MANAGEMENT CONSIDERATIONS:

• 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.
TERMINOLOGY:

• Autonomic dysreflexia (AD) or Autonomic hyperreflexia; involuntary nervous system overstimulation which leads to SEVERE hypertension.

• Bulbocavernous reflex (BCR) or Osinsksi reflex; the test involves monitoring of the internal/external anal sphincter contraction in response to squeezing the glans penis or clitoris, or tugging on an indwelling urinary catheter. The reflex can also be tested electrophysiologically, by stimulating the penis or vulva and recording from the anal sphincter. This test modality is used in intraoperative neurophysiology monitoring to verify function of sensory and motor sacral root as well as the conus medullaris.

• Complete Neurological Status; demonstrates no neurological function BELOW the level of injury after the period of spinal shock (usually 48-72 hours, evidenced by the return of the bulbocavernosus reflex)
TERMINOLOGY:

- Incomplete Neurological Status; partial function and/or sensation below the level of injury after the period of spinal shock.
- Intact Neurological Status; full function and sensation.
- Insensate limbs; limbs lacking physical sensation.