Spinal Cord Injuries: Initial Management

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Acute Management

- ATLS – “A,B,Cs”
- Recognition of associated injuries
  - Fractures – spine, extremities
  - Closed head trauma
  - Chest/abdominal injuries
Acute Management

- Neurogenic shock
  - Results from disruption of sympathetic outflow
  - Hypotension and bradycardia
  - Must be differentiated from hypovolemic shock (hypotension and tachycardia)
  - Treat with Trendelenburg positioning, iv fluids, vasopressors, atropine
Acute Management

- Immobilization of spinal column
  - Rigid cervical collar
  - Trauma board
  - Rotorest bed
Pathophysiology

• Primary mechanism of injury
  – Acute mechanical deformation
  – Contusion more common than laceration
  – Irreversible damage to neural tissue and blood vessels
Pathophysiology

• Secondary mechanisms of injury
  – Initiated by primary mechanical injury/persistent compression
  – Complex cascade of biochemical processes
  – May be preventable, but “window” for treatment is limited
Intact Cord → Mechanical Forces → PRIMARY INJURY

Acute Pathophysiologic Processes

SECONDARY DAMAGE

Neuroprotective Interventions
- In Field Stabilization
- ATLS Resuscitation
- Prompt Medical/Surgical Care
- Pharmacologic Agents
Treatment of Secondary Injury

• Maintain spinal cord perfusion
• Initiation of neuroprotective therapies
• Relieve persistent compression
  – Reduction of fracture/dislocation
  – Surgical decompression
Spinal Cord Perfusion

- Minimize hypoxia/ischemia at site of injury
- May require supplemental O₂ – fiberoptic intubation
- Maintain MAP > 85 mm Hg
Steroid Therapy

- Attenuates inflammatory response
- Scavenges free radicals
- Inhibits membrane lipid peroxidation
- Improves regional blood flow
Steroid Therapy

• NASCIS III – “standard of care”
  – Loading dose (30 mg/kg)
  – Infusion (5.4 mg/kg/hour)
  – 24 hours of therapy if initiated within 3 hours of injury (improved outcomes)
  – 48 hours of therapy if initiated between 3-8 hours of injury (modest benefit)
Steroid Therapy

- Significant side effects (especially with prolonged infusion)
  - Sepsis/pneumonia
  - GI bleed
  - Death
- Results controversial and recommendations not universally accepted
Hypothermia for SCI

- Initially advocated as a method for preserving brain function following traumatic injuries, ischemic stroke, and cardiac arrest
- Lowered metabolic demands may decrease localized inflammation and cellular apoptosis
Hypothermia for SCI

• Animal studies have demonstrated improvements in histopathologic findings and functional outcomes

• May give rise to serious complications
  – Arrhythmia
  – Coagulopathy
  – ARDS
  – Suppression of immune system
Hypothermia for SCI

- Kwon BK et al. *Spine J* 2008;8:859-74
  - Review of literature addressing use of systemic hypothermia for SCI
  - Existing data establishes biological rationale for its neuroprotective role
  - No prospective, controlled studies published in peer-reviewed publications supporting its clinical use in humans
Hypothermia for SCI

- Cappuccino A et al. *Spine* 2010;35:E57-62
  - Extent to which hypothermia contributes to neurologic recovery difficult to ascertain
  - Impossible to advocate this treatment as “standard of care” for SCI until additional studies have elucidated neuroprotective effects of systemic hypotension
Hypothermia for SCI

- Hypothermia and Human Spinal Cord Injury: Position Statement and Evidence Based Recommendations from the AANS/CNS Joint Sections on Disorders of the Spine and the AANS/CNS Joint Section on Trauma
  - Daniel K. Resnick, Michael J. Kaiser, Michael Fehlings, and Paul C. McCormick
Hypothermia for SCI

- Recommendation: There is not enough evidence available to recommend for or against the practice of either local or systemic therapeutic hypothermia as a treatment for acute spinal cord injury. Clinicians should be aware that systemic hypothermia has been associated with medical complications in the head injured population prior to considering this treatment modality.
Closed Reduction

• Significant variability exists among spine surgeons regarding the optimal protocol for managing cervical dislocations\textsuperscript{1-3}
  – Surgeon training/experience
  – Neurologic status of patient
  – Results of imaging studies

• Role of closed reduction (CR) and timing of MRI are still controversial

\textsuperscript{1} Nassr A, et al. \textit{Spine} 2008;33:E188-93
\textsuperscript{3} Arnold PM, et al. \textit{Am J Orthop} 2009;38:E156-61
Closed Reduction

• Potential benefits
  – Restore normal alignment
  – Achieve “indirect” decompression of spinal canal
  – Confer immediate stability
  – Prevent further injury to neural elements
Closed Reduction

- Shown to be a safe and effective method for addressing cervical dislocations in alert, cooperative patients\textsuperscript{4-6}
  - Facilitates correction of deformity
  - Relieves ongoing spinal cord compression

\textsuperscript{4} Cotler JM, et al. \textit{Spine} 1993;18:386-90
\textsuperscript{5} Grant GA, et al. \textit{J Neurosurg} 1999;90:13-8
\textsuperscript{6} Vaccaro AR, et al. \textit{Spine} 1999;24:1210-7
Closed Reduction

- May bring about disc disruption which could increase the risk of further neurologic decline\(^6,7\)
- Multiple authors have suggested that a MRI should be obtained prior to attempting these maneuvers\(^7,8\)

Risks of Delaying Closed Reduction

• Prereduction MRI results in prolonged spinal cord compression
  – Severity of SCI is time-dependent and window for neurologic recovery is extremely limited\(^9\)
  – Obtaining MRI first may delay definitive treatment by several hours or more

• Unstable spine more susceptible to additional iatrogenic injury

Timing of Reduction?

• Anecdotal reports of catastrophic injury following CR involved administration of general anesthesia\textsuperscript{7,10,11}

• Ability to perform neurologic exam provides “real-time” data regarding status of spinal cord which is superior to intraoperative neuromonitoring

\textsuperscript{10} Burke DC, Berryman D. \textit{J Bone Joint Surg Br} 1971;53:165-82

Timing of Reduction?

- Minimal risk of neurologic decline when CR performed in alert, cooperative patients
- No instances of permanent neurologic deficits arising from awake CR published in literature

Immediate Quadriplegia after Manipulation for Bilateral Cervical Facet Subluxation

A CASE REPORT

BY STEVEN C. LUDWIG, M.D.; ALEXANDER R. VACCARO, M.D.; RICHARD A. BALDERSTON, M.D.; AND JEROME M. COTLER, M.D., PHILADELPHIA, PENNSYLVANIA

Investigation performed at the Department of Orthopaedic Surgery, Jefferson Medical College, Thomas Jefferson University, Philadelphia
Timing of Reduction?

- Closed reduction clearly indicated for cervical dislocations resulting in complete SCI
  - Benefits of rapid indirect decompression far outweigh risks of producing a new disc lesion
  - “Nothing to lose and most to gain”
Timing of Reduction?

• Role/timing of closed reduction still controversial for cervical dislocations associated with no or incomplete deficits
  – Prereduction MRI may be beneficial for obtunded patients
  – Reasonable to proceed with immediate reduction in alert patients
Conclusion

• Initial management of patients with SCI may mitigate risk of further injury and facilitate neurologic recovery
• The safety/efficacy of various neuroprotective therapies remain controversial
• Immediate closed reduction of cervical dislocations is a reasonable option for alert patients or those with complete SCI
Thank You!