Disclosures

• I have no relevant financial disclosures to make

Never do anything you wouldn’t want to explain to the paramedics.
Disclaimer

• Out of hospital providers should follow local protocol at all times.
• Estimated that between 1 and 5 million patients receive spine immobilization each year
Which Patient Need Spinal Immobilization?
History of Spinal Immobilization

• “A thorough search of the literature, however, reveals few references to motor vehicle accidents in terms of the environment that is present immediately after the accident, or in terms of the position of the victim in relationship to the various types of injuries, and no reference whatever that might deal with specific treatment techniques at the accident site.”

• “Emergency room personnel accept these patients without questioning whether their injuries are those sustained in the accident, or whether the injuries may have been compounded by the actions incident to the victim’s removal from the wreck and transportation to the hospital.”

History of Spinal Immobilization

• Case series of 958 patients who suffered spinal cord injury over 25 years.
• Delayed onset of paralysis (hours or days)
• “Failure to recognize the injury …and to protect the patient from consequences of his unstable spine”
• “It may have occurred when the patient was being moved from the site of the accident to a hospital. Quite frequently it occurred following admission to hospital.”
• “The importance of proper first aid was deduced from the fact that 29 patients developed further paralysis through faulty handling.”

History of Spinal Immobilization

• Spine boards are of great value in extricating all types of injured, particularly the most frequent mishandled injury, fracture of the spine with actual or impending damage to the cord.
• The spine board is ideal for the victim with such an injury…
• The victim is taken to the hospital on the board, which should be removed only by a physician.

History of Spinal Immobilization

Fig. 17. Grasping ejected victim’s clothing, rescuers turn him part way, position board, turn him back on it.

Fig. 18. After straps carried in every rescue vehicle assure patient’s security, he is ready for journey to hospital.

History of Spinal Immobilization

“Use of long and short spine boards definitely lessens the potential damage to the victims, especially one with an injured spine, and makes difficult tasks relatively easy.”

History of Spinal Immobilization
EMS Gospel

- If there is clinical concern, immobilize
- If in doubt, immobilize
- If you think someone will yell at you, immobilize
And the Word Is Good
What are We Trying to Prevent?

- Aggravation of an existing axial spine injury that could
  - Cause a spinal cord injury
  - Worsen a spinal cord injury
The Magnitude of the Problem

- 3-25% of spinal cord injuries are secondary
  - Occurring during prehospital or early hospital care
  - Result of inappropriate management
    - Lack of spinal immobilization

But Wait

- Not easy to identify a neurological decline throughout the prehospital phase
- Extrapolation of results in the hospital setting to the prehospital arena is questionable
- Several of the cited studies were conducted many years ago
- Approximately 5% of patients with spinal injuries experience some degree of neurological worsening even with good immobilization of spine.

• 12 of 186 patients with ASIA Grade A (6.0%) complete spinal cord injury had neurological deterioration during the first 30 days
  – No patients with penetrating trauma had deterioration
  – Early deterioration (less than 24 hours) was related to traction and immobilization
  – Delayed deterioration (between 24 hours and 7 days) was related to sustain hypotension
  – Late deterioration (more than 7 days) was related to vertebral artery injury

The Magnitude of the Problem

- 2-4% of trauma patients have cervical spine injury
  - 20% have spinal cord injury
- 20% of spinal column injuries involve multiple noncontiguous vertebral levels
- Cervical spine injuries more often observed in
  - Unconscious patients
  - Obtunded patients

Outcome of Spinal Cord Injury

- Shift in functional outcome for patients with spinal cord injuries in Western countries
- Increasing survival rates and life expectancy

Factors Affecting Outcome

Positive Effect
- Education
- Legislation
- Safety features of cars

Neutral or Negative Effect
- Implementation of evidence based guidelines
- Advances in Emergency Medical Services
- Improvements in neurocritical care
- Establishment of regional trauma centers

Systematic Injury Prevention Strategies

Cervical Collar
True Immobilization?

- Collars can be placed and removed without large displacements
- Rigid collar can increase movement of the upper cervical spine
- Similar restrictions in the cervical range of motion using soft and rigid collars
- Less motion with a collar in place than without a collar
- A collar does not effectively reduce motion in an unstable spine
- No extra motion control by adding a collar to a spine board with head blocks
- A collar and spine board provide more immobilization than a collar alone
- A collar and a vacuum mattress offer greater stability and comfort than a collar and spine board
- Immobilization provided by the short board is superior to collars and not augmented by adding collars
- Sandbags, collar and tape is the most effective measure for motion control
- A board, collar and towels/foam wedges is the most stable immobilization

Collar efficacy on motion control has never been examined in real trauma patients.

Penetrating Trauma

- No study has demonstrated that penetrating trauma can produce an unstable spine injury
- Progression of spinal cord injury has not been demonstrated to occur following penetrating trauma
- Immediate and permanent neurologic deficit
- An analysis of the National Trauma Data Bank noted a two fold increase in mortality in patients who were immobilized compared to similar patients who were not.

Haut ER, Kalish BA, Efron DT, Haider AH, Stevens KA, Kieninger AN, Cornwell EE, Chang DC. Spine immobilization in penetrating trauma: more harm than good? J Trauma 2010,68;115-121.
Paramedic Chaun Williams shot outside laundromat

4:35 PM, Jun 9, 2011
By Sharon Stevens

University City, MO (KSDK) - A St. Louis EMT is fighting for his life this afternoon after being shot several times.

Investigators said Chaun Williams was off-duty when he was shot at a University City Laundromat just after 10 p.m. in the 7200 block of Balson Avenue. Dozens of shell casings were recovered at the scene.

Williams was rushed to a nearby hospital, where he remains listed in critical condition. St. Louis fire officials said he's had multiple surgeries and faces additional procedures.

Williams joined the department three years ago and is stationed at Engine House No. 2 in downtown St. Louis. St. Louis Fire Chief Dennis Jenkerson described Williams as an excellent worker. Williams has been a paramedic with the department since February 2008.
Weighing the Balance

- Pros
  - Spinal column injuries will not be aggravated, preventing additional spinal cord injury

- Cons
  - Airway compromise
  - Respiratory compromise
  - Aspiration risk
  - Increased intracranial pressure
  - Cutaneous pressure ulcers
  - Iatrogenic pain
  - Increased difficulty in patient handling
  - Combativeness/resistance
  - Increased cost
  - Delay to definitive care
Airway Compromise

• Endotracheal intubation significantly more difficult inpatients with immobilization
  – 41% failure rate
  – Significant rate of reintubation in the ED for unrecognized EMS endotracheal tube malposition or dislodgement

Airway Compromise

• Use of hard collar, straps and sandbags reduces view for laryngoscopy
  – View improved by 1 grade in 56% of patients with manual in-line stabilization (MLIS)
  – View improved by 2 grades in 10% of patients with MLIS

• MLIS impedes endotracheal intubation
  – 50% intubation failure after 30 seconds
  – 5.7% intubation failure in those without stabilization

• MLIS doubles force applied during intubation

Abram S, Bulstrode C. Routine spinal immobilization in trauma patients: what are the advantages and disadvantages? Surgeon. 2010; 8:218-222.
Respiratory Compromise

- Straps tightened across the torso have a restrictive effect
  - Lowers forced vital capacity (13.97%)
  - Lowers forced expiratory volume over 1 second (14.16%)
  - Lowers forced mid-expiratory flow (18.70%)

- Injuries to the chest wall and lungs further interfere with respiratory mechanics

Aspiration Risk

- Mouth opening compromised by cervical collar
- Supine position
- Easier aspiration
Increased Intracranial Pressure

• A collar may increase intracranial pressure by 5.3 mmHg (51.6 ± 60.6%)
  – Obstruction of venous drainage → edema
  – Persistent painful stimulus from collar pressure points
• Venous congestion by collars exacerbate global brain injuries
  – Observed after attempted suicide by hanging
• 5% of patients with a TBI have an associated spinal injury
• 25% of patients with spinal injury have at least a mild TBI

Cutaneous Pressure Ulcers

- Contact pressure in the occipital and sacral region are above the pressures at which tissue necrosis and pressure ulcers develop
  - Significant hypoxia in sacral tissue of healthy adults after 30 minutes on spine board
  - Early pressure ulcer development begins prior to arrival at the hospital
- In studies, the incidence of collar-related pressure ulcers is 6.8% to 38%
  - Locations included the occiput, chin, shoulders and back
  - Severity ranged from Stage 1 to Stage 4 requiring surgical debridement

Iatrogenic Pain

- Pain in the lower back and cervical spine due to the anatomically incorrect positioning caused by a flat backboard
- Exacerbation of existing painful conditions
- New pain to develop in areas not painful prior to the application of the spine board
  - In 21 uninjured adults, 55% developed moderate to severe pain after being immobilized for 30 minutes
  - In healthy volunteers, lower back and cervical pain reported to persist for 24 hours after being subject to only one hour on a spine board

Time on Board

- Prospective, observational study
- Regional adult level one trauma center
  - Public, urban, tertiary care facility
- 102 subjects
  - Total backboard time 63.63 (±45.87) minutes
  - Total ED backboard time 46.36 (±44.88) minutes
  - Mean transport time 15.8 (±11.4) minutes

Time on Board

- Convenience sampling
- Academic, level 1 trauma center
- 46 patients followed
  - Mean total backboard time 54 minutes (SD ±65)
  - Mean EMS interval 33 minutes (SD ±64)
  - Mean ED interval 21 minutes (SD ±15)
  - ED interval trended inversely with ESI
    - 1 = 5 min, 2 = 10 min, 3 = 25 min, 4 = 26 min, 5 = 32 min
  - No change in ED interval associated with NEDOCS score

Increased Cost

- Difficult to distinguish between pain caused by trauma and pain caused by the spine board
  - Increased number of imaging studies
  - Increased cost of evaluation
- Unnecessary radiological studies have been correlated with increasing risk for the development of cancer
Delay to Definitive Care

- Time required to properly immobilize a cervical spine is not short
  - Experienced emergency medical technicians require 5.6 minutes (± 1.49)
- Can be catastrophic for a patient with penetrating trauma requiring urgent surgical intervention for airway compromise or hemorrhage

Three Column Theory

- Three column theory of spinal injury
  - Assumption of an abrupt acceleration or deceleration to the spine
  - Disruption of the boney and ligamentous anatomy of at least two of the three columns
Biomechanics
• Considerable force is required to fracture the spine
  – >2,000-6,000 N is applied to cervical spine
  – > 4,200 N is applied to lumbar spine
• Subsequent low-energy movements are unlikely to cause secondary spinal cord injury
• Awake patients generally maintain a stable neck position with muscle contractions that protect the spinal cord

Educational effort sponsored jointly by National Association of Emergency Medical Technicians and the American College of Surgeons Committee on Trauma (ACS-COT)

Recommendations

- There are no data to support routine spine immobilization in patients with penetrating trauma to the neck or torso.
- There are no data to support routine spine immobilization in patients with isolated penetrating trauma to the cranium.
- Spine immobilization should never be done at the expense of accurate physical examination or identification and correction of life threatening conditions in patients with penetrating trauma.
- Spinal immobilization may be performed after penetrating injury when a focal neurologic deficit is noted on physical examination although there is little evidence of benefit even in these cases.

Utilization of backboards for spinal immobilization during transport should be judicious, so that the potential benefit outweighs the risk.

Appropriate patients to be immobilized with a backboard may include those with:
- Blunt trauma and altered level of consciousness
- Spinal pain or tenderness
- Neurologic complaint (e.g., numbness or motor weakness)
- Anatomic deformity of the spine
- High-energy mechanism of injury and any of the following:
  - Drug or alcohol intoxication
  - Inability to communicate
  - Distracting injury

EMS spinal precautions and the use of the long backboard. Prehosp Emerg Care. 2013 Jul-Sep;17(3):392-3
Joint Position Statement

• Patients for whom immobilization on a backboard is not necessary include those with all of the following:
  – Normal level of consciousness (GCS of 15)
  – No spine tenderness or anatomic abnormality
  – No neurologic findings or complains
  – No distracting injury
  – No intoxication

• Patients with penetrating trauma to the head, neck, or torso and no evidence of spinal cord injury should not be immobilized on a backboard

EMS spinal precautions and the use of the long backboard. Prehosp Emerg Care. 2013 Jul-Sep;17(3):392-3
Spinal precautions can be maintained by application of a rigid cervical collar and securing the patient firmly to the EM stretcher, and may be most appropriate for:

- Patients who are found to be ambulatory at the scene
- Patients who must be transported for a protracted period of time, particularly prior to interfacility transfer
- Patients for whom a backboard is not otherwise is attached.

EMS spinal precautions and the use of the long backboard. Prehosp Emerg Care. 2013 Jul-Sep;17(3):392-3
Modern Theory of Neurological Deterioration

• Tissue hypoxia
  – Global hypoxia
• Damage to the blood vessels feeding the cord itself
• Microvascular injury
• Compression due to edema
• Cord injury causes a complex series of physiological changes that can result in apoptosis and cell death
  – Hypoxia
  – Contusion
A Shift in Attitudes

- On-line survey of providers in suburban Maryland
  - 22 hospital-based ED providers (16%)
    - Physicians (4)
    - PAs/NPs (6)
    - RNs (10)
    - Technicians (2)
  - 148 prehospital EMS providers
    - 64 EMT-Basics (10%)
    - 84 EMT-Intermediates and EMT-Paramedics (46%)
- Nonselective spinal immobilization protocol based on both the NEXUS criteria and Canadian C-Spine Rule
A Shift in Attitudes

- **I feel comfortable using the Kendrick Extrication Device (KED). (KED_comfort)**
- **I am comfortable appropriately sizing a cervical collar. (collar_comfort)**
- **I am familiar with clinical decision rules (NEXUS, Canadian C-spine rules, etc) that help determine which patients require evaluation for cervical spine injury. (decision_rules_familiarity)**

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A Shift in Attitudes

Spinal immobilization is appropriate in the management of penetrating trauma to the chest and abdomen. (penetrating_trauma_approp)

I regularly use or see padding being used on patients who are being immobilized on a backboard. (regular_padding)

I regularly provide care for patients that have had spinal immobilization initiated after treatment or transport has begun. (secondary_immob)
A Shift in Attitudes

A Shift in Attitudes

Our data indicate that providers believe spinal immobilization is appropriate in the management of penetrating trauma (despite evidence to the contrary), highlighting the need for reeducation regarding this practice. Because this finding was widespread across provider type and independent of length of service, we suggest that this topic be addressed as a part of both initial certification and continuing education. We also suggest that it be explicitly addressed in EMS prehospital protocols.

How Can You Immobilize This?

Do you need to?
Questions?

Email: gilmorew@wustl.edu