Board to death – current strategies in spinal motion restriction

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Incidence

Only 2 – 5% of severely traumatically injured patients have cervical spinal fractures and only 1 – 2% of those has an unstable cervical fracture.

Yet…the risk can have significant impacts on the life of the trauma patient.
Sadly…

It is estimated that somewhere between 3 and 25% of all injuries to the spinal cord occur during the initial management stages causing us to look at our historical practices.
History

Pre 1960s
Advanced first aid was highest level of training for ambulance personnel

1966
Geisler et al published article highlighting spinal cord injury after transport of two patients, medical community accepts backboard as standard of care for all blunt-force trauma

1968
Farrington described placement of a cervical collar and longboard to reduce sagging of head and neck.
History

1971
American Academy of Orthopedic surgeons published first guidelines for EMS treatment advocating use of backboard and cervical collar

1979
Bohlman link delayed paralysis to under-appreciation of spinal cord injuries by emergency physicians and hospital spinal precautions became significant.
Questioning history - 1998

Full standard spinal precautions applied

Patients did not receive spinal precautions

Hauswald et al compared neurological outcomes between New Mexico and Malaysia (comparable age, mechanism of injury and spinal cord level) and found the odds ratio for neurological disability higher in New Mexico.
Concerns with accepted practice

- Backboards
- Log rolling
- Cervical Collars
Effects of backboard use: Pain

- Pain related to backboard
  - Healthy, volunteers asked to lay on a backboard for 80 minutes. Pain and tissue-interface contact pressures were measured every 20 minutes.
  - All patients rated pain at 0/100 at the beginning and increased incrementally each 20 minutes. Average pain rating at 80 minutes was 37.5/100.
Effects of backboard use: Pain

- Healthy volunteers were asked to lay on a backboard for 60 minutes. (Simulate 15 minute transport time and 45 minute ED time on backboard time)
  - 76.9% reported pain at the end.
  - 23.1% reported neck pain
  - 35.9% reported occipital pain
  - 17.9% had pain 24 hours later.
Effects of backboard use: Unnecessary radiological testing

- Difficulty distinguishing between pain caused by injury and pain from backboard may cause extra radiological studies:
  - Increases risk of cancer
  - Increases length of stay
  - Increases cost of care

Oftentimes, patients who didn't have midline point tenderness when placed in a C-collar and/or on a backboard are found to have tenderness after being on the backboard for a short time.
Effects of backboard use: Pressure Sores

- Volunteers were placed on backboards for 30 minutes.
- Sacral transcutaneous oxygen tension was measured throughout.
- At 30 minutes, sacral transcutaneous oxygen tension dropped 14.8% ± 17.5%
- Pressure sores develop in as little as several hours.
40% of patients with spinal cord injuries will develop pressure sores in the immediate post-injury period with a mortality rate of 7 to 8%.
Effects of backboard use: Spinal lordosis

Studies demonstrate that more than 80% of adults require 1.3 to 5.1 cm of occipital padding to maintain the cervical spine in the neutral position relative to the torso, dependent on physical characteristics and muscle development.
Effects of backboard use: Respiratory Compromise

- Studies of healthy, nonsmoking males show that straps tightened across the torso lower:
  - The patient’s forced vital capacity
  - Forced expiratory volume over one second
  - Forced mid-expiratory flow
- These effects exacerbated in patients with chest injuries
Concerns with accepted practice

Backboards

Log rolling

Cervical Collars
Effects of cervical collar – Increase spinal motion

- Rigid cervical collar application results in a 7.3 mm ± 4.0 mm separation between C1 and C2.
- Evidence shows rigid collars can worsen high spinal cord injuries.
Effects of cervical collar – Difficult airway management

Even properly applied cervical collar restricts mouth opening by 25% or more

There is no documented case where endotracheal intubation worsened a cervical spinal injury
Effects of cervical collar – Intracranial Pressure

- A properly applied cervical collar will not impede arterial flow but can impede venous flow.
- Intracranial pressure is dependent on:
  - Size of brain
  - Amount of cerebrospinal fluid
  - Amount of blood (80% of blood in cranium is venous)
Effects of cervical collar – Pressure sores

• Like backboards, cervical collars cause pressure, especially on the occiput.
• Occipital pressure sores are especially serious because of the lack of subcutaneous tissue between the occiput and the skin.
Concerns with accepted practice

Backboards

Log rolling

Cervical Collars
Logrolling

- Numerous studies indicate that log-rolling DOES NOT maintain alignment of the spine.
- The head, shoulders, torso and hips vary in dimensions and log rolling make it difficult to maintain spinal alignment.
- Can cause rotational movement along the axis.
- This is exacerbated with protective equipment (e.g. football)

- Log roll increases the risk of injury to the health care worker.
Where are we at today?
#1 – New terminology

Spinal immobilization

Spinal motion restriction
# 2 – Questioning the need for spinal motion restriction
Current recommendations – use of spinal motion restriction

- Spinal motion restriction should be considered for patients with a plausible blunt mechanism of injury AND any of the following:
  - Altered level of consciousness or clinical intoxication
  - Midline spinal pain or tenderness
  - Focal neurological signs and symptoms
  - Anatomic deformity of the spine
  - Distracting injury
Mnemonic

- **N**eurological Deficits
- **S**pinal Tenderness
- **A**ltered Mental Status
- **I**ntoxication
- **D**istracting Injury
Current recommendations – use of spinal motion restriction

- Spinal motion restriction not required in the following circumstances:
  - Normal level of consciousness (GCS = 15)
  - Lack of spinal tenderness or anatomic abnormality
  - Lack of neurological findings or complaints
  - Lack of distracting injuries
  - Not intoxicated.
Key points

• Remember:
  • The initial mechanism of injury causing the spinal injury is usually much more significant than simple movements during patient care.
  • The natural responses of the body to serious injury creates a de facto splint as the muscles of the neck contract limiting severe motion
  • Patient with injury will avoid movement to reduce pain.
Food for thought!

• Domeier et al:
  • Prospectively collected EMS data on 8975 patients using NSAID criteria:
    • 295 (3.3%) had spine injuries
    • Pre-hospital identified 280 of 295 (94.4%)
    • Thirteen missed injuries had stable injuries
    • Missed injuries did not result in additional neurological compromise
Maine Experiment

- The state of Maine has been utilizing pre-hospital selective assessment protocol since 2002 (similar to NSAID criteria).
  - 32,000 trauma encounters
  - 2220 were immobilized
    - 416 (32%) – unreliable
    - 358 (28%) – distracting injuries
    - 80 (6%) – abnormal neurological findings
    - 709 (54%) spine pain/tenderness
  - 1 patient with unstable fracture was NOT immobilized
  - 19 patients with stable fractures were not immobilized.
Canadian C-Spine Protocol

Is there a high-risk factor present?

• Over age 65
  • Dangerous mechanism
  • Paresthesias

Is there a low-risk factor present?

• Simple rear end mechanism
  • Ambulatory at scene or sitting in ED
  • Delayed onset of neck pain
  • Absence of midline cervical spine tenderness

Can the patient actively rotate the neck 45° to the left or right?

Determines whether patient needs C-Spine radiographs – if a patient does not require radiographs – they do not require immobilization
# 3: Current recommendations – penetrating trauma

Spinal motion restriction in penetrating trauma patients is associated with higher mortality, is unnecessary, potentially hazardous, and not recommended (ENA)

- The Emergency Nurses Association (ENA)
- The National Association of EMS Physicians (NAEMSP)
- The American College of Surgeons Committee on Trauma (ACS-COT)
Penetrating trauma – the facts

Haut et al reported that penetrating trauma for whom spinal immobilization is applied have an odds ratio of death at 2.06 (over twice the rate) than those who are not immobilized.
# 4: Reduce backboard use

- The long back board is an extrication tool
- It is NOT:
  - An effective way to achieve spinal motion restriction
  - A transport tool
- If applied, it should be removed as rapidly as possible
- If back board is removed by advanced practitioner and the patient requires transfer, it should NOT be reapplied.
Extrication and backboard

- If cervical spine cannot be cleared before extrication, apply a cervical collar
- Allow patient to exit situation under their own volition if alert and reliable.
- Otherwise extrication should be performed with a KED (or similar device) and immobilized on stretcher or vacuum mattress.
Backboard versus ambulance stretcher

- Wampler et al:
  - Healthy volunteers driven through course in ambulance on backboard, then driven through same course without backboard.
  - Backboard allowed 0.8 cm greater mean lateral motion, increased patient movement and more torso movement relative to the head.
Backboard versus hospital stretcher

Healthy volunteers laid on a firm backboard and a thin mattress. Ability to flex, extend, rotate or laterally bend the cervical spine were made using a goniometer. There was no significant difference in flexion ($p = 0.410$), extension ($p = 0.231$), rotation ($p = 0.891$), or lateral bending ($p = 0.230$) between the two positions.
Current recommendations – Hospital Care

If patient does arrive in the ED with a backboard in place, it should be removed as soon as possible after arrival (Do not need to wait for radiological exams).
Is abolishment of backboards accepted practice?

- Pre-hospital examples
  - Xenia Fire Department (Ohio)
  - Alameda Country (California)
  - Rio Rancho Fire Department (New Mexico)
  - State of Maryland
- 42% of hospitals have protocols to remove trauma patients from the backboard immediately on arrival (before radiological exam)
#5: Use alternatives to logrolling

Log Roll

Lift and Straddle

6+ lift and slide

Scoop Stretcher

Lift and Slide
Alternatives to log roll

(A) Horizontal slide.
(B) Diagonal adjustment
(C) V-adjustment.
Alternatives to logroll

(Movement of C5-C6 in millimeters)

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<th>LB</th>
<th>AT</th>
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FE = Flexion/Extension
AR = Axial Rotation
LB = Lateral Bending
AT = Axial Translation
ML = Medial/Lateral
AP = Anteroposterior
Alternatives to log roll

Log roll may be required in certain circumstances:

- Patient found in prone position
- Lack of appropriate personnel to carry out other techniques
- Patient vomits and suction is not immediately available.

Overall, cumulative motion to the unstable spine can be reduced by approximately 50% if the log roll is avoided and alternative measures are employed.
Split and scoop stretchers

LR = Log Roll
LS = Lift and Slide Technique
Scoop = Scoop Stretcher
Consider alternatives

Slider boards

Roller boards

Air assist device

Vacuum mattress
The final word!

Rigid cervical collar + backboard reduces cervical motion to 34% of normal.
Add head blocks and motion reduced to 12% of normal.
The final word

The most restrictive devices still allow 57.8% of axial rotation and 53.8% of lateral bending.
The final word!
Questions?
References


References


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