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EMS Long Spine Board Immobilization

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Continuing Education Activity

Spinal motion restriction using a long spine board and cervical spine collar is implemented in the case of trauma, when certain criteria are met, to help reduce the chance of spinal cord injury. The indications for applying spinal motion restriction are a GCS of less than 15, evidence of intoxication, midline neck or back tenderness or pain, focal neurologic signs and/or symptoms, anatomic deformity of the spine, and distracting circumstances or injuries. This activity outlines and reviews the role of the interprofessional team in evaluating, treating, and managing patients who undergo spinal motion restriction.

Objectives:

- Review the indications for utilizing spinal motion restriction.
- Summarize the potential complications of spinal motion restriction.
- Review the anatomy and pathophysiology of spinal column trauma and how it can lead to spinal cord injury, necessitating immobilization..
- Outline some interprofessional team strategies to improve care coordination in cases where spinal immobilization is necessary, improving patient outcomes.

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Introduction

Blunt traumatic injuries are the leading cause of spinal cord injuries in the United States, with an annual incidence of approximately 54 cases per million population and about 3% of all blunt trauma admissions to the hospital.

[1] Although spinal cord injuries represent only a small percentage of blunt trauma injuries, they are among the largest contributors to morbidity and mortality.[2][3]

As a result, in 1971, the American Academy of Orthopedic Surgeons proposed using a cervical collar and a long spine board for spinal motion restriction for patients with suspected spinal injuries, which was based entirely on the mechanism of injury. At the time, this was based on consensus rather than evidence.[4] In the decades since spinal motion restriction, using a cervical collar and long spine board has become the standard in prehospital care. It can be found in several guidelines, including the Advanced Trauma Life Support (ATLS) and Prehospital Trauma Life Support (PHTLS) guidelines.

Despite their widespread use, the efficacy of these practices has been called into question. In one international study comparing those who underwent spinal motion restriction to those who did not, the study found that those who did not receive routine care with spinal motion restriction had fewer neurologic injuries with disability. However, it should be noted that these patients were not matched for the severity of the injury.[5]

Using healthy young volunteers, another study looked at lateral spine motion on a long spine board compared to a stretcher mattress and found that the long spine board allowed the greater lateral motion.[6] In 2019, a retrospective, observational, multi-agency prehospital study examined whether or not there was a change in spinal cord injuries after

implementing an EMS protocol that limited spinal precautions to only those with significant risk factors or abnormal exam findings and found that there was no difference in the incidence of spinal cord injuries.[7]

There are currently no high-level randomized control trials to either support or refute the use of spinal motion restriction. It is unlikely there will be a patient to volunteer for a study that could result in permanent paralysis violates current ethical guidelines.

As a result of these and other studies, newer guidelines recommend limiting the use of long spine board spinal motion restriction to those with a concerning mechanism of injury or concerning signs or symptoms as described later in this article and limiting the duration that a patient spends immobilized.

Anatomy and Physiology

The spinal column is the principal support system of the body and comprises 33 vertebrae, with the spinal cord passing through the center of each vertebra. The spinal column is divided into five sections: cervical spine, thoracic spine, lumbar spine; sacral spine; and the coccyx.

Vertebrae themselves have several anatomical features, but they can be broadly classified into the portions anterior and posterior to the spinal cord for the sake of this review. The anterior portion contains the large, rounded vertebral body lined anteriorly by the anterior longitudinal ligament and posteriorly by the posterior longitudinal ligament. The posterior portion contains the spinous and transverse processes, vertebral arch, and the posterior ligament complex comprised of the facet joint capsules, the supraspinous ligament, the interspinous ligament, and the ligamentum flavum.

Between each vertebra are fluid-filled discs (the nucleus pulposus) surrounded by a tough ring of ligament fibers (the annulus fibrosus) that act as shock absorbers.

Several classification systems were used to categorize spinal fractures, with one of the most widely adopted being the three-column theory proposed by Francis Denis in 1983.[8] In this theory, the spine is divided into three columns

The anterior column contains the anterior portion of the vertebral body, the anterior longitudinal ligament, and the anterior annulus fibrosus.

The middle column contains the posterior portion of the vertebral body, the posterior longitudinal ligament, and the posterior annulus fibrosus.

The posterior column contains the posterior ligament complex, vertebral arch, and transverse and spinous processes.

In Denis' theory, injury to two or more columns is considered an unstable fracture to injure the spinal cord that lies within the spinal column. The purported benefit of spinal motion restriction is that by minimizing spinal motion, one can reduce the potential for secondary spinal cord injuries from unstable fracture fragments during extrication, transport, and evaluation of trauma patients.[9]

Indications

The indications for spinal motion restriction are dependent on the protocol developed by local emergency medical service directors and may vary accordingly. Although there may be some variation, they will typically incorporate either the NEXUS C-Spine Rule or the Canadian C-Spine Rule. However, the American College of Surgeons Committee on Trauma (ACS-COT), the American College of Emergency Physicians (ACEP), and the National Association of EMS Physicians (NAEMSP) have developed a joint statement on spinal motion restriction in adult blunt trauma patients in 2018 and has listed the following indications:[10]

- Altered level of consciousness, signs of intoxication, GCS < 15
- Midline spinal tenderness or pain
- Focal neurologic signs or symptoms such as motor weakness, numbness
- Anatomic deformity of the spine
- Distracting injuries or circumstances (e.g., fractures, burns, emotional distress, language barrier, etc.)

The same joint statement also made recommendations for pediatric blunt trauma patients, noting that age and ability to communicate should not be a factor in decision making for prehospital spinal care. The following are their recommended indications:[10]

- The complaint of neck pain
- Torticollis
- Neurologic deficit
- Altered mental status, including GCS <15, intoxication, and other signs (agitation, apnea, hypopnea, somnolence, etc.)
- Involvement in a high-risk motor vehicle collision, high impact diving injury, or has substantial torso injury

Contraindications

A relative contraindication in patients with penetrating trauma to the head, neck, or torso without neurologic deficit or complaint.[11]

According to studies published in the Eastern Association for the Surgery of Trauma (EAST) and The Journal of Trauma, patients with penetrating trauma who underwent spinal immobilization were twice as likely to die as patients who did not. Immobilizing a patient is a time-consuming process, between 2 to 5 minutes, that not only delays transport for definitive care but also delays other prehospital treatments as this is a two-person procedure.[12][13]

Equipment

The equipment necessary for spinal motion restriction requires a spine board (either long or short) and a cervical spine collar.

Long Spine Boards

Long spine boards were initially implemented, in conjunction with a cervical collar, to immobilize the spine as it was thought that improper handling in the field could cause or exacerbate spinal cord injuries. The long spine board was also cheap and served as a convenient method to transport unconscious patients, reduce unwanted movement, and cover uneven terrain.[14]

Short Spine Boards

Short spine boards, also known as intermediate-stage extrication devices, are typically more narrow than their longer counterparts. Their shorter length allows for their use in closed or confined areas, most commonly in motor vehicle collisions. The short spine board supports the thoracic and cervical spine until the patient can be placed on a long spine board. A common type of short spine board is the Kendrick Extrication Device, which differs from the classic short spine board in that it is semi-rigid and extends laterally to encompass the flanks and head. Similar to long spine boards, these are also used in conjunction with cervical collars.

Cervical Collars

Cervical collars can be classified into two broad categories: soft or rigid. In trauma settings, rigid cervical collars are the immobilizer of choice as they provide superior cervical restriction.[15] Cervical collars are generally designed to have a posterior piece that uses the trapezius muscles as a support structure and an anterior piece that supports the mandible and uses the sternum and clavicles as a support structure. Cervical collars by themselves do not offer adequate cervical immobilization and require additional lateral support structures, often in the form of Velcro foam pads found on long spine boards.

Technique or Treatment

Several techniques are available for placing someone in spinal motion restriction, one of the most common being the supine log-roll technique outlined below and is performed, ideally, with a 5-person team, but at minimum, a team of four.[16]

For a Team of Five

Before immobilization, have the patient cross their arms over their chest.

A team leader should be assigned to the head of the patient who will perform inline manual stabilization by grasping the patient's shoulders with their fingers on the posterior aspect of the trapezius and their thumb on the anterior aspect with the forearms pressed firmly against the lateral aspects of the patient's head to limit motion and stabilize the cervical spine. If available, a cervical collar should be placed at this time without lifting the patient's head off the ground. If one is not available, maintain this stabilization during the log roll technique.

Team member two should be positioned at the thorax, team member three at the hips, and team member four at the legs with their hands positioned on the far side of the patient. Team member five should be ready to slide the long spine board under the patient after they are rolled.

On team member 1's command (typically on a count of three), team members 1 to 4 will roll the patient, at which time team member five will slide the long spine board under the patient. Once again, on team member one's command, the patient will be rolled onto the long spine board.

Center the patient on the board and secure the torso with straps followed by the pelvis and upper legs.

Secure the head by placing either rolled towels on either side or a commercially available device and then place tape across the forehead and secured to the edges of the long spine board.

For a Team of Four

Again, a team leader should be assigned to the patient's head and follow the same technique outlined above.

Team member two should be positioned at the thorax with one hand on the far shoulder and the other on the far hip.

Team member three should be positioned at the legs, with one hand positioned on the far hip and the other on the far leg. Note that it is recommended that the arms of the team members cross over each other at the hip.

Team member four will slide the long spine board under the patient, and the rest of the technique is followed as outlined above.

Complications

Pressure Injuries

A potential complication in those undergoing prolonged long spine board and cervical spine motion restriction are pressure ulcers, with an incidence reported as high as 30.6%.^[17] According to the National Pressure Ulcer Advisory Panel, pressure ulcers have now been reclassified as pressure injuries. They result from pressure, usually over bony prominences, for a prolonged time resulting in localized damage to the skin and soft tissue. In the early stages, the skin remains intact but may progress to an ulcer in later stages.^[18]

The amount of time it takes to develop a pressure injury varies, but at least one study demonstrated that tissue injury might begin in as little as 30 minutes in healthy volunteers.^[19] Meanwhile, the average time spent immobilized on a long spine board is around 54 to 77 minutes, approximately 21 minutes of which is accrued in the ED after transport.^{[20][21]} With this in mind, all providers must try to minimize the time patients spend immobilized either on rigid long spine boards or with cervical collars as both may lead to pressure injuries.

Respiratory Compromise

Multiple studies have demonstrated a reduction in respiratory function due to the straps used on long spine boards. In healthy young volunteers, the use of long spine board straps over the chest resulted in a decrease of several pulmonary parameters, including forced vital capacity, forced expiratory volume, and forced mid-expiratory flow resulting in a restrictive effect.^[22] In a study involving children, there was a reduced forced vital capacity to 80% of baseline.^[23] In yet another study, both rigid board and vacuum mattresses were found to restrict respiration by an average of 17% in healthy volunteers.^[24] Careful attention must be paid when immobilization patients, particularly to those with a pre-existing pulmonary disease as well as children and the elderly

Pain

The most common, well-documented complication of long spine board spinal motion restriction is pain, resulting in as little as 30 minutes. Pain is most commonly manifested with headaches, back pain, and mandible pain.[25] Again, and by now a recurring theme, time spent on a rigid long spine board should be minimized to reduce pain.

Clinical Significance

Blunt force trauma can cause spinal column injury and, consequently, spinal cord damage that can result in serious morbidity and mortality. In the 1960s and 1970s, spinal motion restriction was employed to reduce or prevent neurological sequelae thought to be secondary to spinal column injuries. Though widely adopted as the standard of care, the literature lacks any high quality, evidence-based research that investigates whether or not spinal motion restriction has any impact on neurological outcomes.[26] Additionally, in recent years there has been a growing body of evidence highlighting the potential complications of spinal motion restriction.[17][22][25][20]

Consequently, newer guidelines have recommended that spinal motion restriction be utilized judiciously in specific patient populations.[10] Although spinal motion restriction may be beneficial in some situations, the provider needs to be familiar with both the guidelines and potential complications for providers to be better equipped to apply these techniques and improve patient outcomes.

Enhancing Healthcare Team Outcomes

Patients who have been involved in blunt force trauma may present with a myriad of symptoms. It is important for health care professionals responsible for the initial evaluation of these patients to be familiar with the indications, contraindications, potential complications, and proper technique of implementing spinal motion restriction.

Several guidelines can exist to help determine which patients meet the criteria for spinal motion restriction. Perhaps the most well known and widely accepted guidelines is that of the joint position statement by the American College of Surgeons Committee on Trauma (ACS-COT), the National Association of EMS Physicians (NAEMSP), and the American College of Emergency Physicians (ACEP).[10] Although these are the current guidelines and recommendations, there are no high-quality randomized control trials to date, with recommendations being based on observational studies, retrospective cohorts, and case studies.[26]

In addition to being familiar with the indications and contraindications for spinal motion restriction, it is also important for health care professionals to be familiar with the potential complications such as pain, pressure ulcers, and respiratory compromise.

When implementing spinal motion restriction, all members of the interprofessional health care professional team must be familiar with their preferred technique and exercise good communication to execute the technique properly and reduce excessive spinal motion. Health care professionals should also recognize that time spent on a long spine board should be minimized to reduce complications. When transferring care, the EMS team should communicate the total time spent on the long spine board.

Utilizing the latest guidelines, being familiar with known complications, limiting time spent on the long spine board, and exercising excellent interprofessional communication outcomes for these patients can be optimized. [Level 3]

Review Questions

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