
AMBULANCE ENTRANCE ONLY

The Changing Standard of Care for Spinal Immobilization

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New guidelines suggest a more limited role for prehospital spinal immobilization based on increasing evidence that the practice often is not only unnecessary, but possibly harmful.

Prehospital spinal immobilization has long been the standard of care (SOC) to prevent spinal cord injury in trauma patients, but utilizing the best data currently available, some professional societies recently released new recommendations that question this practice. Guidelines released in 2014 from the National Association of EMS Physicians (NAEMSP) and the American College of Surgeons Committee on Trauma (ACS-COT) support limited application of spinal immobilization.[1] These guidelines note, "Given the rarity of unstable spinal injuries in EMS trauma patients, the number that might benefit from immobilization to prevent secondary injury is likely extremely small. For each patient who has potential benefit, hundreds to thousands of patients must undergo immobilization with no potential benefit." Further, they advise "utilization of backboards for spinal immobilization during transport should be judicious, so that potential benefits outweigh risks."[1] Spinal immobilization should not be used at all in patients with penetrating trauma who do not present with obvious neurological injury and should be selective, based on objective findings of injury or the high potential for same.[1]

Questioning a Long-standing Practice

Fear of the consequences of spinal cord injury from significant vertebral fractures has dictated prehospital spinal immobilization to manage injured trauma patients for decades. For almost 50 years, it has been the SOC. However, increasing evidence that spinal immobilization is not only unnecessary, but may even cause harm has resulted in questioning this paradigm, which has lead to promoting a change in the SOC.

Spinal immobilization dates back to the mid-1960s, when Geisler et al[2] reported on a cohort of patients who suffered long-term paralysis from what was believed to be improper handling and failure to discover spinal injuries. Soon after, Farrington[3,4] developed and published a systematic approach to spinal immobilization during extrication following blunt force trauma, supporting the widespread acceptance of backboards and cervical collars to immobilize the spine in injured trauma patients. Logic dictated that an unstable spine fracture could be worsened, or a cord injury could result, by unnecessary movement during extrication, transport, and initial evaluation in the ED, resulting in avoidable

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injury. This fear of potential secondary injury grew as more papers were published examining the link between prehospital handling of blunt force trauma patients and delayed paralysis. This resulted in the use of spinal immobilization on the majority of trauma patients, regardless of mechanism of injury or presenting symptoms.[5,6]

One review estimated that over 50% of trauma patients with no complaint of neck or back pain were transported with full spinal immobilization.[7] This immobilization on uncomfortable long backboards typically continued in the ED for prolonged periods, until the spine could be cleared by physical examination and/or imaging studies. Yet a 2001 Cochrane review found that despite increasing use of spinal immobilization, no prospective, randomized controlled trial of the appropriate use of spinal immobilization or patient outcomes had ever been conducted.[8]

What the Evidence Says

How much evidence exists that supports the benefits of spinal immobilization? Not much. Studies on healthy volunteers and cadavers evaluating spinal motion with immobilization have been contradictory.[9] One study found there was less motion with a cervical collar in place than without,[10] whereas others found that the use of a cervical collar did not effectively reduce motion in an unstable spine.[11,12] Perry et al[13] studied the effectiveness of different head immobilization techniques and found that none could eliminate head and neck motion during emergency medical services (EMS) transport. Still other reports, including two biomechanical studies, demonstrated increased neck motion when using conventional extrication techniques (cervical collar with backboard) versus controlled self-extrication with cervical collar only.[14,15]

An Abundance of Literature on the Risks

Whereas data regarding the actual benefits of spinal immobilization is lacking, an abundance of literature details the risks. One of the most frequently cited studies is also one of the most controversial. Hauswald et al[16] compared the outcomes of two groups of patients with blunt force trauma who were either immobilized during transport (in New Mexico) or non-immobilized (in Malaysia) and found that the risk of disability was higher in the immobilized group (odds ratio, 2.03). Although these environments are very different, the authors noted that mechanism of injury, resources, and the size of the hospitals were similar.[16]

Studies of spinal immobilization in patients with penetrating trauma report even worse outcomes. In separate studies, Haut et al[17] and Vanderlan et al[18] demonstrated increased mortality when immobilization led to increased transport times and interference with other resuscitative measures. These and other studies have led the American College of Emergency Physicians, NAEMSP, ACS-COT, the Prehospital Trauma Life Support Executive Committee, and other national organizations to recommend no spinal immobilization in patients with penetrating neck trauma.[1,19,20]

Many trauma patients arrive with complaints of pain at one or more sites. Some of these complaints, particularly back pain, may be secondary to the use of the backboard itself, especially in cases of prolonged transport.[21,22] In a study of healthy volunteers who were immobilized on a backboard for 30 minutes, all of them reported pain, along with headaches, most often involving the occipital and sacral regions.[23] A 1996 study compared spinal immobilization utilizing a backboard versus a vacuum mattress in 37 healthy volunteers with no history of back pain or spinal disease.[24] Compared to those immobilized with the vacuum mattress, patients immobilized with a backboard for 30 minutes were 3.1 times more likely to have symptoms, 7.9 times more likely to complain of occipital pain, and 4.3 times more likely to have lumbosacral pain.[24]

Increased pain complaints in the setting of trauma can result in increased imaging, leading to increased costs and unnecessary radiation exposure.[25] Prolonged backboard times can also result in sacral pressure ulcers.[26] A recent study has shown that patients who undergo computed tomography (CT) scans with automatic tube current modulation (as most modern multidetector row CT systems utilize) while on a backboard may be exposed to a significant increase in radiation dose.[27]

Spinal immobilization has also been linked to respiratory compromise, particularly with the use of straps across the chest, even when not applied tightly. One study found worse lung function test results in healthy immobilized volunteers.[28] Other studies have shown that older patients (even when healthy) and those with lung or chest injury have an even larger degree of restriction and respiratory compromise.[29,30]

Risks from immobilization are not isolated to backboards. The use of cervical collars alone also carries potential risks. (See "What About Cervical Collars?"[8,31-39])

Risk of Secondary Neurological Deterioration Is Low

Many EMS systems have already adopted the new standards calling for less use of spinal immobilization. Though the evidence is compelling, not all EMS systems have adopted these standards due to strongly rooted beliefs and fears of long-term patient disability and subsequent litigation. However, these fears do not appear justified.

A recent review by Oto et al[40] found only 42 cases of early secondary neurological deterioration after blunt trauma in all of the indexed medical literature. They noted, "In twelve cases the authors did attribute deterioration to temporally associated precipitants, seven of which were possibly iatrogenic; these included removal of a cervical collar, placement of a halo device, patient agitation, performance of flexion/extension films, 'unintentional manipulation,' falling in or near the ED, and forced collar application in patients with ankylosing spondylitis." Thirteen of these cases occurred during prehospital care, none of them sudden and movement-provoked, and all reported by a single study." This review highlights the rarity of secondary deterioration.

When Should Immobilization Be Used?

So what's the next step for spinal immobilization in the field? How do we appropriately protect trauma patients during transport? As always seems to be the case in medicine, more evidence is needed. Oteir

What About Cervical Collars?

Decreased mouth opening while in a C-collar can lead to increased difficulty with airway management.[31] In a 2007 update of its 2001 review of spinal immobilization, the Cochrane team stated, "Because airway obstruction is a major cause of preventable death in trauma patients, and spinal immobilization, particularly of the cervical spine, can contribute to airway compromise, the possibility that immobilization may increase mortality and morbidity cannot be excluded."[8]

Multiple studies have shown a positive correlation between cervical collar placement and increased intracranial pressure (ICP). Davies et al[32] found a mean rise in ICP of 4.5 mm Hg when a collar was placed. Similarly, a review comparing ICP of injury-matched patients with cervical collars in place versus those without collars found a nearly 36% increase in the risk of increased ICP among those with cervical collars.[33] In a prospective study, researchers measured ICP before and after cervical collar placement in head injured patients with a Glasgow Coma Scale (GCS) score ≤9 and found a statistically significant increase in ICP with the collar in place.[34]

Although the mechanism for this increase in ICP is unclear, it may be due to venous congestion in the neck.[35] Since head trauma with traumatic brain injury (TBI) is a common finding in blunt-force injury, any potential rise in ICP has the potential to worsen an already significant injury. Avoiding or reducing an increase in ICP is a fundamental principle in the management of TBI.

Cervical collars may worsen existing spinal injury in certain situations. A cadaver study revealed a 7.3 mm separation of C1 and C2 when a cervical collar was applied after researchers cut the anterior-posterior ligamentous support to simulate ligament injury.[36] This possibility is of even greater concern in patients with predisposing conditions, such as ankylosing spondylitis, that can increase risk of spinal injury. Several case reports of exacerbated spinal injury in such patients when placed in cervical collars suggest that a vertebral injury without initial cord injury can result in a cord injury by forcing the neck into a cervical collar.[37-39]

et al[41] recently published a review of new literature on the epidemiology and current practice of prehospital spine management. They reported that early (8-24 hours) transfer of patients with spinal injury to spinal care units, along with effective resuscitation, was the most important determinant of better neurological outcomes.[41] This review reaffirms the need for more data evaluating the relationship between spinal immobilization and neurological outcomes.

Currently, recommendations call for selective spinal immobilization to decrease unnecessary application and potential harm. Use of backboards for spinal immobilization should be limited to the following types of patients:[1,20]

- Blunt trauma and altered level of consciousness;
- Spinal pain or tenderness;
- Neurological complaint (eg, numbness or motor weakness);
- Anatomic deformity of the spine;
- High-energy mechanism of injury and:
  - Drug or alcohol intoxication;
  - Inability to communicate; and/or
  - Distracting injury.

Patients for whom immobilization on a backboard is not necessary include those with all of the following:

- Normal level of consciousness (GCS 15);
- No spine tenderness or anatomic abnormality;
- No neurological findings or complaints;
- No distracting injury;
- No intoxication.

Cervical collars alone are still recommended for use in patients who do not meet validated clinical rules, such as the NEXUS or Canadian C spine rules.[1,20,42,43] As these rules are well validated, they can be safely used to determine who should have a cervical collar placed, with or without a backboard. In a retrospective review, selective spinal immobilization was found to be 99% sensitive in identifying patients with cervical injuries.[44]

Clearly, there is still work to be done. Due to the relative rarity of actual spinal cord injury with the consequences of neurological injury, prospective trials in this area are rare and very difficult to safely design. However, there is growing confidence that selective spinal protocols, together with the inclusion of validated clinical rules, can effectively limit exposure to unnecessary spinal immobilization. As the current evidence continues to mount for the potential harm in indiscriminate backboard and cervical collar use, it seems clear we should strive to decrease the overuse of prehospital and early spinal immobilization consistent with current position statements and validated clinical rules.

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