TITLE: The Use of Spine Boards in the Pre-Hospital Setting for the Stabilization of Patients Following Trauma: A Review of the Clinical Evidence and Guidelines

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CONTEXT AND POLICY ISSUES

Traumatic spinal cord injuries (SCI) predominantly affect adolescents and young adults[1] and males.[1-3] The annual occurance is estimated to be 1,785 Canadians[1] and 10,000[3] to 12,000[2] Americans. The most common causes of SCI are motor vehicle collisions,[1-3] followed by falls, violent acts, and sports.[1,2] In the United States upwards of $3.48 billion dollars is spent annually as a result of traumatic SCI following motor vehicle accidents[3] while the combined annual cost of short- and long-term care in patients sustaining SCI is estimated to exceed $7 billion.[2] Patients with acute SCI are at risk for neurologic deterioration as a result of secondary injury to the spinal cord caused by movement.[4,5] It is estimated that 3 to 25% of spinal cord injuries occur subsequent to the original trauma during early management of the patient or during transportation.[5] Therefore, current acute management focuses on the stabilization of the spinal column to prevent secondary injury or further neurologic insult.[2]

The improved status of patients with SCI arriving in the emergency department over the past 30 years has been attributed to emergency medical services (EMS), including spinal immobilization, provided by trained EMS personnel.[5] Spinal immobilization for all patients with suspected SCI after trauma has been advocated by nationwide EMS programs[6] and the American College of Surgeons.[5] The recommendations from the American College of Surgeons include immobilizing the patient with suspected SCI onto a hard backboard and using a rigid cervical collar,[2,5] lateral support devices, and straps or tape to further secure the patient to the backboard.[5]

In some patients, spinal cord immobilization has also been associated with additional morbidity.[5,6] The National Association of EMS Physicians and the American College of Surgeons Committee on Trauma acknowledge that long backboards can lead to various morbidities including pain, the development of pressure ulcers, and compromised respiratory function.[6] In addition, patient agitation has also been observed.[6] These groups have determined that immobilization with backboards, “may be indicated in patients 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, or distracting injury."[6] Another important aspect in the acute management of SCI is the time required to fully immobilize the patient. As tissue hypoxia remains the most important factor in trauma management, Hauswald (2012)[7] pointed out that delaying hospital care (i.e. surgery, airway management, blood transfusions) through the act of spinal stabilization can subsequently harm even those patients with unstable spinal injury. Patients who have undergone severe trauma with suspected SCI also often require urgent care for numerous other critical injuries.[7]

The use of spinal immobilization in the patient at low risk of cervical spinal injury, regardless of the traumatic situation, has recently been under scrutiny.[5] Triage systems based on clinical criteria[5] particularly the Hoffman criteria,[3] have been developed to assess the likelihood of SCI in patients and the need for pre-hospital spinal cord immobilization.[5] The National Association of EMS Physicians and the American College of Surgeons Committee on Trauma stated that, "patients for whom spinal immobilization has not been deemed necessary include those with all of the following: normal level of consciousness (Glasgow Coma Score [GCS] 15), no spine tenderness or anatomic abnormality, no neurologic findings or complaints, no distracting injury, and no intoxication."[6] Spinal immobilization has also been cautioned in the patient with penetrating injuries to the body, neck, or head without neurologic complaint or deficit as an association with increased mortality has been observed with its use.[8]

Pre-hospital spinal immobilization techniques, including the use of the long backboard, have been used extensively but lack the typical supporting evidence one would acquire through prospective, randomized clinical trials. These types of trials are unlikely both based on ethical and practical reasons.[5] Therefore, current supporting evidence for spinal immobilization use in every potential SCI trauma scenario remains scarce. In addition, variation exists in the administration of care for both adult[4] and pediatric[9] patients with potential SCI and cervical spine injury in the pre-hospital setting.

The purpose of this report is to provide evidence on the clinical effectiveness, safety, and harms associated with the use of spine boards in the pre-hospital setting for the stabilization of patients following trauma. It will also report on any evidence-based guidelines regarding the use of spine boards in the pre-hospital setting for the stabilization of patients following trauma.

RESEARCH QUESTIONS

1. What is the clinical evidence regarding patient outcomes associated with the use of spine boards in the pre-hospital setting for the stabilization of patients following trauma?

2. What are the evidence-based guidelines regarding the use of spine boards in the pre-hospital setting for the stabilization of patients following trauma?

KEY FINDINGS

No health technology assessments, systematic reviews, meta-analyses, randomized controlled trials, non-randomized studies, or evidence-based guidelines were identified regarding patient outcomes associated with the use of spine boards in the pre-hospital setting for the stabilization of patients following trauma.

METHODS

Literature Search Strategy

A limited literature search was conducted on key resources including PubMed, The Cochrane Library (2013, Issue 4), University of York Centre for Reviews and Dissemination (CRD) databases, Canadian and major international health technology agencies, as well as a focused Internet search. No filters were applied to limit the retrieval by study type. Where possible, retrieval was limited to the human population. The search was also limited to English language documents published between January 1, 2003 and May 1, 2013.

Selection Criteria and Methods

One reviewer screened citations and selected studies. In the first level of screening, titles and abstracts were reviewed and potentially relevant articles were retrieved and assessed for inclusion. The final article selection was based on the inclusion criteria presented in Table 1.

Table 1: Selection Criteria

Population	Any patient in a trauma situation in the pre-hospital setting
Intervention	Spine boards for stabilization
Comparator	Other spinal stabilization devices or no spinal stabilization
Outcomes	Safety, risks and adverse events, short and long-term patient outcomes, guidelines
Study Designs	Health technology assessments, systematic reviews, meta-analyses, randomized controlled trials (RCTs), non-randomized studies, and guidelines

Exclusion Criteria

Studies were excluded if they did not satisfy the selection criteria, if they were duplicate publications, or were published prior to January 1, 2003. In addition, health technology assessments, meta-analyses, systematic reviews and guidelines were excluded if there was incomplete reporting of methods or if they were superseded by a more recent or more rigorous review or guideline.

Critical Appraisal of Individual Studies

No relevant studies were identified regarding patient outcomes associated with the use of spine boards in the pre-hospital setting for the stabilization of patients following trauma, hence no critical appraisal was performed.

SUMMARY OF EVIDENCE

Quantity of Research Available

The literature search identified a total of 737 citations. Of these, 717 citations were excluded during the title and abstract screening while 20 full text documents were retrieved based on their potential relevance. No articles were identified in the grey literature search. Of the 20 potentially relevant articles, none met the inclusion criteria and were subsequently excluded. Reasons for exclusion included inappropriate populations (mixed populations of healthy volunteers and trauma patients), inappropriate outcomes (examining pre-hospital assessments of SCI, rather than spinal board effectiveness), and inappropriate comparators (cervical spinal collars).

A PRISMA diagram demonstrating the study selection process is presented in APPENDIX 1.

Additional references that did not meet the inclusion criteria but may be of potential interest are provided in the APPENDIX 2.

CONCLUSIONS AND IMPLICATIONS FOR DECISION OR POLICY MAKING

No relevant clinical evidence or evidence-based guidelines were identified regarding the clinical effectiveness, harms, or benefits associated with the use of spine boards in the pre-hospital setting for the stabilization of patients following trauma.

Studies in healthy volunteers have addressed both biomechanical and immobilization issues when applying spinal immobilization techniques, however it remains unclear whether these results hold true for trauma patients experiencing SCI. These studies did not address the research question, but may offer some insights into the use of spinal boards

For example, Ahn et al.[4] systematically reviewed evidence regarding the optimal duration, types, and biomechanics of spinal immobilization in a mixed population of patients with acute SCI in the pre-hospital setting and healthy volunteers. The ensuing recommendations stated that patients over the age of 12 years with acute SCI should receive spinal immobilization, which includes the use of the spinal board, cervical collar, and proper head immobilization. To reduce pressure on the occiput and sacrum, padded boards or inflatable bean bags should be implemented.[4] In addition, upon admission to the hospital or when awaiting transfer to another hospital (while during transfer the use of the backboard in recommended), patients should be transferred off of the spinal board as soon as possible.[4] Recommendations from Theodore et al.[5] were similar and indicated that securing patients to a backboard with straps and a cervical collar was sufficient to reduce movement and is recommended for the acute SCI patient. However, this article did not meet the inclusion criteria for this review as studies contained mixed populations (cadaver, healthy volunteers, trauma patient populations, and those with penetrating injury), or had inappropriate outcomes (pre-hospital spinal assessment). The main limitation to the Ahn et al.[4] systematic review and subsequent recommendations was the inability to relate these findings solely to the trauma patient population as it can be presumed that healthy volunteers would respond differently to full spinal immobilization than trauma patients.

A systematic review by Kwan et al.[3] also supported the use of the hard backboard in the process of spinal immobilization as its use was associated with a reduction in spinal movement in healthy volunteers. The authors also noted adverse events, such as restricted ventilation,

pain, and discomfort when using full spinal immobilization. Specifically, increased pain, tissue-interface pressures, and discomfort were reported in patients using a hard backboard when compared to a vacuum mattress.[3] The main limitation of the systematic review was in its relevance to the trauma patient population.

The recommendations produced from these reviews indicated that spinal immobilization may be appropriate for the acute SCI patient to minimize secondary movement post-trauma. However, solely using these results to change practice should be cautioned due to the mixed population and which may not be generalizable to the actual trauma patient.

PREPARED BY:
Canadian Agency for Drugs and Technologies in Health
Tel: 1-866-898-8439
www.cadth.ca

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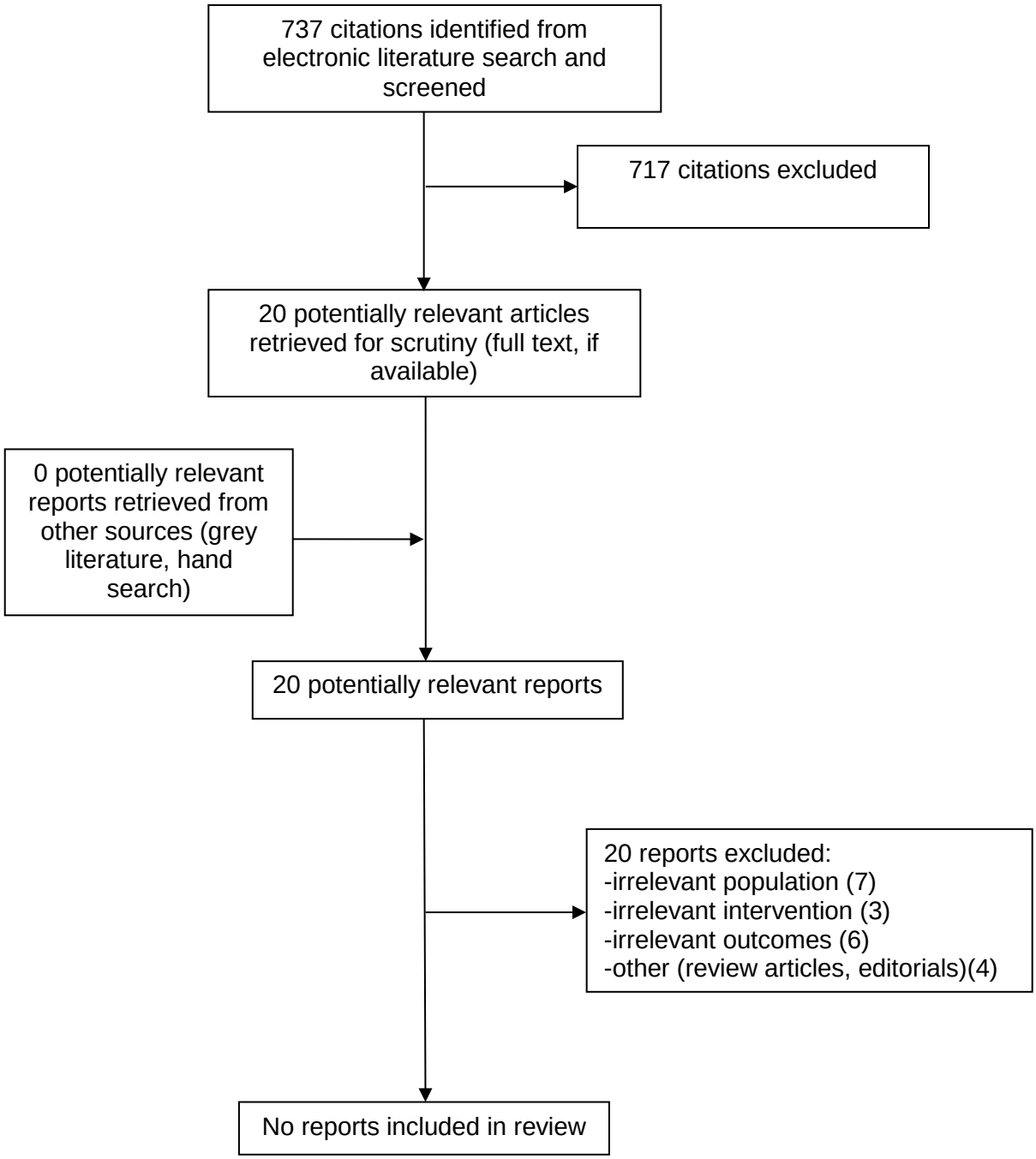
APPENDIX 1: SELECTION OF INCLUDED STUDIES



APPENDIX 2: ADDITIONAL ARTICLES OF POTENTIAL INTEREST

Systematic Reviews - Mixed Healthy and Patient Populations

1. Fehlings MG, Cadotte DW, Fehlings LN. A series of systematic reviews on the treatment of acute spinal cord injury: a foundation for best medical practice. J Neurotrauma. 2011 Aug;28(8):1329-33. Available from: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3143392

Non-Randomized Studies - Comparing Technologies in Healthy Volunteer Populations

2. Ay D, Aktas C, Yesilyurt S, Sarikaya S, Cetin A, Ozdogan ES. Effects of spinal immobilization devices on pulmonary function in healthy volunteer individuals. Ulus Travma Acil Cerrahi Derg. 2011 Mar;17(2):103-7.

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