ORIGINAL RESEARCH

Long Backboard versus Vacuum Mattress Splint to Immobilize Whole Spine in Trauma Victims in the Field: a Randomized Clinical Trial

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Abbreviations:
EMS: Emergency Medical Services
LBB: long backboard
VMS: vacuum mattress splint

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Abstract

Introduction: Patients with possible spinal injury must be immobilized properly during transport to medical facilities. The aim of this research was comparing spinal immobilization using a long backboard (LBB) with using a vacuum mattress splint (VMS) in trauma victims transported by an Emergency Medical Services (EMS) system.
Methods: In this randomized clinical trial, 60 trauma victims with possible spinal trauma were divided to two groups, each group immobilized with one of the two instruments. Speed and ease of application, immobilization rate, and the patients' comfort were recorded.
Results: In this survey, LBB was faster to apply: 211.66 (SD = 28.53) seconds vs 654.00 (SD = 16.61) seconds. Various measures of immobilization were better by LBB. Also, LBB offered a significant improvement in comfort over a VMS for the patient with possible spinal injury. All of the results were statistically significant.
Conclusion: The results of this study showed that immobilization using LBB was easier, faster, and more comfortable for the patient, and provided additional decrease in spinal movement when compared with a VMS.

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Introduction

Trauma victims are suspected to have some degree of spinal injury, which can be even more important when accompanied with decreased level of consciousness and/or head trauma, as incorrect transport can lead to secondary injuries to the spinal column and spinal cord.[1,2]

Prehospital management includes basic resuscitative measures as well as rapid full spinal immobilization and transport to a medical center.[3,4] There are different devices used to immobilize the spinal column.[5,6] Two popular options are the long backboard (LBB) and the vacuum mattress splint (VMS).[7]

Each device has some advantages and disadvantages. Few studies, all conducted on healthy volunteers, have been done to compare the two options.[8-11] In a systematic review study, it was suggested to compare different immobilization strategies on trauma victims in order to establish an evidence base for devices used to immobilize the spinal column.[12]

The current study was designed to compare the LBB and the VMS based on immobilization rate, comfort, and speed of application on the trauma victims transported by the Emergency Medical Services (EMS) system in Tehran, the capital city of Iran.

Materials and Methods

This study was a prospective, randomized clinical trial. After registration in the Iranian Registry of Clinical Trials (code number IRCT201112278543N1), 60 trauma victims with possible spinal trauma (considering the mechanism of injury) were included using a simple randomization method.[13] Included cases were randomly assigned to be immobilized on either an LBB or VMS according to cards drawn from a box one by one. The LLB consisted of a Spencer Rock plastic backboard stretcher with Spencer contour head immobilizer (Spencer Italia S.r.l., Collecchio, Italy); the VMS was an Attucho

"NYB" vacuum mattress TPU (Attucho/Hitas Ortopedi, Istanbul, Turkey). In each case, the cervical spine was immobilized immediately using a rigid cervical collar.

Exclusion criteria for the study were: altered mental status (Glasgow Coma Scale <14); airway compromise (patients who needed intubation); circulatory shock (systolic blood pressure <90 mmHg); and neurological deficit (functional abnormality of a body area). For prevention of further injury by body movement, verbal informed consent was obtained from the patients who were included in this study.

All the EMS technicians involved were trained about how to immobilize the patients using both devices. In the field, every patient was immobilized by two technicians. A third person measured and recorded the time needed from the beginning of the procedure to the completion of immobilization of the patient. The recorder asked the technicians about the ease of the procedure (a score of 1 or "very low" indicated the most difficult and a score of 5 or "very high" signified the easiest). The recorder also asked each patient about the severity of pain and discomfort generated by the immobilization process. The patient scored his pain or discomfort using a VAS (visual analog scale), a 10 cm ruler-like device. The patient was asked to slide the marker to a point on the scale from 0 (indicating "fully comfortable") to 10 ("the worst and intolerable"). The recorder also noted patient movement (flexion, extension, lateral bending, and rotation) especially in cervical and thoraco-lumbar regions during immobilization and transport, requesting the patient to move his or her spine in these directions and rating the immobilization objectively using a 5-point scale (1 or "very low" through 5 or "very high").

A statistical analysis was performed by means of the Mann-Whitney *U* test and chi-square test, with $P<.05$ considered as significant. Analysis was completed using

SPSS 15 for Windows (IBM Corporation, Armonk, New York USA).

Results

This study was done to compare spinal immobilization using LBB with VMS in trauma victims transported by Emergency Medical Service in Tehran, Iran.

Demographic characteristics of 60 trauma victims are shown in Table 1. There was no statistically significant difference between the two groups in terms of sex, mean age, and mean weight.

Immobilization procedure took much less time using LBB compared with VMS, 211.66 (SD = 28.53) seconds vs 654.00 (SD = 16.61) seconds, $P<.001$.

Cervical and rest of spinal immobilization (flexion, extension, lateral bending, and rotation) were more effective using LBB compared with VMS, $P<.001$.

For EMS technicians, immobilization by LBB was easier and patients felt more comfortable compared with VMS, $P<.001$. Results of comparisons between the two groups are shown in Tables 2 and 3.

Parameter	Long Backboard n = 30	Vacuum Mattress Splint n = 30
Age, y	30.25 (SD = 2.95)	35.50 (SD = 3.13)
Sex, male	25 (83.3%)	24 (80%)
Weight, kg	75.48 (SD = 3.72)	78.89 (SD = 1.70)

Table 1. Demographic Characteristics of Patients

Discussion

The results of this study showed that full body immobilization by LBB was easier (for EMS technicians), faster to apply, more effective and more comfortable (for patients) compared to VMS.

Considering the importance of correct immobilization and transport of trauma victims, multiple studies have compared LBB with VMS in immobilizing healthy volunteers. They researched patients' comfort levels and pain scores on each patient's neck and back.

Sheerin et al[14] immobilized three healthy volunteers using three different devices. They measured pressure rate on the occipital and sacral regions. They found marked reductions in pressure under the occiput and sacrum when using the inflatable raft and the vacuum mattress compared with LBB. In another study, 18 healthy volunteers were immobilized using LBB and two models of VMS. Each volunteer rated the pain at multiple locations on their body using a visual analog score at 0, 30, and 60 minutes. The most severe pain was induced in the occiput, lower back, and sacrum. In this study, LBB generated more severe pain than the two vacuum mattresses.[8] Other studies showed similar results.[9,10]

In the current study, patients felt more comfortable on LBB. This study showed more effective immobilization in cervical and whole spine using LBB compared with VMS. Johnson et al[11] found more effective immobilization of the neck with LBB but better immobilization of the rest of the spine with VMS.

Hamilton et al[15] immobilized 26 healthy volunteers on LBB and VMS, both with and without a cervical collar. With the cervical collar, neck flexion and rotation were restricted equally using LBB and VMS, but extension and lateral bending were restricted better using VMS. In all situations except extension, the VMS alone showed immobilization superior to the LBB alone.

Another important point was comparison of application time between two devices. In contrast to the current study, Mallmann et al[16] showed that immobilization is easier, faster, and more effective in spinal immobilization, and more comfortable for the patient using VMS rather than LBB, concluding that VMS can be used for image-guided interventions.[15] Ahmad and Butler reached the same conclusion in another study.[17]

The most significant points of this study were more comfort and more effective immobilization of the patient while immobilized on an LBB compared with a VMS. Neither of these two points is dependent upon the user's skill. These results differ greatly from the results of all previous studies. The likely explanation for this difference is that in the current study, for the first time, researchers evaluated true trauma victims while, in contrast, the other studies were conducted on healthy people.

Numerous studies have compared methods of immobilizing trauma victims suspected of spinal injury using these two devices, and all of them showed VMS superiority to LBB. Nevertheless, LBB is the recommended device for immobilization in Advanced Trauma Life Support (ATLS) guidelines.[18] The authors believe that the current study is the first to be conducted on real trauma victims. Considering the results of this study, other clinical trial studies with larger sample sizes might be necessary to verify this conclusion.

Spinal Site	Long Backboard								Vacuum Mattress Splint								*P* Value (Chi-Square)
	Very Low	Low[a]	Inter-mediate	High[b]	Very High	Lower Quartile	Median	Upper Quartile	Very Low	Low	Inter-mediate	High	Very High	Lower Quartile	Median	Upper Quartile	
Neck																	
Flexion & extension	0	0	3	17	10	H	H	VH	14	16	0	0	0	VL	L	L	<.001
Lateral bending	0	1	3	13	13	H	H	VH	8	22	0	0	0	VL	VL	L	<.001
Rotation	0	0	2	25	3	H	H	VH	8	22	0	0	0	VL	VL	L	<.001
Thoraco-lumbar	0	0	12	12	6	H	H	VH	14	15	1	0	0	VL	VL	L	<.001

Table 2. Spinal Immobilization Rate with Devices
Abbreviations: H, high; VH, very high; I, intermediate; L, low; VL, very low
[a]Low scale means immobilization of device is not good.
[b]High scale means immobilization of device is good.

Spinal Site	Long Backboard								Vacuum Mattress Splint								*P* Value (Chi-Square)
	Very Low	Low[a]	Inter-mediate	High[b]	Very High	Lower Quartile	Median	Upper Quartile	Very Low	Low	Inter-mediate	High	Very High	Lower Quartile	Median	Upper Quartile	
Patient comfort	0	0	2	16	12	H	H	VH	24	5	1	0	0	VL	VL	VL	<.001
Ease of device application	0	0	12	12	6	I	H	VH	20	9	0	1	0	VL	L	L	<.001

Table 3. Comparison of Devices from the Point of Patient Comfort and Ease of Application
Abbreviations: H, high; VH, very high; I, intermediate; L, low; VL, very low
[a]Low scale means device is not comfortable and its application is hard.
[b]High scale means device is comfortable and its application is easy.

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Limitation

In the current study, application time was longer with VMS in comparison with LBB. The only device to be used for immobilization of trauma victims in Iran is LBB. Although all the technicians who participated in the study were well educated about immobilization of healthy volunteers with VMS, their routine practice with LBB could explain the differences in results.

Conclusion

Results of this study showed LBB superiority to VMS in terms of ease and speed of application, immobilization rate, and patient comfort while used in immobilization of trauma victims.

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