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ORIGINAL ARTICLE

Relationship Between Shock Index and Clinical Outcome in Patients with Multiple Traumas

Seyed Mostafa Shiryazdi[1]*, Mohammad Mirshamsi[2], Hamid Reza Piri-Ardekani[3], Seyed Ali Shiryazdi[4]
[1]*Associate Professor of General Surgery, Shahid Sadoughi University of Medical Sciences & Health Services, Yazd, Iran*
[2]*Assistant Professor of General Surgery, Shahid Sadoughi University of Medical Sciences & Health Services, Yazd, Iran*
[3]*General Practitioner, Shahid Sadoughi University of Medical Sciences & Health Services, Yazd, Iran*
[4]*Medical Student, Shahid Sadoughi University of Medical Sciences & Health Services, Yazd, Iran*
Corresponding Author: Seyed Mostafa Shiryazdi, E-mail: smshiryazdi@yahoo.com

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ABSTRACT

Background: Initial assessment of hemodynamic parameters and timely management of trauma patients who have hypovolemic shock are essential clinical actions, and shock index is a very accurate measurement to indicates level of occult shock. In this study of patients with multiple traumas who were referred in 2011 to Shahid Sadoughi Hospital in Yazd, Iran, we evaluated the relationship between shock index and clinical outcomes. **Methods:** This was a descriptive cross-sectional study of 334 patients with multiple traumas. Patients were divided into two groups based on their shock index score (≥ 0.9 as abnormal shock index and < 0.9 as normal shock index). Data were analyzed using the chi-square test and the independent sample t-tests. **Results:** Significant differences were observed between the two groups in terms of mean and sex distribution (P=0.001) and between patients with head and neck trauma and pelvic injuries in terms of frequency distribution (P<0.05). Hemodynamic parameters were also significantly different between the two groups (P< 0.001). Additional significant differences were observed in terms of frequency distribution of intensive care unit admission and mortality rate. **Conclusion:** Shock index has considerable predictive value in patients with multiple traumas. Since it is easily calculated, it can be used in the initial assessment and management of patients before any other diagnostic tests are performed. Shock index can also rapidly diagnose the real condition of trauma patients in the first hours and prevent secondary negative clinical outcomes.

INTRODUCTION

Uncontrolled bleeding is a major cause of premature death in patients with multiple traumas (1,2). Thus, the initial assessment of hemodynamic parameters and timely management of traumatic hypovolemic shock are crucial actions to maximize the chances of recovery. However, in many cases, hemodynamic parameters alone may have normal values despite clinically adverse conditions (3-7), so testing a combination of hemodynamic parameters is important in the initial management of trauma patients. Shock index is the most accurate measurement and the most commonly used criterion for trauma patients. Shock index is ratio of the number of heart beats per minute to systolic blood pressure and was first defined in 1967 by Allgower and Burri (8,9).

Many studies have investigated the diagnostic value of shock index in the initial management of trauma patients and for predicting clinical outcomes. The American Surgical Association, as part of the Patient Trauma Program or the Advanced Trauma Life Support program, classified patients into four classes based on lost blood volume. They used a combination of hemodynamic parameters, such as heart rate and systolic blood pressure, along with level of consciousness, when grouping patients (10). Despite the increasing number of road accidents and trauma patients in Iran, no study has been conducted to assess the predictive power of shock index in patients with multiple traumas.

Therefore, in this study of patients with multiple traumas who were referred in 2015 to Shahid Sadoughi Hospital in Yazd, Iran, we evaluated the relationship between shock index and clinical outcomes.

METHODS

This was a descriptive cross-sectional study of 334 patients with multiple traumas. Patients were selected using a simple sampling method. We included all trauma patients for whom records of their hemodynamic status and level of

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consciousness were available. Patients were excluded if they had a history of hypertension, were taking beta-blocker drugs, or had a fever at the time of referral. Trauma patients who were pregnant were also excluded. At the time of referral, patients' data were completed in a checklist, and then their clinical data were recorded until discharge from the hospital. Data were later entered in SPSS software (SPSS Inc., Chicago, IL, USA), and patients were divided into two groups: those who had a shock index ≥ 0.9 (abnormal shock index) and those who had a shock index < 0.9 (normal shock index). Data were analyzed with SPSS v16 using the chi-square test and independent sample t- tests.

RESULTS

A total of 334 patients with multiple traumas were divided into two groups based on their shock index score and a cut-off point of < 0.9 (259 patients [77.5%]) and ≥ 0.9 (75 patients [22.5%]). The two groups of patients were significantly different in terms of mean age (P=0.001) and sex frequency distribution (P=0.001) (Table 1). Trauma characteristics, including type of trauma (penetrating or blunt) and trauma site, were investigated in the two groups (Table 2). We observed that the shock index value was significantly different in cases of penetrating or blunt trauma (P =0.023). Also, the frequency distribution of patients with head and neck trauma and patients with pelvic trauma was significantly different between the two groups based on shock index (P<0.05). Hemodynamic parameters, such as systolic blood pressure, diastolic blood pressure, and heart rate, as well level of consciousness (as measured by the Glasgow Coma Scale), were studied in the two groups. Independent sample t-tests showed that all of these parameters were significantly different between the two groups (Table 3). Additionally, intensive care unit (ICU) admission and mortality were investigated as two significant outcomes of patients with multiple traumas. A total of 26 patients in the shock index < 0.9 group (10%) were admitted to the ICU, whereas 28 patients (37.3%) in the shock index ≥ 0.9 group were admitted to the ICU. Also, results from the chi-square test showed a significant difference between the two groups in terms of frequency distribution in ICU admission (P=0.001). Ten patients (3.9%) and 13 patients (17.3%) in the shock index <0.9 and shock index ≥ 0.9 groups died, respectively. The chi-square test (P=0.001) showed a significant relationship between the two groups in terms of mortality rate.

Table 1. Characteristics of patients with multiple traumas in terms of shock index (SI)

Characteristics	SI		P
	SI<0. 9	SI≥0.9	
Age (years)	35.64±18.20	26.79±15.57	0.023
Sex (men/women)	45.207	23.49	0.01
	18.820	32.69	

Table 2. Frequency distribution of injury site in patients with multiple traumas in terms of shock index (SI)

Site of injury	SI (Percent) number		P
	SI≥0.9	SI<0. 9	
Head and neck	(46.3) 120	(73.3) 55	0.001
Chest	(29) 75	(28) 21	0.872
Abdomen	(29) 75	(29.3) 22	0.95
Pelvis	(0.5) 13	(12) 9	0.032
Organs	(53.7) 139	(59) 39	0.799
Spine	(14.7) 38	(6.7) 5	0.068

Table 3. Average hemodynamic findings and level of consciousness in patients with multiple traumas according to shock index (SI)

Hemodynamic parameters	SI Number (percent)		P
	SI≥0.9	SI<0. 9	
Systolic blood pressure	118.93±12.8	100.26±12.9	<0.001
Diastolic blood pressure (mmHG)	79.16±9.3	0.65±9.4	0.001
Heart beat (bpm)	80.96±9.2	101.17±13.7	<0.001
Level of consciousness (GCS)	14.36±1.9	11.93±4.3	0.001

DISCUSSION

Shock Index has long been used for the management of patients with multiple traumas (8,9), but it has also been used at short time intervals in other patients with possible bleeding (10). In this study, we investigated the relationship between shock index and the clinical outcomes of patients with multiple traumas. Also in this study, the mean age and sex distribution were significantly different between the two groups. Since most patients at the study setting (Yazd City) suffered from multiple traumas caused by accidents—and since young motorcycle riders accounted for most accidents—considering the driving patterns of the society in question, observed differences were not unexpected, although official statistics on the demographic data of injuries caused by road accidents were not available in Yazd.

However, regarding the relationship between age and sex in patients with a recorded shock index score, King et al. (11) agree and Cannon et al. (12) disagree with the findings of this study. In this study, penetrating trauma was significantly related to shock index, which has been previously confirmed (4,13). The important point is the significant relationship between shock index and all hemodynamic findings and between shock index and patient trauma characteristics (such as type and site of injury). In contrast to the findings from similar studies, we found shock index to be a reliable parameter for predicting the clinical outcome of trauma patients.

Concurrent with bleeding in trauma patients, vascular contractions have occurred, which, despite bleeding, increases the blood pressure of the patients. The difference is that the heart rate increases, and these changes can be

measured only by monitoring the shock index (14). Conversely, shock index is inversely correlated with left ventricular stroke volume and directly related to defects in blood supply and environmental hypoxia, which leads to shock. Although hemodynamics appear to be stable in the early minutes in patients with a shock index of <0.9, parameters such as arterial oxygen saturation and PH blood undergo quick and clear changes (15,16).

Shock index is a simple, low-cost, and reliable parameter that not only has significant predictive power, but also requires no specific tools and facilities. It can be efficacious in managing trauma patients in the early hours after injury. If used effectively, it can ultimately improve clinical outcomes.

CONCLUSION

Shock index is a reliable parameter for predicting the clinical outcome of trauma patients. It can also be effective in the emergency management of these patients. It can not only help practitioners decide to take essential measures for patients at risk of bleeding and hypovolemic shock, but can also help prevent further complications. Given the importance of making timely decisions when treating trauma patients, we recommend using the shock index to manage these patients, especially at the scene of the incident, until they can be transferred to medical centers and the extent of bleeding can be determined and necessary therapeutic measures can be taken to prevent hypovolemic shock.

Study Limitations

A limitation of this study was that complete patient clinical information was not always recorded or was incomplete, misleading, or invalid, which resulted in some patients being excluded. Clearly, a comprehensive network for recording patient clinical data should be developed and implemented.

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AUTHORS CONTRIBUTION

All authors contribute in this study equally.

CONFLICTS OF INTEREST

There were no conflict of interest in this study.

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