Clinical Paper

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Modified shock index as a predictor of mortality in septic patients

Abstract

Introduction: Sepsis and septic shock are medical emergencies that require immediate recognition and management. In order to stratify the severity of septic patients, it is necessary to have simple and rapid markers. The modified shock index (MSI) considers valuable information related to cardiovascular and hemodynamic stability by integrating heart rate and mean blood pressure makes it an inclusive tool in the evaluation of septic patients.

Objective: To determine the usefulness of the modified shock index as a predictor of mortality in septic patients at ICU admission.

Methodology: Retrospective study. From January 01 to June 30, 2021,all patients admitted to intensive therapy under the diagnosis of sepsis fromdifferent sites were included. MSI values, epidemiological variables and site of infection were recorded at admission to intensive care unit.\

Results: 50 patients were analyzed where 52% had a modified shock index > 1.3, which when compared with the clinical characteristics, it was observed that the predominant gender was female with 28% p value 0.416,arterial hypertension with the 26% p value 0.170 was the predominant comorbidity, in terms of the site of infection, the lung with 22% p value 0.046was the clinical characteristics with statistical significance since its p value < 0.05. The mean days of stay in the ICU was 5.65, 42% of patients with anindex > 1.3 ended up dying, p value <0.001

Conclusions: In our study, the patients with modified shock index greater than 1.3 ended up dying mostly.

Keywords: modified shock index, sepsis, mortality

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Introduction

Sepsis and septic shock are medical emergencies that require immediate recognition and management. Sepsis is defined as life-threatening organ dysfunctioncaused by a dysregulated host response to infection.[1] It is one of the most prevalent causes of mortality in intensive care units (ICU).[2] The first hour for identification and initiation of treatment is crucial and starts from the patient's arrival at triage.[3,4]

Identifying septic patients from those with uncomplicated febrile illnesses is challenging. To assess the degree of organ dysfunction in septic patients, the Sequential Organ Failure Assessment (SOFA) scoring system is used during the ICU stay.[5] SOFA predicts clinical expectations, but should not be used todetermine treatment success as it has some limitations[6] and can be a constraint in resource-limited areas. Additionally, the criteria for systemic inflammatory response syndrome (SIRS) have been used, but they have shown low specificity indetecting sepsis in the first 24 hours of admission to ICU.[7,8]

In order to optimize the process of identification, classification and severity stratification of septic patients, it is necessary to have simple screening parametersin a shorter time,[9] which can make reliable and valid diagnoses to optimize resources.[10,11]

Vital signs are essential to identify shock and a combination of them, such as heartrate (HR), systolic blood pressure (SBP), along with changes in mental status and urine output, have traditionally been used to assess the presence and degree of hemodynamic instability.[12] However, vital signs do not change until late in the course of the disease, and signs of sepsis can be subtle, non-specific, and easily missed in dynamic areas such as triage in the emergency room or prehospital setting.[13]

A commonly used index, the shock index (SI), which is obtained by dividing HR by SBP, assesses shock severity, with a normal range defined between 0.5 to 0.7.[14] It is a sensitive marker for states of hidden hypoperfusion compared with vital signsalone. SI has been evaluated in various clinical scenarios, including hemorrhagic shock due to trauma, hemodynamic response, sepsis, among others.[15] Its main limitation is cardiovascular compensation, especially in young patients.

As an alternative to the SI, the modified shock index (MSI) is used.[16] It is obtainedby dividing HR by mean arterial pressure (MAP), since MAP is a better marker of organ perfusion compared to SBP. MAP is more useful to decide fluid resuscitation,vasopressor titration and is a more accurate predictor of disease severity.[17] The MSI assesses shock severity, with a normal range defined between 0.7 and 1.3.It is a sensitive marker for hypoperfusion states, myocardial dysfunction, and has been found to be superior to SI in predicting mortality in ED studies.[17,18] For these reasons, we believe that MSI assessment of patients at ICU admission correlates with mortality in septic patients.

Methods

Retrospective study. From January 01 to June 30, 2021, all patients admitted to theICU under the diagnosis of sepsis from different sites were admitted. The Third International Consensus Definitions for Sepsis and Septic Shock was used. The primary objective was to determine the usefulness of the MSI as a predictor of mortality through its correlation with discharge status. The MSI, epidemiological variables and the site of infection were calculated upon admission to the ICU withoutconsidering the use or not of vasopressors.

The data of the patients admitted to the study were collected from the electronic medical record. A database was created in an electronic spreadsheet using the Microsoft Excel tool, where all the patient information was entered, which allowed the results to be developed. SPSS version 22 software was then used to process the records. The collected data was tabulated, analyzed and interpreted applying descriptive statistics (measures of central tendency: frequency and mean) and inferential statistics (chi-square tests, Student's T, odds ratio). The graphic representation wasmade using bar charts and box charts for a better understanding of the data.

Results

A total of 50 patients were analyzed. The general clinical-demographic characteristics are shown in Table 1. 26 patients (56%) were male; the mean age was 52.7 years; 23 patients (46%) had a history of diabetes mellitus; 17 (34%) presented both the pulmonary and intra-abdominal sites of infection. Regarding the discharge condition, 22 patients (44%) died; 26 (52%) had a modified shock index >1.3. The mean number of days of stay in intensive care was 7.2.

Table 1 Clinical-demographic characteristics

Gender [f (%)] Values		
Male	26	(52.0)
Female	24	(48.0)
Comorbidities [f (%)]		
Hypertension	22	(44.0)
Diabetes mellitus	23	(46.0)
Chronic kidney disease	5	(10.0)
Site of infection [f (%)]		
Pulmonary	17	(34.0)
Urinary	8	(16.0)
Intra - abdominal	17	(34.0)
Skin	5	(10.0)
Vascular	3	(6.0)
Discharge condition [f (%)]		
Alive	28	(56.0)
Death	22	(44.0)
Modified shock index [f (%)]		
> 1.3	26	(52.0)
< 1.3	24	(48.0)
Age [mean (SD)]	52.78	(18.38)
Days of stay in ICU [mean (SD)]	7.220	(5.60)

Table 2 shows the comparison of the clinical characteristics in relation to the MSI. Among the characteristics of those with a value > 1.3 include: female gender with 28%, mean age of 55 years, arterial hypertension with 26% and the pulmonary focuswas the most predominant, with 22% (p= 0.046). Patients with MSI > 1.3 had a mean number of days in the ICU of 5.65, lower compared to those with values < 1.3, where the mean number of days in the ICU was 8.9 (p= 0.038), statistically significant, but clinically irrelevant. , since the fewerdays of stay, the greater severity and early death. In relation to the discharge condition, we found that 42% of the patients with MSI values> 1.3 ended up dying (p = <0.001) (Figure 1).

Table 2 Comparison of clinical characteristics with the modified shock index

Modified shock index	> 1.3	< 1.3	Total	p
Gender				
Male	12 (24%)	14 (28%)	26 (52%)	0.389
Female	14 (28%)	10 (20%)	24 (48%)	0.416
Comorbidities				
Hypertension	13 (26%)	9 (18%)	22 (44%)	0.17
Diabetes mellitus	9 (18%)	14 (28%)	23 (46%)	0.374
Chronic kidney disease	4 (8%)	1 (2%)	5 (10%)	0.093
Site of infection				
Pulmonary	11 (22%)	6 (12%)	17 (34%)	**0.046**
Urinary	2 (4%)	6 (12%)	8 (16%)	0.197
Intra - abdominal	6 (12%)	11 (22%)	17 (34%)	0.095
Skin	4 (8%)	1 (2%)	5 (10%)	0.09
Vascular	3 (6%)	0 (0%)	3 (6%)	0.187
Age	55.03	50.33	52.78	0.371
	-20.43	-15.93	-18.38	
Discharge condition				
Alive	5 (10%)	23 (46%)	28 (56%)	**0.000**
Death	21 (42%)	1 (2%)	22 (44%)	**0.000**
Total	26 (52%)	24 (48%)	50 (100%)	**0.000**

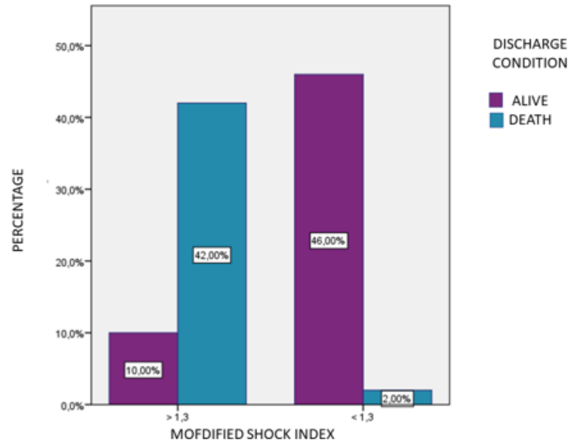

Figure 1 Modified shock index and discharge condition.

Discussion

The establishment of surrogate markers for the severity of the disease that predict mortality is of vital importance in critically ill patients, since treatments aimed at reducing or normalizing these markers can affect overall mortality. A high MSI value indicates low stroke volume and systemic vascular resistance, reflecting a hyperdynamic circulation. This could indicate that the patient is in the compensation phase and decompensation may occur soon.[15]

Liu et al. evaluated in their retrospective study with 22,161 patients the relationshipbetween MSI, SI and mortality. It showed superiority of the MSI over the SI in termsof mortality prediction, with a higher value of 1.3.[19] Singh et al., in their prospectivestudy, found that MSI scores below 0.7 and above 1.3 were associated with a significantly higher mortality rate. In addition, MSI of ≥1.3 was found to be associatedwith sepsis, hyperlactatemia, increased ICU admission, and 28-day mortality.[14,20] In our study, it was shown that 52% had an MSI greater than 1.3. Of them, 42%ended up dying (p < 0.001).

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Prasad conducted a study in 235 subjects with sepsis. The mean age of the participants was approximately 56 years. He found that 139 (59.15%) were men; the majority (53.52%) of the participants had type 2 diabetes mellitus as a comorbidity, followed by chronic kidney disease with 10.21%, with a mean MSI value of 1.47.[20] These data correlate with the findings found in our study, 52% were male, which correlates with what was previously commented. 46% had type 2 diabetes mellitus,as found in the series. The mean age was 52.78 years and the main focus found, in34%, was pulmonary and abdominal, the former being statistically significant (p= 0.0469).

Although comorbidities, age group, sex, as well as mortality and the origin of sepsiswere the main findings of the study, clinical trials with a larger number of patients arenecessary to correlate the usefulness of the MSI with mortality in this group.

Conclusion

In our study, the modified shock index proved highly useful as a predictor of mortality, since the majority of patients with an MSI greater than 1.3 ended up dying.

Acknowledgments

None.

Conflicts of interest

The authors declare no conflicts of interest.

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