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Original Research Article

Shock index as a predictor of vasopressor use in patients with sepsis

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ABSTRACT

Background: Sepsis is life-threatening organ dysfunction caused by a dysregulated host response to infection. Sepsis and septic shock are major healthcare problems affecting millions of people around the world each year and killing as many as one in four. The documented incidence of sepsis worldwide is 1.8 million each year with mortality rate of almost 30%. Sepsis is the 10th leading cause of death in the United States. Shock index (SI) is defined as "Heart rate divided by Systolic blood pressure (HR/SBP)". Normal range is 0.5 to 0.7 in healthy adults.
Methods: A Prospective study was conducted between August 2018 to March 2019 comprising of 100 consecutive patients presenting to emergency department and ICU with sepsis. Subjects were identified by having evidence of infection presenting with cardiovascular collapse or organ failure with help of q-SOFA(quick- sepsis related organ failure assessment) and SOFA scores (sequential organ failure assessment score).Cases with clear alternative diagnosis were excluded. Vital signs were recorded, and Shock index was calculated. Primary outcome, which was use of Vasopressor therapy was analysed.
Results : A Total of 100 cases were studied, of which 70 patients were males and 30 females with mean age of 48.5 ±16.2 yrs. Most of the cases were between 35 to 60 years. Patients were classified into 3 categories based on shock index:1. <0.8 (normal, n=16) 2. 0.8 to <1.2 (n=29) 3. >1.2 (n=55). The use of vasopressor therapy within first 24 hours for each group was 18%, 34%, and 78%. This difference was statistically significant (p=<0.05).
Conclusion : In patients with sepsis an elevated shock index was indicator of early vasopressor therapy in the first 24hours. It is a simple bedside tool to identify septic patients in need for early vasopressor therapy thereby preventing further clinical deterioration.

Keywords: Heart rate, Shock index, Sepsis, Systolic blood pressure

INTRODUCTION

Sepsis is life-threatening organ dysfunction caused by a dysregulated host response to infection. Sepsis and septic shock are major healthcare problems, affecting millions of people around the world each year and killing as many as one in four.[1]

The documented incidence of sepsis worldwide is 1.8 million each year with mortality rate of almost 30%. The incidence is set to rise as the population ages, the elderly being worse affected.[2,3]

Sepsis is the 10th leading cause of death in the United States.[4] Shock index (SI) is defined as Heart rate divided by Systolic blood pressure. Normal range being 0.5 to 0.7 in healthy adults.[5]

Shock index is valuable in prognosticating outcome of critically ill patients. It is cost effective, simple bedside tool easily attainable which is based on parameters

assessed clinically which will greatly assist in the effective management of septic patients, especially in emergency departments.

Shock index was first described by Allgower and Bwri in 1967. It has been reported to be a sensitive marker for shock and for success of resuscitation efforts than the standard vital signs alone and has the advantage of not requiring invasive monitoring.[6]

While it was originally designed to identify apparently stable yet critically ill trauma patients, the SI has since been shown to be a simple, noninvasive risk stratification tool useful for detecting changes in cardiovascular performance before the onset of systemic hypotension and cardio-respiratory collapse.[7]

The management of sepsis is closely related to the availability of relevant equipment and efficacy of clinical and serological indices, which is used as a guide for the prognostication and effective treatment goals. The development of cost effective and easily attainable clinical parameters that would effectively prognosticate the outcome of sepsis patients would be invaluable within an emergency department setting.

Objectives

- To calculate Shock Index in patients presenting with sepsis
- To determine need for vasopressor therapy in patients with respect to shock index.

Quick Sequential Organ Failure Assessment (SOFA) score

qSOFA (Quick SOFA) Criteria	Points
Respiratory rate ≥22/min	1
Change in mental status	1
Systolic blood pressure ≤100 mmHg	1

THE SEQUENTIAL ORGAN FAILURE ASSESSMENT (SOFA) SCORE

SYSTEM	0	1	2	3	4
Respiration PaO2/FIO2 mm Hg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
Coagulation Platelets ×10³/uL	≥150	<150	<100	<50	<20
Liver Bilirubin mg/dL (umol/L)	<1.2 (20)	1.2-1.9 (20-32)	2.0-5.9 (33-101)	6.0-11.9 (102-204)	>12.0 (204)
Cardiovascular	MAP ≥70mmHg	MAP <70mmHg	Dopamine <5 or Dobutamine (any dose)	Dopamine 5.1 - 15 or Epinephrine ≤ 0.1 or Norepinephrine ≤ 0.1	Dopamine >15 or Epinephrine >0.1 or Norepinephrine >0.1
CNS GCS Score	15	13-14	10-12	6-9	<6
Renal Creatinine, mg/dl (umol/L) Urine Output, ml/d	<1.2 (110)	1.2 -1.9 (110-170)	2.0 - 3.4 (171-299)	3.5 - 4.9 (300 -440) <500	> 5.0 (440) <200

Catecholamine Doses = ug/kg/min for at least 1hr

Inclusion criteria

- Patients willing to give informed consent
- Age ≥18 year
- Patients in study who fulfill sepsis criteria (Q-SOFA, SOFA).[8]

Exclusion criteria

- Patients with acute coronary syndrome, upper GI bleed due to independent vasopressor need
- Trauma and blood loss states which need vasopressor support without sepsis.

METHODS

It is a prospective study involving 100 consecutive patients who present with features suggestive of sepsis (with evidence of infection, circulatory collapse, organ dysfunction) and satisfying sepsis criteria by q-SOFA and SOFA scoring systems getting admitted to hospitals affiliated to Bangalore Medical College & Research Institute were selected for study.

Shock index as described was calculated at arrival. Voluntary informed consent taken Information is collected and detailed history is taken using pre-formed proforma at the time of admission. Steps were taken to send for all the relevant necessary investigations and detailed clinical examination of the patient is done. Based on shock index need for vasopressor use was assessed clinically.

Statistical analysis

From the values gathered, data analysis was done by descriptive statistics to determine the value of SI in prognosticating the need for vasopressor use.

Analysis was also performed to determine whether other parameters that were gathered had value in prognosticating the outcome. Data obtained were presented in numerical variables with mean, median, minimum and maximum values noted. Outcome was to look for vasopressor need in patients with sepsis.

Among the significant parameters attained (p value <0.05), sensitivity and specificity analysis was carried out to attain the best cutoff point for shock index. Analysis of area under the curve (AUC) was performed for these variables.

RESULTS

There was a total of 100 patients recruited for the study. The study population comprised 70 males and 30 females mean age group being 48.8±16.12 (Table 2) maximum patients lie between 35–60 years old.

There were 36 cases of pneumonia, 20 cases of chronic liver disease, 14 cases of urinary intestinal tract related infections and 8 cases of CVA with aspiration

pneumonia, 5 cases of chronic immuno suppresion and 17 other cases (Figure 2).

Clinical parameter distribution of the variables stratified

Table 1: Age distribution.

Age	Number
20 to 35 Years	21
35 to 60 Years	51
60 to 75 Years	21
75 to 90 Years	07

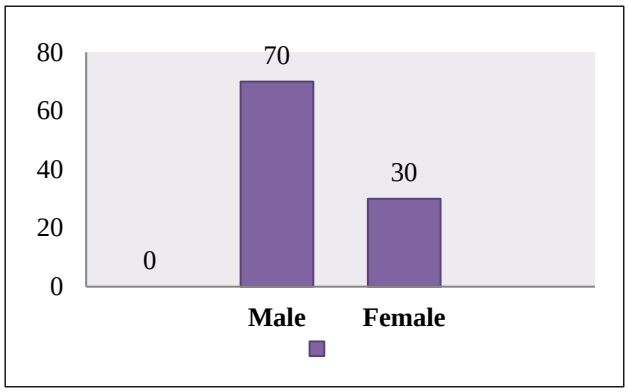


Figure 1: Gender distribution.

Table 2: Vital parameter analysis.

Parameters	Mean	Standard Deviation
Age	48.89	16.12
RR	26.40	4.97
SBP	88.07	25.31
HR	102.97	15.52
SI	1.25	0.45

Among the vital parameters assessed mean HR was 102.97±15.52, SBP of 88.07±25.31 and SI was 1.25±0.45 (Table 2).

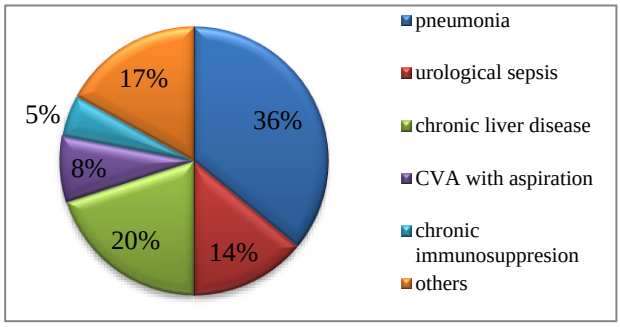


Figure 2: Comorbid conditions.

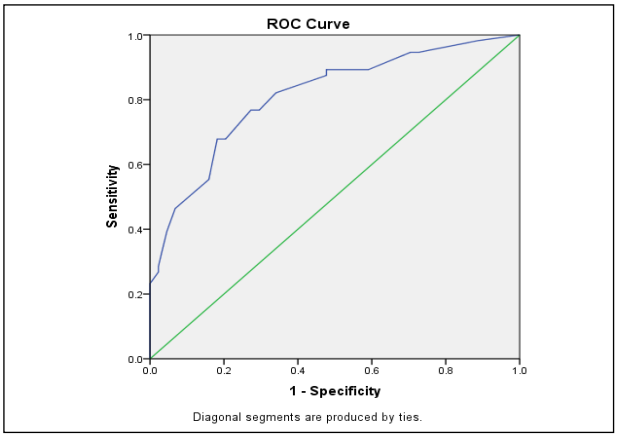
There was leucocytosis seen with mean of 17.9±7.8 and Creatinine value was on the higher side of normal mean being 1.3. Shock index when analysed as a predictor for need of vasopressor use in patients with sepsis showed high sensitivity and specificity and ROC curve was used for the same.

Table 3: Laboratory parameters.

Parameters	Mean	Standard Deviation
CBC:		
HB	11.29	2.84
TLC	17998.76	7851.06
PLT	216755.00 (179500.00)	142520.44 (112000,318000)
RFT:		
UREA	62.70(50.00)	43.58(34,81.75)
CREAT	1.39(1)	1.27(0.7,1.5)
LFT:		
TB	1.59(0.85)	2.86(0.3,1.67)
DB	0.91(0.3)	1.57(0.17,0.90)
ALB	3.14	0.86
AST	159.25(52.0)	508.21(27.75,100.25)
ALT	111.15(42)	274.93(20.50,101.75)
ALP	166.05(111.00)	163.47(83,185.25)
ABG:		
PH	7.34	0.14
PaO2	79.13	40.69
PaO2/FiO2	376.82	193.78
PT	13.65	2.48
INR	1.21	0.30

Table 4: Sensitivity, specificity analysis with respective ROC values of the significant (p <0.05) clinical parameters tested towards the outcome of survival.

	Total	Vasopressor use	
<0.8	16	03(18.8)	
0.8 to 1.2	29	10(34.5)	P value <0.05
>1.2	55	43(78.2)	



AOC=0.811 Cut of value 1.16 Sensitivity=0.76 Specificity=0.72

Figure 3: ROC curve.

Cut off for shock index was 1.16 in our study. Patients were classified into 3 groups of which 16 patients had normal shock index (<0.8) and 3 out of them required vasopressor.55 patients had shock index >1.2 of which 78.18% needed vasopressor support (n=43).

Thereby patients with shock index >1.2 the need for vasopressor use was.

DISCUSSION

Sepsis is a life-threatening event and early recognition and intervention is important. Simple bedside tools at the emergency department like shock index helps to identify the risk of clinical deterioration and need for vasopressor therapy at earliest. Clinicians evaluate the HR and SBP on every patient but rarely analyze them in a unified way. This can be easily accomplished by calculating a SI.

Total of 100 patients with sepsis were included in the study population. Mean age of study population was 48.5±16.2 which predominantly included male population (70%) and females were 30%. A Study by Asaari et al, done on 50 patients of Sepsis, median age was 54.5 years and study population consisted 62% females and 38% males.[9]

Most common presenting co-morbidities were pneumonia (36%), chronic liver disease (20%), urological sepsis (14%), CVA with aspiration (8%), chronic immunosuppression (5%) and others contributed to (17%). A study done by Wira et al, showed respiratory infection in 42%, urological sepsis in 21%, chronic liver disease in 16%, abdominal infections in 16% and others included 10%.[10]

After analyses of the data, shock index shows high sensitivity and specificity in prognosticating the need for early vasopressor use in patients with sepsis. Analysis showed that gender, race, age and temperature had no significance in predicting the outcome.

Among the vital signs studied mean HR was 102.97±15.52, SBP of 88.07±25.31. A study done by Wira et al, showed mean HR of 112 and SBP of 102.6 comparatively our study showed slightly less HR and SBP.[10] 55% of patients had altered mental status at presentation. This was slightly higher in a study done by Wire et al., in which it was 52% (p-0.552).[10]

Leucocytosis was the predominant blood picture (17.9±7.8) in our study. In a study done by Wira et al, the total WBC count was 12.8±8.3. Our study showed a higher range of total leucocyte count.[10] Total Bilirubin in this study was 1.59±2.8 mg/dl. A study by Wira et al, total Bilirubin >1.2 mg/dl was seen in 80% of patients with sepsis with a p value of 0.0007.[10]

On further analysis, Patients had slightly deranged renal functions with a mean Urea of 62.70 mg/dl and Creatinine of 1.3±1.27mg/dl. A study by Ho BC et al, mean Urea was 13.6±7.6 mmol/L (38.09mg/dl) and mean Creatinine was 222±218 μmol/l (2.5mg/dl) in their study population with septic shock.[11]

In this study, cut-off point determined for (SI 1) was ≥1.16. A study done by Berger et al, on adult patients with suspected sepsis showed that SI ≥0.7 was the most sensitive screening test for hyperlactemia and 28-day mortality, and SI ≥1.0 was the most specific predictor of both outcomes.[12]

In this study, the ROC curve demonstrated that shock index has a high sensitivity (76%) and specificity (72%) in predicting the need for vasopressor therapy in patients with sepsis.

In a retrospective study by Yussof et al, a comparison of the initial SI calculated at presentation and SI calculated after 2 hours of resuscitation was done. They determined that the SI calculated 2 hours after resuscitation had 80.8% sensitivity and 79.2% specificity for predicting death (overall mortality 54%). The optimal cutoff used for this prediction was 1.0 and correlated well with our study also.[13]

In our study among 100 patients, 55% had SI >1.2 and 78% among them required vasopressor therapy. A study by Mann B et al, also showed that vasopressor use in patients with sepsis having SI >1.2 was 73%. Our study showed a higher percentage of vasopressor use.[14]

In our study, SOFA score increased in patients with increased respiratory rate and low SBP. Similar result was also seen in Kenzaka et al, which showed that increased respiratory rate (95% CI = 0.112 to 0.240) and low BP (95% confidence interval [CI] = -0.046 to -0.013) correlated with disease severity in patients with sepsis.[15] However, at any value of SI, there was a significant range of SOFA scores, including patients with low SOFA scores and high SI values.

SI is an index that needs to be analyzed together with other sepsis parameters in determining the course and management efficacy of the patient. It is an easy bedside tool to guide clinicians with early interventions in patients presenting with features of sepsis not awaiting investigations and preventing further clinical deterioration.

CONCLUSION

Shock Index is a simple, convenient, easy and noninvasive bedside tool at the emergency department which is helpful in assessing patients requiring early vasopressor therapy. Shock Index of >1.2 was associated with poor prognosis and higher rates of vasopressor usage.

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