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Original Article

Shock Index as Prognostication Tool in Sepsis at A Tertiary Care Center

Dr M Arun Pandiyan[1], Dr Avinash S[2], Dr Apurva Rao K S[3]

[1] MD, Assistant professor, Department of General Medicine, Mahatma Gandhi Medical College and Research Institute, Puducherry.
[2,3] DNB, Assistant professor, Department of General Medicine, Yenepoya Medical College, Mangalore.

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Corresponding Author:

Dr Avinash S
DNB, Assistant professor,
Department of General Medicine,
Yenepoya Medical College,
Mangalore

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ABSTRACT

Background: Sepsis remains a leading cause of hospital mortality, contributing significantly to clinical and financial burdens. Early detection is crucial, as timely diagnosis improves survival and recovery. However, limited resources at various healthcare levels often hinder early identification. The Shock Index (SI), defined as the ratio of heart rate to systolic blood pressure, is a simple, practical tool that requires no specialized training, making it feasible even in primary care.
Methodology: A cross-sectional study was conducted at Yenepoya Medical College and Hospital on 100 patients presenting with sepsis who met ≥2 SIRS criteria. Heart rate and systolic blood pressure were recorded at admission to calculate SI, which was monitored throughout hospitalization. ROC analysis was performed to assess diagnostic performance.
Results: Of the 100 patients, 52 had SI >1, of whom 32 (61.5%) died. The mean SI was 1.031 (SD 0.303). ROC analysis identified an optimum cut-off of 0.431, yielding 86% sensitivity and 44% specificity (p = 0.00). Mortality was significantly higher in patients with SI >1 (52%) compared to those with SI <1 (10%), showing a 42% difference.
Conclusion: SI >1 at presentation was strongly linked with mortality. When correlated with qSOFA scores and lactate levels, SI proved to be a valuable prognostic tool. Its simplicity and feasibility support its widespread use in primary care and resource-limited settings for early sepsis detection and mortality risk assessment.

Keywords*: qSOFA, sepsis, emergency department, organ dysfunction.*

INTRODUCTION

Sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection. The immune system's pro- and anti-inflammatory arms are triggered in tandem with the activation of monocytes, neutrophils, and macrophages in response to an inciting agent. These cells interact with the endothelium via pathogen recognition receptors to produce cytokines, proteases, kinins, reactive oxygen species, and nitric oxide [22].

Sepsis continues to rank among the leading causes of morbidity and death in critically ill patients, despite tremendous progress in our understanding of the biology of this clinical illness, improvements in haemodynamic monitoring equipment, and resuscitation techniques [10]. Nevertheless, it is challenging to determine the worldwide epidemiological burden of sepsis. Around 30 million individuals globally are thought to have sepsis each year, which might lead to 6 million fatalities [13]. In India, sepsis is a frequent cause of hospital admission, especially in tertiary care centers where a high proportion of critically ill patients are referred [4].

The clinical spectrum of sepsis ranges from an uncomplicated infection with systemic manifestations to severe sepsis and septic shock, each step associated with progressive organ dysfunction and escalating mortality risk [15]. Early recognition, timely resuscitation, and appropriate escalation of care remain the cornerstone for improving outcomes. In this context, simple bedside tools that help identify patients at risk of deterioration are of immense clinical value [24].

Heart rate, blood pressure, respiration rate, urine output, and oxygen saturation are all measured in traditional septic patient monitoring. When evaluated separately, tachycardia and hypotension, which are frequently among the first indications of systemic compromise, may not accurately reflect the severity of the underlying shock [25,24]. For instance, vital signs are frequently within normal limits during the beginning of the compensatory phase of shock.

Hence, there is a pressing need for a simple tool to predict and stratify patients diagnosed with sepsis. Numerous prognostic scoring systems exist for sepsis, including SOFA (Sequential Organ Failure Assessment), qSOFA (quick SOFA), APACHE II (Acute Physiology and Chronic Health Evaluation), and NEWS (National Early Warning Score). While these tools are well-validated, they often require multiple clinical and laboratory parameters, which may not be readily available in busy emergency departments or low-resource tertiary care settings [16].

In contrast, a simple tool—Shock Index (SI)—is defined as the ratio of heart rate to systolic blood pressure (HR/SBP) [5]. It was initially presented in 1967 as a rapid and easy way to assess haemodynamic state in hemorrhagic shock patients [1]. In healthy persons, a typical SI falls between 0.5 and 0.7. A higher likelihood of haemodynamic instability, the requirement for major transfusion in trauma, and poor outcomes in a variety of acute diseases have all been linked to values higher than 0.9 [11].

The capacity of SI to identify early physiological deterioration before overt hypotension happens is what makes it useful in clinical settings. Systolic pressure and tachycardia are combined into a single quantity, SI, which represents the equilibrium between perfusion capacity and circulatory demand. It has been proven to be accurate in emergency situations for predicting death from pulmonary embolism [20], myocardial infarction [7], gastrointestinal haemorrhage [6], and trauma [9]. Its use has lately expanded to sepsis, when prompt identification of an imminent circulatory collapse is essential for directing resuscitation. Furthermore, for early aggressive treatment, SI can assist medical professionals in classifying patients into higher-risk groups. Serial SI monitoring can also reveal how well a treatment is working; consistently high results suggest continued circulatory impairment [19]. This is particularly relevant in resource-limited settings, where advanced hemodynamic monitoring such as lactate levels or invasive arterial pressure measurements may not be immediately available.

Despite growing evidence, the role of SI as a prognostic indicator in sepsis remains underexplored in Indian tertiary care centers. Given the high patient load, delayed referrals, and frequent constraints in laboratory support, a bedside index that can stratify risk quickly is invaluable. In view of the aforementioned, the study was planned with an aim to assess the predictive value of SI in patients with suspected sepsis and septic shock. Additionally, correlation of shock index with mortality predictors like qSOFA score and serum lactate levels was determined.

RESULTS

The study comprised of 100 patients diagnosed with sepsis based on the aforementioned diagnostic criteria. The age of participants ranged from 22 to 93 years, with a mean age of 57.98 years and a standard deviation of 14.35 years, indicating that the study population largely comprised middle-aged and elderly individuals. The patient characteristics are detailed in *Table 1*.

Table1: Clinico-demographic details.

Clinicodemographic data	Observation	Frequency
Gender distribution (n)	Female	68
	Male	32
Age distribution in years (n)	22-32	4
	33-42	10
	43-52	25
	53-62	20
	63-72	26
	73-82	11
	83-92	3
	93-102	1
Heart rate (n)	50-60	2
	61-70	2
	71-80	4
	81-90	8
	91-100	14
	101-110	27
	111-120	28
	121-130	14
	131-140	1

Systolic blood pressure (n)	71-80	12
	81-90	26
	91-100	17
	101-110	14
	111-120	9
	121-130	8
	131-140	7
	141-150	3
	>151	4

The study population was further stratified according to qSOFA scores and serum lactate levels. Analysis revealed that the majority of patients (60%) had a qSOFA score between 0–1, while 32% had a score of 1–2, and only a small proportion (8%) presented with higher scores of 2–3, indicating more severe illness. Similarly, serum lactate levels were assessed as an additional prognostic marker enlisted in *table 2*.

Table 2: Distribution of Serum lactate levels.

Serum lactate levels in mmol/L	Frequency
0.6-1.4	30
1.5-2.2	32
2.3-3	19
3.1-3.8	10
3.9-4.6	5
4.7-5.4	1
>5.5	2

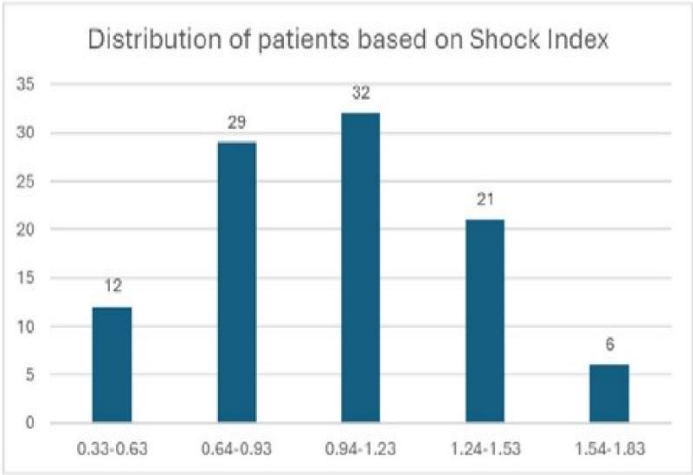

Figure 1: Distribution based on Shock index

Further, patients were stratified based on the SI.
The *figure 1* illustrates the distribution of patients based on SI. The largest group of patients (32 individuals) had a SI ranging between 0.94–1.23, followed closely by 29 patients with SI in the range of 0.64–0.93. A total of 21 patients fell within the 1.24–1.53 range, while 12 patients had lower values between 0.33–0.63. Only a small proportion of patients (6 cases) exhibited the highest SI values between 1.54–1.83.

The analysis of patient outcomes revealed that 57% of patients showed clinical improvement during their hospital stay, whereas 43% succumbed to mortality due to sepsis-related complications. Additionally, 20% of patients required intensive care unit (ICU) admission, highlighting the severity of their condition, while the majority were managed without the need for intensive care.

The outcomes showed a strong correlation between higher qSOFA scores and mortality, with deaths rising from 1 at score 0 to 8 at score 3 ($p < 0.05$). Similarly, shock index >1 was associated with 32 deaths versus 18 improvements, confirming its prognostic significance in sepsis ($p < 0.05$), illustrated in *figure 2*.

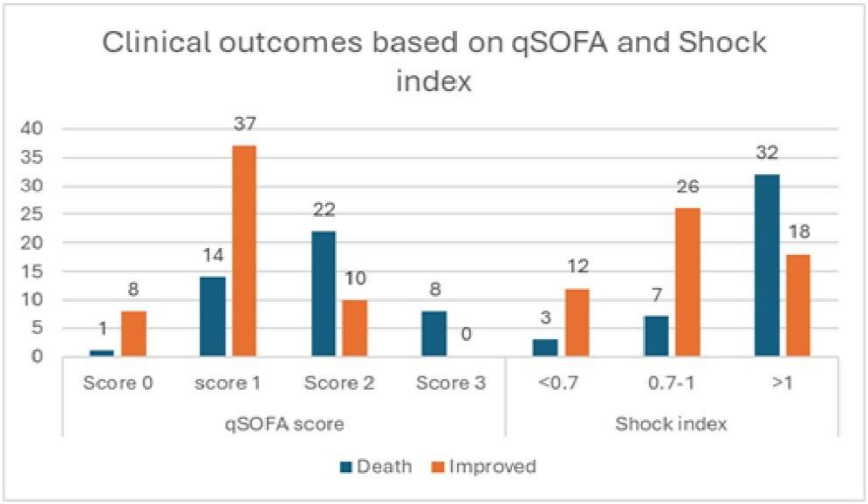

Figure 2: Association of qSOFA score with Shock index with clinical outcomes.

The ROC analysis provided a valuable insight into the prognostic performance of shock index and serum lactate levels in predicting outcomes among patients with sepsis. (Figure 3).

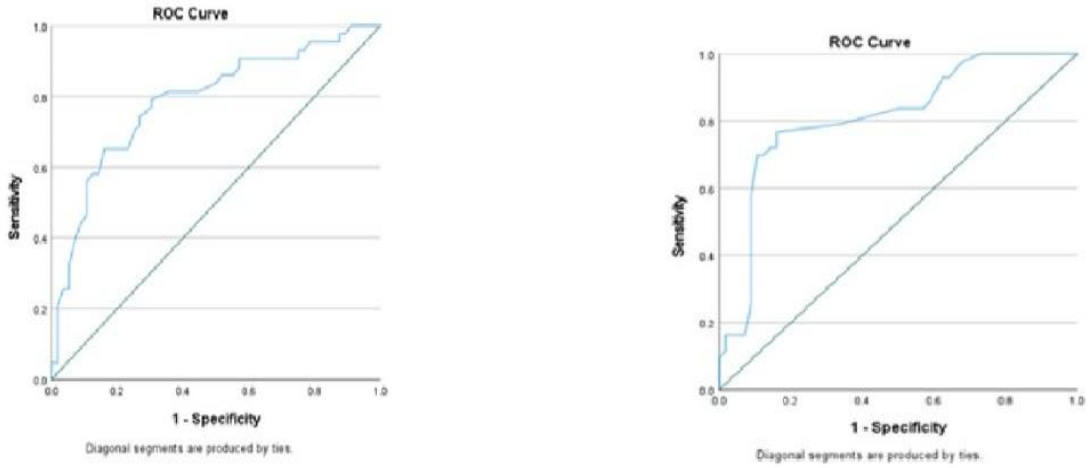

Figure 3: ROC of A) shock index and B) serum lactate levels in predicting outcomes among patients with sepsis.

For SI, the area under the curve (AUC) was 0.788, with a standard error of 0.047 and a statistically significant p-value (<0.001). The 95% confidence interval ranged between 0.695 and 0.880, indicating good discriminative ability. The optimal cut-off value was 0.430, which demonstrated 86% sensitivity and 44% specificity. This means that shock index is highly sensitive for detecting patients at risk of poor outcomes, though its lower specificity implies it may overestimate some cases. Laguvaram S et al [18] also noted that patients necessitating ICU care had a higher SI score.

For serum lactate, the AUC was slightly higher at 0.812, with a standard error of 0.045 and a highly significant p-value (<0.001). The 95% confidence interval (0.724–0.900) confirms reliable predictive accuracy. The best cut-off was 7.85 mmol/L, yielding 76% sensitivity and 83% specificity. This shows that lactate, while slightly less sensitive than shock index, is more specific in identifying patients truly at risk.

DISCUSSION

Sepsis is still a major worldwide health concern, accounting for over 6 million fatalities per year and being one of the most expensive hospital-treated illnesses, even with recent improvements in emergency treatment [8]. Critical time is frequently wasted during patient transfers as a result of delayed diagnosis and treatment. Timely diagnosis and risk assessment enhance outcomes and aid in optimal resource allocation [17]. Because predictive scoring systems facilitate

quick decision-making, they are essential for improving outcomes. Examples of such systems include the qSOFA score, serum lactate levels, and Shock Index (SI), all of which were utilized in this investigation.

In the present study conducted on 100 patients with suspected sepsis, only individuals aged above 18 years were included. The mean age of participants was 57.98 ± 14.35 years, indicating that the study population largely comprised middle-aged and elderly individuals who are generally more susceptible to sepsis and its complications. The gender distribution revealed a male predominance, with approximately 68% males and 32% females, suggesting a higher incidence of sepsis in men within this study group. Uppal et al. [23] also observed a similar trend in age distribution; however, their study did not demonstrate any significant gender preponderance. This demographic profile provides a representative baseline for further analysis of prognostic indicators such as Shock Index and serum lactate levels in the studied population.

In this cohort of adult patients with suspected sepsis, stratification by qSOFA score, serum lactate, and Shock Index demonstrated clinically important patterns that align with prior literature. Most patients had low-to-moderate qSOFA scores (60% with 0–1; 32% with 1–2; 8% with 2–3). This distribution is consistent with the utility of qSOFA as a rapid bedside screening tool that identifies a minority of patients with high scores who account for a disproportionate share of adverse outcomes, as highlighted in the Sepsis-3 assessments [21]. The principal strength of qSOFA lies in its simplicity and role in early risk stratification rather than definitive diagnosis.

In our investigation, the majority of patients (62%) had serum lactate levels within lower to moderate ranges (0.6–2.2 mmol/L), whereas a smaller proportion demonstrated markedly elevated values (>3.9 mmol/L). Higher lactate thresholds (≥4 mmol/L) are associated with greater disease severity and a need for aggressive resuscitation; however, even mild elevations (≥2 mmol/L) correlate with increased mortality risk. Elevated lactate has been consistently associated with worsening organ dysfunction and mortality in sepsis. Our finding that lactate demonstrated good discriminative ability (AUC ≈ 0.812) is concordant with prior studies identifying lactate as a robust prognostic biomarker in sepsis [14,8].

Shock Index findings were particularly noteworthy. Most patients clustered within the borderline SI range (0.64–1.23), with the largest subgroup falling between 0.94 and 1.23. ROC analysis yielded an AUC of 0.788 (95% CI 0.695–0.880), indicating strong predictive capability for adverse outcomes. These findings support the role of SI as an effective bedside indicator of early haemodynamic compromise prior to overt hypotension, corroborating previous pilot and observational studies that reported AUC values ranging from 0.7 to 0.8 for mortality and ICU admission across sepsis and other acute conditions [3,2].

Comparative diagnostic evaluation further clarifies the complementary roles of SI and serum lactate. In our study, the optimal SI cut-off (0.430) demonstrated high sensitivity (86%) but low specificity (44%). This suggests that SI may be more suitable as a screening tool rather than a definitive prognostic marker. Combining a highly sensitive haemodynamic index with a more specific biochemical marker such as lactate may therefore enhance early triage accuracy and resource utilization. While our findings align with prior literature, they also emphasize that optimal SI cut-off values and operating characteristics are context-dependent and require local validation [26].

Several limitations should be acknowledged. This was a single-center study with a modest sample size, which may limit generalizability. Variability in timing of clinical and laboratory measurements could have influenced calculated cut-offs. Additionally, data collection largely coincided with the COVID-19 pandemic, potentially restricting disease spectrum representation and introducing referral bias. These factors should be considered when interpreting the findings and planning future multicenter studies.

CONCLUSION

This study, conducted among patients with suspected sepsis admitted to a tertiary care centre, highlights the importance of early identification and prognostication. Findings revealed that a Shock Index of 1.0 or higher was associated with increased mortality at the time of initial evaluation in the emergency department.

Hence, SI offers an immediate, equipment-free screening tool that can be calculated at triage to flag patients for early intervention. Lactate measurement adds specificity and can guide resuscitation priorities. Furthermore, its predictive ability for mortality was found to be comparable with qSOFA scores and serum lactate levels during initial assessment in the emergency setting.

Declaration

Conflicts of interests: The authors declare no conflicts of interest.
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