Efficacy of Emergency Severity Index (ESI) in Early Identification of Patients with Sepsis and Septic Shock at Triage

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Research note

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Abstract

Objectives The objective of the study is to determine the efficacy of Emergency Severity Index (ESI) tool in early recognition of “sepsis” and “septic shock” at the triage of an emergency room at a tertiary care hospital in Pakistan.

Results A total of 240 patients were included in this study. The area under the curve (AUC) for the ESI score I for septic shock was 0.943 [0.921–0.964] with the optimal cutoff value of 2.0 with sensitivity of 88.5% and specificity of 100%. Similarly, the sensitivity and specificity of ESI score II for the diagnosis of sepsis was found to be 100.00% (CI 97.63–100.00%) and 66.28% (CI 55.28% to76.12%) with accuracy of 87.92% (83.11–91.76%)

Introduction

Sepsis is life-threatening organ dysfunction due to a dysregulated host response to infection and an important health problem.[1]Sepsis is a global health problem contributing to high mortality rates as highlighted by several studies. In 2017, the global estimates for sepsis incidence were around 49 million cases, with approximately 19.7% deaths, this increases to 55% of all in-hospital sepsis related deaths.[2]Data from emergency rooms of USA account for approximately 500,000 ED visits annually with suspected sepsis.[3] With each hour delay in effective antimicrobial administration, the mortality of sepsis is expected to increase by 7.6%.[4] A significant component of sepsis-related deaths is attributed to “septic shock” which is characterized by persistent hypotension requiring vasopressors and hyper-lactatemia. The mortality from septic shock ranges from 24–41%.[5]

Across the globe huge sepsis burden are from low and middle -income countries, and 90% deaths attributable from pneumonia, meningitis or other infections from developing countries and majority of deaths dueto sepsis occur in Asia and sub-Saharan Africa.[6]In Pakistan, the annual incidence of sepsis was 1600–2500 per 100,000, with 30% mortality rate.[7]

Considering the burden and significant mortality rates associated with sepsis, these patients must be prioritized and managed immediately in order to prevent adverse outcomes including death.To minimize the door to treatment time is even more challenging in overcrowded Emergency Departments (EDs) especially in resource-limited settings like Pakistan. The ED overcrowding and choked throughput is directly related with inadequate management of septic patients like delay in administration of antibiotics.[8]Hence it is necessary to introduce a purposeful and effective triage tool for ED nurses and physicians to prioritize and manage the patients according to the severity of their illness.[9]

Emergency severity index (ESI), a widely used tool that was developed in order to assess illness severity, hence to identify the sick patients that need immediate attention at triage. The ESI algorithm is a reliable tool with 4 decision points which provide good assistance with regard to early and reliable identification of patient with sepsis. (Fig.S1)

In ESI, patients are either assigned to one of the five triage categories, ESI level 1 being the most acute and life threatening, while ESI level 5 being the least acute triage category, however patients with ESI levels 1 and 2 are those critical patients who should not wait to be seen and treated.[1]Patient in category 2 are the one who are clinically unstable (septic or not) and category 3 are one with abnormal vitals.[1]

This study is aimed to identify the efficacy of ESI tool in early recognition of patients with sepsis and septic shock presented at the triage of our emergency department to help minimize the delay in appropriate management of these patients.

Methods

This is a single center, cross-sectional study conducted at the Emergency Department of the Aga Khan University Hospital. The university hospital is tertiary care teaching center that provides emergency care to over 75,000 patients per year. Ethical approval from ethics review committee of the Aga Khan University was taken to conduct the study.

All adult patients (≥ 18yrs) presented to the emergency department over a period of six months from December 2016 to May 2017 with emergency diagnosis of sepsis and septic shock were enrolled. We enrolled cases through non-probability consecutive sampling via calculating the prevalence (7%) of sepsis in Pakistan. Calculating with 95% confidence interval (CI), 3% margin of error and 0.05 level of significance, with WHO sample size calculator the estimated sample size was 240. Patients were followed by reviewing their electronic medical records through patient care information software where patient medical diagnosis and discharge diagnosis were present.

Exclusion criteria was pregnancy, poly-trauma, patient had major surgery in past 30 days, prior do-not-resuscitate orders or known chronic deliberated patient like new onset cerebrovascular accident and seizure disorder. Data was collected on a predesigned data sheet. No study-related therapeutic or diagnostic interventions were carried out.

Data was analyzed on SPSS v 20. Descriptive and Demographics results were presented in term of Mean ± SD, frequency and percentages. Utility of Emergency Severity Index (ESI) in Adults with Sepsis were the unit of analysis Proportions and percentage was calculated for gender, sepsis and septic shock. Analysis on ROC area under curve was calculated to see overall performance of ESI in diagnosing sepsis and septic shock with 95% confidence interval (CI). The results have been analyzed using the R-programming software version (3.5.2). Sensitivity and specificity of ESI was also assessed.

Results

A total of 240 patients were included in this study, out of which 57.9% (139) were male. The mean age was 52.7 ± 15.3 years with more than 59.6% above 50 years of age. Emergency severity index criteria comprises of 24.2% (58) ESI I, 64.2% (154) ESI II and 11.6% (28) ESI III patients. Mean length of hospital stay was 2.2 ± 1.1. Out of total 240 patients, 183 patients were diagnosed with sepsis and 57 with septic shock. 179

(74.6%) patients were recovered and discharged. Most of the discharged patients (87.1%) were belong to sepsis category. The mortality was found to be 19.6% (47 patients) out of the total study sample of which 63.8% (30) patient were belong to septic shock category and it was statistically significant. Fourteen patients were left against medical advice. Patients belong to sepsis category were more elderly as compared to septic shock (P-value < 0.001*). 65% (156) of patients with the diagnosis of sepsis were recovered and discharged and that was statistically significant (P-value < 0.001*). Demographic and clinical characteristics of the enrolled patients stratified by Sepsis and Septic shock are presented in Table 1.

Table-1: Demographic and clinical characteristics stratified by Sepsis and Septic shock

	Sepsis	Septic Shock	Total	P-value
	[n=183]	[n=57]	[n=240]	
	(%) f	(%) f	(%) f	
Age Groups				
<= 50 Years	35% (84)	5.4% (13)	40.4% (97)	0.002*
> 50 Years	41.3% (99)	18.3% (44)	59.6% (143)	
Total	76.3% (183)	23.8% (57)	100% (240)	
Length Hospital				
<=2 Days	49.6% (119)	13.8% (33)	63.3% (152)	0.329
> 2 Days	26.7% (64)	10% (24)	36.7% (88)	
Total	76.3% (183)	23.8% (57)	100% (240)	
Gender				
Male	45.8% (110)	12.1% (29)	57.9% (139)	0.218
Female	30.4% (73)	11.7% (28)	42.1% (101)	
Total	76.3% (183)	23.8% (57)	100% (240)	
ESI Criteria				
ESI I	0.4% (1)	23.8% (57)	24.2% (58)	<0.001*
ESI II	64.2% (154)	0% (0)	64.2% (154)	
ESI III	11.7% (28)	0% (0)	11.7% (28)	
Total	76.3% (183)	23.8% (57)	100% (240)	
Disposition				
Critical Area	41.3% (99)	11.7% (28)	52.9% (127)	0.755
Resuscitation	14.6% (35)	4.6% (11)	19.2% (46)	
Step Down	20.4% (49)	7.5% (18)	27.9% (67)	
Total	76.3% (183)	23.8% (57)	100% (240)	
Fate				
Discharged	65% (156)	9.6% (23)	74.6% (179)	<0.001*
Expired	7.1% (17)	12.5% (30)	19.6% (47)	
Left against medical advice	4.2% (10)	1.7% (4)	5.8% (14)	
Total	76.3% (183)	23.8% (57)	100% (240)	

Sepsis was taken as reference category. The area under the curve (AUC) for the ESI score I for septic shock was 0.943 [0.919–0.996] with the optimal cutoff value of 2.0 with sensitivity of 88.5% and specificity of 100% Table 2 & Fig. 1. Similarly, the sensitivity and specificity of ESI score II for the diagnosis of sepsis was found to be 100.00% (CI 97.63–100.00%) and 66.28% (CI 55.28% to76.12%) with accuracy of 87.92% (83.11–91.76%)

Table-2: AUC, Sensitivity and specificity of Validation of Emergency severity index (ESI score I) at triage with septic shock

ESI Criteria	Statistics
Cutoff	1.5
AUC (95% CI)	(95% C.I: 0.919 - 0.996)
P-value	<0.001*
TP	162
FP	0
TN	57
FN	21
TP proportion (Sensitivity)	0.885
TN proportion (Specificity)	1

Discussion

Early recognition of patients with sepsis, defined as a life threatening organ dysfunction due to a dys-regulated host response to infection, remains a major challenge. Our study showed a mortality of 19.6% in patients with sepsis which is in alignment with the global mortality of 19.7%. [2] In addition the mortality from septic shock in our study was 63.8% which is almost double the mortality rate reported in some other studies. [5]The Surviving Sepsis Campaign 1-h bundle stressed once more on the importance of time-sensitive measures. In this single centered prospective study, we statistically validated the relevance of ESI as a tool to identify and screen the patients with sepsis and septic shock. We found out that ESI category I was 88.5% sensitive and 100% specific in identifying septic shock at triage (Table-2). This was probably due to the hemodynamic instability of the patients with septic shock on presentation at triage that led to their categorization in ESI for immediate intervention and treated as a life-threatening condition. This could have helped in timely management of these patients in the initial 1st hour which is much crucial and critical period, and may have major detrimental effect on the clinical outcome.

Our study also showed 100% sensitivity and 66.28% specificity of ESI score II in diagnosing patients with sepsis. A study done by R. Nieves Ortega et al showed that ESI score of ≤ III was 32.5% specific and 97.4% sensitive in identifying sepsis with high number of false positives.

Another study done by Geier F. et.al, and in their study ESI didn't show the high values of diagnostic accuracy in identifying patients with sepsis (AUC 0.609; 95% CI: 0.704–0.853). This can be due to variable presentation with regards to presenting complains and vital signs of the patients They gave an example of 73-year-old male who visit ED with fever of 39.2^{O}C, cough and yellow discoloration. This case had history of organ transplantation, but was not identified at triage assessment. As per the ESI decision rule, he was assigned ESI III, and was waited for minutes or hours before been seen by physician. Hence Geier F et. al. identified that ESI triage system has weakness with regards to early identification of patient with sepsis, however patient with septic shock are able to identified reliably as with our results[12]

Our study showed that 11.6% of the patients were categorized as ESI III, which is a high number considering the significant mortality associated with sepsis and further studies are required to assess the factors associated with the variation in categorization of these patients in ESI III and above.

We can recommend that ESI application at the triage is useful in the prioritization of patients with sepsis and septic shock. Further studies will be required to compare ESI with other scoring systems and triage tools in order to compare their efficacy.

Conclusion

Sensitive and simple decision tools are required to promptly identify patients at risk of sepsis, as waiting times and resource allocation rely mostly on clinical information alone. Sepsis and septic shock is one of the major concerns in the lower to middle income country and is one of the major diagnoses responsible for morbidity and mortality in patients presenting to emergency departments. Identifying such patients in whom the first hour is claimed to be a golden hour and is decisive of patient's outcome is important and life saving measure. Having a reliable triage tool is of paramount importance which enables emergency physicians not to miss out any patient with sepsis and septic shock

In our study, ESI proved to be a useful "triage-tool" with high sensitivity and specificity in the identification and prioritization of patients with sepsis and septic shock in a busy emergency department. We were able to identify all patients with septic shock as ESI category I and most of the patients with sepsis as ESI category II. This would help physicians in managing the sickest patient first in order to improve outcomes in terms of mortality.

Limitations

One of the major limitations of our study is that we did not compare ESI with other scores like APACHE or SOFA scores that may have provided us with robust inferences. In addition, the analysis may have been

influenced by the revised definitions of sepsis and septic shock as we merged the patients previously diagnosed as severe sepsis with those diagnosed as sepsis as per the modified definitions.

List Of Abbreviations

ESI: Emergency Severity Index

Declarations

Ethics approval and consent to participate: Attached

Consent for publication: Not Applicable

Availability of data and material: The data is the property of The Aga Khan University and any decision for the acquisition of data will be made by the desired authorities (HIMS, the AKUH).

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Author's contributions:

1-Emaduddin Siddiqui : Conception & Design

2- Noman Ali: Design & Analysis

3- Mirza Noor Baig: Interpretation of data, revision of the work, correspondence

4- Ahmed Rahim: Analysis & Interpretation

5- Nazir Najeeb: Drafting, Acquisition of data

6- Kazi Khalid: Acquisition of data

7- Feroza Parveen: Acquisition of data.

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Figures

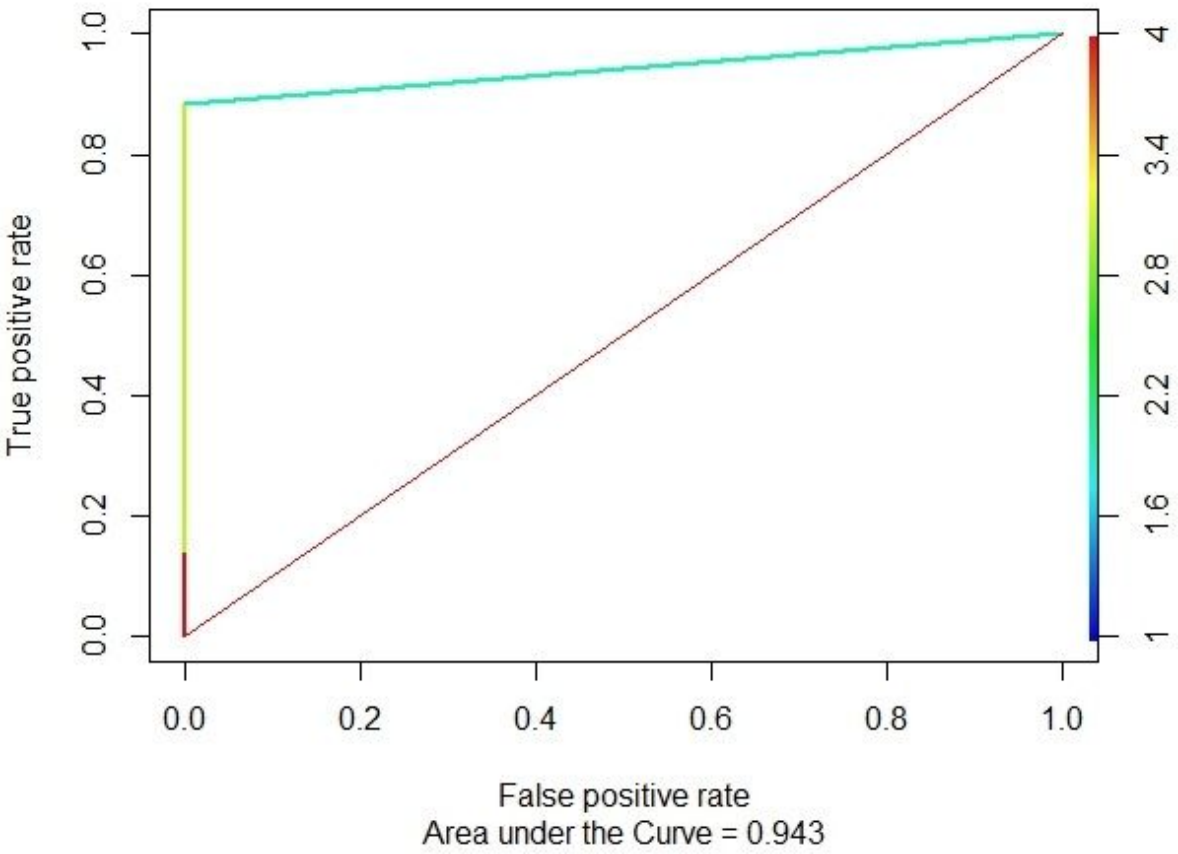

Figure 1

Validation of Emergency severity index (ESI) I with Septic Shock