Comparison of SOFA and qSOFA Scores in Predicting Infection and Mortality in HDU and ICU Patients at a Tertiary Care Center

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ABSTRACT

Objective: The objective of this study is to compare the sensitivity and specificity of the SOFA (Sequential Organ Failure Assessment) and qSOFA (Quick Sequential Organ Failure Assessment) in predicting infection and mortality in ICU (intensive care unit) and HDU (high dependency unit) patients admitted at a tertiary care center of excellence.

Study Design and Setting: Prospective observational non-interventional study. Anesthesia Department of Combined Military Hospital, Rawalpindi from Jan 2023-Jun 2023.

Methodology: Patients in both ICU (n=220) and HDU (n=220) setups admitted with a suspicion of sepsis were evaluated for onset of sepsis and mortality. Primary variables studied were the sensitivity and specificity for both scores for predicting infection and mortality in the ICU and HDU. Positive predictive value for both scores were calculated as secondary variable.

Results: While assessing the primary variables, the sensitivity of SOFA for predicting infection in the ICU was 25.6% with a specificity of 85.3% versus a sensitivity of 76.8% and specificity of 59.0% for qSOFA. In the HDU, It showed sensitivity and specificity with PPV for SOFA being 64.7%, 95.1% and 64.7% versus 79.3%, 85.3% and 46.9% for qSOFA respectively. While assessing for mortality, SOFA values in the ICU for sensitivity, specificity and PPV were 81.8%, 93.5% and 69.2% versus 88.8%, 58.3% and 90.9% for qSOFA respectively.

Conclusion: We conclude that qSOFA to be good predictor of mortality in the HDU and SOFA with good specificity for infection and mortality in the ICU.

Key Words: HDU, ICU, Infection, mortality, SOFA, qSOFA

INTRODUCTION:

Sepsis and sepsis-related complications remain the greatest cause of hospital admissions in the intensive care unit.[1,2] These patients present a challenge to the multi-disciplinary team since most of these patients present with associated co-morbidities and sepsis related derangements causing electrolyte abnormalities, multi organ dysfunction and severe disruption to normal body homeostasis.[3] With advancements in the treatment strategies, the tier of care has also expanded especially in centers of excellence where escalation and de-escalation of therapy requires shifting of patients to and from the intensive care setups.[4] The major bulk of patients coming to the intensive care setups are either shifted post-operatively requiring ventilator care before extubation or are stepped up from non-critical care setups citing more cautious care to prevent morbidity and mortality.[5]

The mainstay of tiered care is the development of scoring systems to standardize and early detection of cases requiring intensive care or non-intensive care setups.[6] Even though various scoring systems have been developed to diagnose sepsis and its sequelae effectively and efficiently, a single best scoring system with sensitivity and specificity is still lacking.[7] The sepsis-3 task force proposed the Sequential Organ Failure Assessment Score (SOFA) as mainstay to evaluate and diagnose sepsis in the ICU setup in 2016.[8] The score has been a point of interest in ICU setups globally. Since the score requires multiple patient characteristics and metabolic panel details, its use in diagnosing or suspecting sepsis in non-ICU setups is not practically feasible due to lack of advanced test and no routine to carry out critical investigations in the wards. Seymour et al developed the qSOFA including only three basic parameters of respiratory rate, systolic blood pressure and Glasgow Coma Scale to evaluate patients requiring less expertise and investigations.[9] Both these tests represent two points of care, one being the critical care and second being non-critical care setups.

HDU (High Dependency Unit) represent another paradigm

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in point of care, which falls between general ward care and intensive care setups which receives patients from the ICU no longer requiring ventilator care or support and from the wards with suspicion that the patient may end in complications if care is not escalated.[10] It has been proven that HDUs in the tier of care is associated with a significantly reduced hospital mortality in ICU patients, underlining the impact of an HDU as a bridge between the ICU and the regular ward when patient care is concerned. Most of these patients require risk stratification to evaluate for sepsis as they may complicate. The question arises whether to use the SOFA or qSOFA in these patients in the intermediate level of care.[11]

Both the SOFA and qSOFA have been scarcely used to evaluate for infection and mortality in HDU setups. The aim of our study is to compare the sensitivity and specificity of the SOFA (Sequential Organ Failure Assessment) and qSOFA (Quick Sequential Organ Failure Assessment) in predicting infection and mortality in ICU (intensive care unit) and HDU (high dependency unit) patients admitted at a tertiary care center of excellence.

METHODOLOGY:

This prospective observational non-interventional study was carried out at the Department of Anesthesiology, Combined Military Hospital from Jan 2023-Jun 2023 after approval from the ethical review board vide letter no: BIH-RWP-0010. A total of 440 patients (minimum sample size 163 as per WHO calculator) were included in the study (220 from ICU and 220 from HDU) as per the inclusion criteria furnished keeping the confidence interval at 95%, margin of error at 5% with the global population prevalence of admissions with sepsis requiring ICU/HDU care at 88%.[12] The method of sampling was non-probability consecutive by lottery method.

Inclusion criteria included patients both from the ICU and HDU setups admitted directly or transferred either from the ICU or ward with suspected episodes of infection within 72 hours of admission to the care setting while on broad spectrum antibiotics.

Exclusion criteria included patients with no history or metabolic suspicion of infection, patients with a resolving PCT (procalcitonin) titer, patients where SOFA or qSOFA could not be assessed (lack of investigations or unable to assess GCS) and unwilling to be included in the study.

The study method included all patients as per the inclusion criteria furnished. Patients in both ICU and HDU setups admitted with a suspicion of sepsis were evaluated with episodes of infection defined as the occurrence during the initial 72 hours after starting broad spectrum antibiotics according to institutional protocol. Antibiotics not falling in the category of broad spectrum were not used (ampicillin, colistin, erythromycin, azithromycin, metronidazole etc.). SOFA and qSOFA scores were evaluated and endorsed by the attending critical care resident after evaluation by a critical care consultant in the ICU thrice a day and by a medicine or anesthesia resident on duty in the HDU by the attending consultant respectively. Median values of both scores were calculated daily and endorsed. For the SOFA score, an increase in two score points from the previous day or a total score of >11 was considered as positive and endorsed. For the qSOFA evaluation, presence of two or more of the parameters was considered positive and endorsed.

Primary variables studied were the sensitivity and specificity for both scores for predicting infection and mortality in the ICU and HDU. Positive predictive value for both scores were calculated as secondary variable. Demographic data were statistically described in terms of mean and SD, frequencies, and percentages when appropriate. Mean values were compared using the independent samples t-test while non-parametric data was compared using the Mann Whitney-U test. A p value of 0.05 was considered statistically significant. All statistical calculations were performed using Statistical Package for Social Sciences 26.0.

RESULTS:

A total of 440 patients were included in the study protocol as per the inclusion criteria furnished with 220 patients each from HDU and ICU setups. Mean age of patients was 56.70±4.30 years in the ICU group versus 56.69±4.25 years in the HDU group (p=0.982). Mean weight was 65.47±5.76 kg in the ICU versus 65.12±5.48 kg in the HDU group (0.514). Mean duration of stay was 8.21±1.87 days in the ICU versus 5.15±1.16 days in the HDU group (Table-1).

Frequency of variables studied showed that need for invasive ventilation was required in 84 (38.2%) patients in the ICU versus 05 (2.3%) patients in the HDU group (p<0.001). Need for inotropic support was needed in 68 (30.9%) patients in the ICU versus 12 (5.5%) patients in the HDU group (p<0.001). Frequency of new onset infection was in 57 (25.9%) patients in the ICU versus 19 (8.6%) patients in the HDU group (p<0.001). Overall, 15 (6.8%) patients died in the ICU versus 04 (1.8%) in the HDU group (p=0.010) (Table-1).

While assessing the primary variables, the sensitivity of SOFA for predicting infection in the ICU was 25.6% with a specificity of 85.3% versus a sensitivity of 76.8% and specificity of 59.0% for qSOFA. Positive predictive value (PPV) for SOFA was 25.6% versus 89.7% for qSOFA for infection. The same variables for infection in the HDU showed sensitivity and specificity with PPV for SOFA being 64.7%, 95.1% and 64.7% versus 79.3%, 85.3% and 46.9% for qSOFA respectively (Table-2).

While assessing for mortality, SOFA values in the ICU for sensitivity, specificity and PPV were 81.8%, 93.5% and 69.2% versus 88.8%, 58.3% and 90.9% for qSOFA respectively. Same assessment done in the HDU for both scores for mortality showed a sensitivity, specificity and

PPV of 56.0%, 90.3% and 42.4% for SOFA versus 93.4%, 75.0% and 93.9% for qSOFA respectively (Table-2).

Table-1 Demographic Variables (n=440)

Variable	ICU (n=220)	HDU (n=220)	p value
Mean age (years)	56.70±4.30	56.69±4.25	0.982
Mean weight (kg)	65.47±5.76	65.12±5.48	0.514
Mean stay (days)	8.21±1.87	5.15±1.16	<0.001
Need for invasive ventilation	84 (38.2%)	05 (2.3%)	<0.001
Need for inotropic support	68 (30.9%)	12 (5.5%)	<0.001
Frequency of infection	57 (25.9%)	19 (8.6%)	<0.001
Frequency of mortality	15 (6.8%)	04 (1.8%)	0.010

Table-2 Sensitivity, Specificity, Positive and Negative Predictive Values for SOFA and qSOFA in ICU and HDU for Infection (n=440)

Variables	ICU (n=220)		HDU (n=220)	
	SOFA	qSOFA	SOFA	qSOFA
Sensitivity	25.6%	76.8%	64.7%	79.3%
Specificity	85.3%	59.0%	95.1%	85.3%
Positive predictive value	25.6%	89.7%	64.7%	46.9%
Negative predictive value	82.5%	35.4%	95.1%	96.2%

Table-3 Sensitivity, Specificity, Positive and Negative Predictive Values for SOFA and qSOFA in ICU and HDU for Mortality (n=440)

Variables	ICU (n=220)		HDU (n=220)	
	SOFA	qSOFA	SOFA	qSOFA
Sensitivity	81.8%	88.8%	56.0%	93.4%
Specificity	93.5%	58.3%	90.3%	75.0%
Positive predictive value	69.2%	90.9%	42.4%	93.9%
Negative predictive value	93.5%	58.3%	94.1%	73.2%

DISCUSSSION:

The study was carried out at our institute to better assess the outcome of the SOFA and qSOFA scoring system and whether they can be reliably applied to identify sepsis and mortality in patients admitted to two different treatment setups. While none of the tests proved to be ideal in diagnosing both sepsis and mortality in the ICU and HDU setups; the sensitivity, specificity and positive predictive values were variable for both scores concluding that one score may be better suited to one variable for a given setup. To our knowledge before starting our study, the prospective assessment for both the scoring system has been scarce and majority of the studies done have been retrospective with data pulled out of archives and databases. We present this study as the first one in our institute as well employing a prospective approach to provide more appropriate results.

The SOFA system has been employed by the Sepsis Task Force as both a predictor for sepsis and mortality. The qSOFA on the other hand was originally described by Seymour et al to predict for mortality and not for the identification of infection or sepsis but our study employed it for both and found results which may prove its use as a tool for diagnosing sepsis in the appropriate setup.[13] We concluded from our study that sensitivity and specificity of the qSOFA score in predicting sepsis in the ICU was not significant and was marginally better for specificity in the HDU. It was in line with studies carried out by X Qiu et al[14] and AK Toker et al[15] They also concluded that the qSOFA score was not effective in the ICU for sensitivity and specificity. However, it has a better predictive value in the ICU for sepsis than the HDU. This was also demonstrated in results of study carried out by H Yu et al.[16] Except for sepsis in the ICU for qSOFA, the predictive power was poor for diagnosing sepsis in the HDU. The SOFA score showed similar results for predictive power for sepsis both in the HDU and ICU, however, it showed good specificity for sepsis both in the HDU and ICU. This was in line with results carried out by BR Adegbite et al.[17] When talking about predicting mortality in the HDU and ICU for both scores, SOFA score was superior to predicting mortality both in the HDU and ICU with good specificity. The specificity of qSOFA was not significant but had a good predictive value for mortality both in the HDU and ICU. Our results were also confirmed by studies carried out by S Liu et al[18] and GL Nugraha et al.[19]

Our predictive values were slightly better with better specificity than some studies done by Koch et al.[11] The reason is attributed to a majority of patients being admitted with medical conditions and less with surgical complications in our study group. This may have resulted in a slightly better predictive power and sensitivity and specificity for both scores. It is also pertinent to mention that since most post-surgical patients present after the operation room with surgical stress related pain, tachycardia and hypertension and a systemic inflammatory response to surgery rather than infection, it becomes challenging in these patients to accurately label sepsis or immune response causing variation in results. We aimed to improve this by carrying out procalcitonin levels to check for titer rise or fall to better identify sepsis from immune response.[20]

CONCLUSION:

We conclude that qSOFA to be good predictor of mortality in the HDU and ICU and SOFA with good specificity for infection and mortality in the ICU.

Authors Contributions:
Sarah Khan: Conception, Design, Acquisition, analysis and interpretation of data, drafting of article
Jawad Khan: Conception, Design, Acquisition, analysis and interpretation of data, drafting of article
Shaista Khan: Conception, Design, Acquisition, analysis and interpretation of data, drafting of article

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