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Original Research Article

ROLE OF QUICK SOFA (qSOFA) SCORE IN EARLY DETECTION AND USE OF SERUM LACTATE LEVEL AS PROGNOSTIC MARKER IN SEPSIS

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Abstract
Background: To explore and compare the prognostic accuracy of the lactate level the qSOFA score for mortality in septic patients, and to diagnose sepsis at early stages and to analyze percentage of mortality in sepsis patients based on using new qSOFA score with prognosis in sepsis using serum lactate level. **Materials and Methods:** Retrospective cohort study of 50 patients was conducted on a merged dataset of suspected or proven sepsis and admitted in Intensive Care Unit from Emergency Department and Inpatient ward of Darbhanga Medical College and Hospital (DMCH), Laheriasarai, Bihar, India. Data sharing was performed across sites of demographics, qSOFA, serum lactate thresholds (≥ 2 mmol/L) and outcome data for included patients. Serum lactate and qSOFA scores were calculated by three criteria scoring system in patients. **Results:** Sepsis is a common critical condition caused by the body's overwhelming response to certain infective agents. Many biomarkers, including the serum lactate level, have been used for sepsis diagnosis and guiding treatment. Lactate has been shown to be a very important severity marker in sepsis cases and has been found to be more useful for predicting the outcome of sepsis than common severity scores. Thus, quick Sequential Organ Failure Assessment SOFA (qSOFA) is incorporated with lactate for screening sepsis and assess prognosis. In our study out of 50 patients with suspected infection observed that the qSOFA score of ≥ 2 were found in total 46 (92%) patients while the remaining 4 (8%) patients had the score of <2, which showed 3-14 fold increase in mortality rate. The highest number of patients were 52% (26) with range of Serum lactate value of 2.1 - 4.0 mmol/l of total population, comprising 18% (9) of male and 34% (17) of female patients. **Conclusion:** Serum lactate levels and qSOFA are all trustworthy and effective prognostic indicators of sepsis. These are efficient, faster, and good bedside diagnostic tools.

INTRODUCTION

Sepsis is defined as a life-threatening syndrome of biochemical, pathological and physiological abnormalities that are caused by a dysregulated host response to microbial invasion leading to organ dysfunctioning.[1] Sepsis if left untreated may lead to fatal conditions such as septic shock, multiple organ failure, disseminated intravascular coagulation, respiratory distress syndrome and cardiac arrhythmia. It is the major reason of morbidity and mortality among intensive care unit's patients worldwide.[2] Global burden of sepsis was surveyed by Rudd et al. during 1990-2017 and it was documented that approximately 48.9 million sepsis cases and 11 million deaths (22.49%) due to delay diagnosis of sepsis occurred globally.[3] Millions of the sepsis cases were estimated each year and

around 30% deaths were accounted due to sepsis.[4] It is also reported that 85% cases of sepsis and sepsis related deaths existed in middle and low-revenue generating regions across the world.[3] Diarrheal disease and pulmonary infections are major contributors to sepsis and sepsis-related deaths globally.[5]

Surgery of any organ or microbial infections results in activation of complex pro-inflammatory and anti-inflammatory responses, in turn triggering individual's immune system. The phenomenon of sepsis initiates when microorganisms either whole or partly or toxins produced by them are recognized by soluble or membrane-bound pattern recognition receptors. It activates a series of cellular response such as release of cytokines, proliferation of lymphocytes, and activation of the complement, coagulation, and fibrinolytic

systems.[6,7]Consequently, causing fever, suppressing blood formation, and other important pathways required for proper functioning of human body, ultimately resulting in cell/tissue damage, organ dysfunction and deaths.[6]

According to WHO factsheets released in 2020, clinical manifestation of infections in sepsis is caused due to poor community setting and health-care facilities during care delivery.[5] The factsheet stated that the individuals with poor/suppressed immune response are more vulnerable to sepsis. The populations at higher risk of sepsis include patients suffering from liver cirrhosis, kidney disease, auto-immune disease, AIDS/HIV, cancer or individuals undergone organ transplantations.[5] It has been observed to be age, sex and race dependent. Sepsis have been observed at higher rates among older population, pregnant women, neonates or those overusing antibiotics for treating any infection and have developed resistance against those infecting strains.[5]

Sepsis is a multi-symptomatic emergency condition that is often characterized by high fever, chills and shivering, increased heart rate, low body pressure, low urine output and extreme body ache.[5] Researchers have proved that sepsis has been observed even in patients without systemic inflammatory response syndrome (SIRS).[8] It is difficult to diagnose sepsis using single diagnostic tools. It is often predicted using physical examinations and clinical testing such as blood tests, kidney function test and liver test.[9] For rapid diagnosis of infection and organ dysfunctioning certain screening tools were designed such as sequential organ failure assessment (SOFA), quick SOFA (qSOFA) and Lactate level.[1,8,10] SOFA screens mortality risk in sepsis patients on the basis of 6 organ-system tests that are renal, cardiovascular, respiratory, hepatic, central nervous system and hematological tests. Change in sequential organ failure assessment (SOFA) score ≥2 signifies increase of mortality risk by 10% in infected patients.[1] Since the SOFA score utilized multiple laboratory tests for assumption; it was time taking and laborious. A screening app qSOFA was developed using logistic regression on established datasets.[8] It depended on alteration in Glassgow coma score <15, systolic blood pressure ≥100mm Hg or respiratory rate ≥22/min, was cost effective and helped in early management of the patient, hence lead to better prognosis.[1,8]

Serum lactate level acts as biomarker in early prediction of sepsis. It has been reported that during oxidative stress and other clinical –metabolic disorder, lactate is produced as a byproduct in anaerobic glycolysis pathway.[10,11] This hyperlactemia condition indicates higher risk of mortality among infected patients.[10] Increase in lactate level above 2mmol/L is indicator of hypo-perfusion and septic shock and thus help in early prognosis of sepsis.[9,11] The hyperlactatemia and delayed lactate clearance related to increased incidence of organ failure and mortality in sepsis have been predicted in several literatures.[1,8-11] The present study emphasized on validity of qSOFA in early detection of sepsis and prognostic role of serum lactate levels in patients with sepsis.

MATERIALS AND METHODS

Study Design and Setting
A single-centered hospital based prospective study was conducted between July 2021 and January 2023 at the Department of General Medicine, Darbhanga Medical College and Hospital (DMCH), Laheriasarai, Bihar, India. This study was approved by Research Ethics Committee of the Darbhanga Medical College and Hospital. Following inclusion and exclusion criteria of the patients were set for the study:

Inclusion Criteria
➢ Patient above 18 years of age
➢ qSOFA>=2
➢ Cases confirmed as sepsis using SOFA

Exclusion Criteria
➢ All trauma
➢ Pulmonary embolism
➢ Patient less than 18 years of age
➢ Congestive cardiac failure
➢ Dyselectrolytemia

Study Population and Sample Size
Patients diagnosed as sepsis and admitted in Intensive Care Unit from Emergency Department and Inpatient ward of DMCH, fulfilling inclusion-exclusion criteria were taken into study.

The sample size was calculated using the following formula:

$$N = (z\alpha/2)^2 p\,(1-p)\,/\,d^2$$

Where, N = sample size;
z= level of confidence;
α= 5% level of significance;
p= expected prevalence of the condition;
d= tolerated margin of error

Based on the above calculation total 50 patients were included in the study. All selected patients signed an informed consent (Annexure I).

Study Tools
Thorough general and systemic examination
Arterial Blood Gas analysis
Serum lactate level at admission and 6hrs post admission

Data Collection
The demographic details including age, sex, dietary habits, smoking, alcoholic consumption of each patient's was noted down in the pre-set Performa. Patient's pulse rate, respiratory rate, blood pressure was recorded at the time of their admission to hospital. These data were used for calculating the qSOFA scores.

Mental status was monitored on Glassgow comma scale and noted down. All the patients were regularly monitored for change in symptoms,

urination and health conditions during their stay in hospital.

CLINICAL PARAMETERS FOR SOFA AND qSOFA SCORES CALCULATION

PaO2/FiO2 ratio: PaO2/FiO2is the ratio of partial pressure of arterial oxygen to fractional inspired oxygen. PaO2is expressed in terms of mmHg and FiO2 expressed as a fraction, not a percentage.[12] It is also known as Horowitz index, the Carrico index, or the P/F ratio. It is a measure to assess the hypoxemic respiratory failure in sepsis patients.[13] Both PaO2 and FiO2 are measured from arterial blood gas (ABG). PaO2/FiO2 ≤100, between 100 and 200, and 200-300 signifies severe, moderate and mild respiratory distress.[14,15]

Creatinine: The breakdown of creatinine phosphate present in muscle produces creatinine. It is excreted everyday through globular filtration, tubular secretion and non-renal gastro-intestinal secretion. Excessive creatinine concentration signifies kidney damage and renal failure in sepsis patients.[16,17] It is measured by colorimetric Jaffe's assay from patient's blood.[18]

Bilirubin: Liver plays a central role in regulating several metabolic pathways in body. it secrets bile salt everyday which consists of hydrophobic and hydrophobic fractions. Due to liver malfunctioning bilirubin level elevates resulting in inflammation, oxidative stress and apoptosis.[19] It is characterized by jaundice and can be measured by direct spectrophotometry from blood at 450 nm.[20]

Platelet count: Platelets help in regulating blood flow and immune response. Sepsis associated multi-organ failure results in hyper-permeability of endothelial cell resulting in microvascular thrombosis. This creates impairment in oxygen delivery to cells. Platelet and coagulation system alters hemostasis. Decrease in platelet develops thrombocytopenia which is marker for mortality in sepsis patients.[21] Platelets are counted using phase contrast microscopy in laboratory.[22]

Blood pressure: Regulated blood pressure is necessary for maintaining tissue perfusion and oxygen supply to the cells. Systolic aterial pressure <90 mmHg and mean arterial pressure <65 mmHg results in hypotenison. Hypotension creates disbalance between oxygen supply and demand, generated hypoxemic condition which results in poor outcome.[23,24]

Glasgow coma scale: Glasgow coma scale is used to measure the mental status in trauma or critically ill patients. It makes assessment on the basis of three parameters namely, best eye response (E), best verbal response (V) and best motor response (M). 1 point is given for 'no response' and so on the number score increases with better response. 4 point is for eye opening response, 5 for verbal response and 6 for motor response.[25]

Statistical Analysis

The statistical analysis was performed to validate the results using GraphPad Prism software and Microsoft Excel. The results were described as frequencies, percentages and mean± standard deviation. P-value ≤0.05 was considered statistically significant.

RESULTS

Sepsis-3 also derived a bedside assessment tool for sepsis screening in patients with infection who are not in intensive care units (ICUs). Called the quick SOFA (qSOFA) score, it includes 1 point for each of 3 criteria:

1. Respiratory rate (RR) ≥ 22 breaths/min,
2. Altered mental status, or
3. Systolic blood pressure (SBP) ≤ 100 mm Hg.

A qSOFA score ≥ 2 is suggestive of sepsis. Sepsis-3 recommends that, for a qSOFA score < 2, the full SOFA score, including laboratory results, should be used 26.

Age

The age of the study sample among 50 patients ranged from minimum 18 years to maximum 78 years of age with the mean SD age of 52.58 ± 17.4 (Table 1). Highest number of patients belonged to age group of 61 – 80 years with total number of 20 (40%) patients among total 50 patients, followed by the age group of 41 – 60 years with 18 (36%) of patients. In this study, there were only 6% of patients in the age group of below 20 years. However, 18 patients comprising of 9% of total patients were in the age group of 21 – 40 years of the total study population (See Table 1).

Gender

In this study, out of 50 patients of suspected sepsis, 19 patients comprising of 38% of total population were male, whereas 31 (62%) were female (Table 2). Thus, the majority of the total populations of suspected sepsis patients were male compared to female population (Figure 1).

Serum lactate

Serum lactate level was studied in all the population study of 50 patients in which the mean SD value calculated was 4.01 ± 3.38 mmol/l (Table 3). Out of 50 patients, the mean SD value of serum lactate in 31 females calculated was 4.34 ± 3.3 with the minimum and maximum range of serum lactate analyzed 1.36 mmol/l and 15.42 mmol/l. Similarly, the mean SD value of serum lactate in 19 males calculated was 3.57 ± 3.8 with the minimum and maximum range of serum lactate analyzed 1.2 mmol/l and 13.53 mmol/l. The mean average value of serum lactate was high in females compared to males as depicted in Figure 2.

Different range of Serum lactate value was calculated and differentiated into different ranges for both male and female patients suffering from sepsis (Table 4). Number of patients with Serum lactate value of 1.2 - 2 mmol/l were 11 (22%), in which 14% (7) were male and 8% (4) were female. The highest number of patients were with range of Serum lactate value of 2.1 - 4.0 mmol/l were 52% (26) of total population, comprising 9 (18%) of male

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and 17 (34%) of female patients. However, there were only 1 male patient each in the range 4.1 - 8.0 mmol/l, 8.1 - 12.0 mmol/l and >12.1 mmol/l of Serum lactate comprising of 2% of total population study. On the other hand, 2 (4%) female patients each were observed in each Serum lactate range of 8.1 - 12.0 mmol/l and >12.1 mmol/l. However, there were 6 (12%) female patients in the Serum lactate range of 4.1 - 8.0 mmol/l (Figure 3).

Systolic blood pressure (SBP)
Different range of SBP value was calculated and differentiated into different ranges for both male and female patients suffering from sepsis (Table 5). The highest number of patients in this study having SBP value of 60-70 mm Hg measured was 32 (64%), in which 24% (12) were male and 40% (20) were female. However, there were no male patients in the range 81-90 mm Hg with only 2 (4%) females observed in the similar range. On the other hand, 16 (32%) patients were observed in SBP range of 71-80 mm Hg with 14% of male and 18% of female patients.

SBP and altered mental status
In this study, the range of SBP was correlated and studied with the presence of altered mental status of the male and female patients (Table 6). The highest number of patients (19) having altered mental status was having the SBP range of 60-70 mm Hg, in which the 12 females and 7 males had altered mental status. Followed by 71-80 mm Hg of SBP range in which 7 females and 2 males had altered mental status with total of 9 patients in this range of SBP (Figure 4 and 5). However, there were no patients in the range of 81-90 mm Hg SBP having altered mental status.

Respiratory rate (RR)
Different range of RR value was calculated and differentiated into different ranges for both male and female patients suffering from sepsis (Table 7). The highest number of patients in this study having RR value of 22-25 breaths/min measured was 24 (48%), in which 16% (8) were male and 32% (16) were female. However, there were 2 (4%) male patients in the range <21 breaths/min with only 3 (6%) female observed in the similar range. On the other hand, 21 (42%) patients were observed in RR range of 26-30 breaths/min with 18% of male and 24% of female patients.

**RR and altered mental status**
In this study, the range of RR was correlated and studied with the presence of altered mental status of the male and female patients (Table 8). The highest number of patients (16) having altered mental status was having the RR range of 26-30 breaths/min, in which the 10 females and 6 males had altered mental status. Followed by 22-25 breaths/min of RR range in which 3 females and 3 males had altered mental status with total of 6 patients in this range of RR. However, there was only 1 female patients in the range of <21 RR breaths/min having altered mental status.

Analysis of qSOFA score with serum lactate and other parameters
According to the results, serum lactate remained an independent prognostic marker for sepsis. Serum lactate ranges correlations were measured for the three parameters viz SBP, RR and altered mental status for calculation of QSOFA score (Table 9). The highest number of total 26 patients having QSOFA score of ≥ 2 had the serum lactate range of 2.1 - 4.0 mmol/l. This result is comprised of 26 patients having ≤ 100 mm Hg of SBP, 26 patients with ≥ 22 breaths/min RR and 9 patients had altered mental status. Similarly, the lowest number of 3 patients in each were analyzed having the having QSOFA score of ≥ 2 with the serum lactate range of 8.1 - 12.0 mmol/l and >12.1 mmol/l. The number of patients having QSOFA score of ≥ 2 with different range serum lactate is depicted in Figure 6.

P value for each parameter was also calculated according to single test ANOVA using serum lactate as prognostic marker. P value of 0.0009, 0.0001 and 00.0005 were calculated in SBP, RR and altered mental status respectively which shows the test is statistically significant. The p value of 0.0009 of QSOFA score ≥ 2 was also significant which indicates sepsis score is statistically significant with all the three above mentioned parameters using serum lactate as prognostic marker.

There were total 17 male patients with QSOFA score of ≥ 2 in which 19, 17 and 9 patients had ≤ 100 mm Hg SBP, ≥ 22 breaths/min RR and Altered Mental Status. Similarly, there were total 29 male patients with QSOFA score of ≥ 2 in which 31, 28 and 14 patients had ≤ 100 mm Hg SBP, ≥ 22 breaths/min RR and Altered Mental Status (Table 10). The p value of correlation between male and female patients with sepsis was 0.002 indicating statistically significant result. The number of male and female patients with QSOFA score ≥ 2 is depicted in Figure 7.
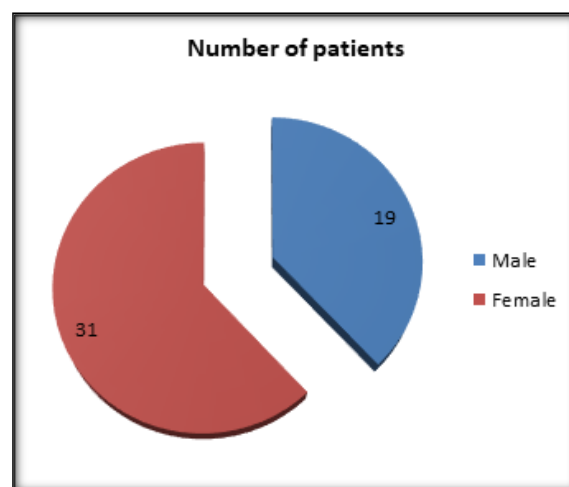
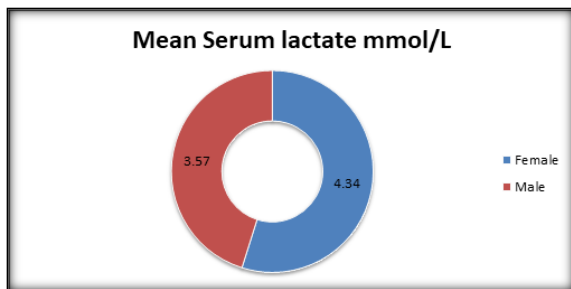**Figure 1: Chart representing number of in male and female**

Figure 2: Chart representing the mean average value of serum lactate in male and females.
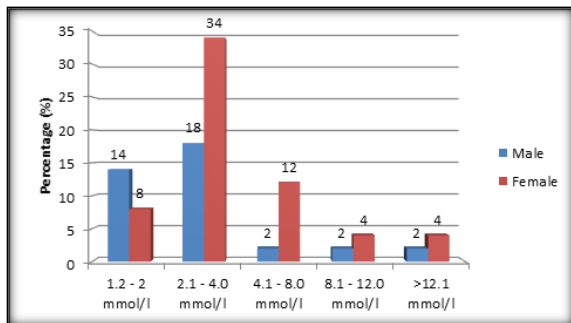

Figure 3: Graphical representation Serum lactate value range of male and female
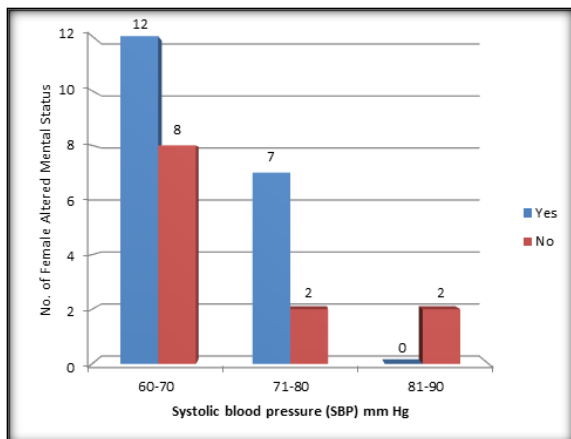

Figure 4: Altered mental status in females with different range of SBP.
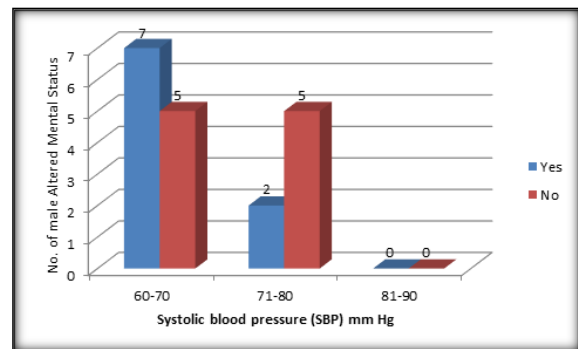
Figure 5: Altered mental status in male with different range of SBP
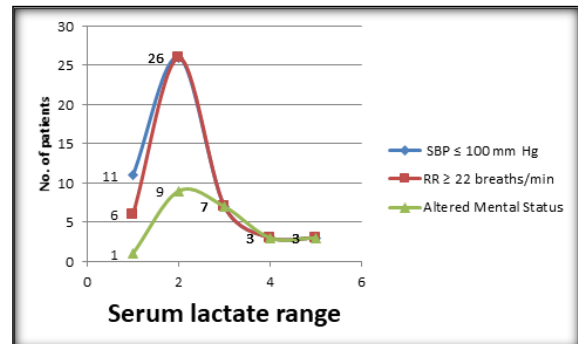
Figure 6: Chart depicting no. of patients with qSOFAscore ≥ 2 using serum lactate as prognostic marker.
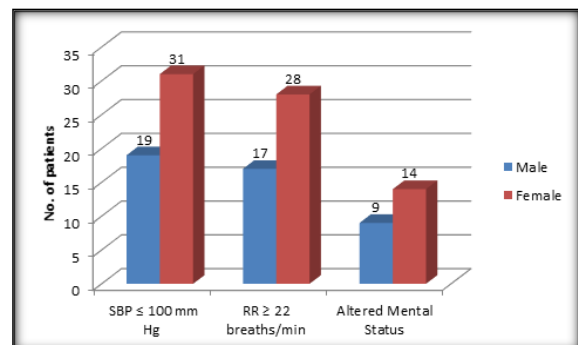
Figure 7: Chart representing number of male and female patients with qSOFA score ≥ 2.

Table 1: Distribution of patients according to age group

Age in Years	Male		Female		Total	
	No.	%	No.	%	No.	%
<20	0	0	3	0	3	6
21-40	3	33.3	6	66.6	9	18
41-60	7	38.8	11	61.1	18	36
61-80	9	45	11	55	20	40
Total	19	38	31	62	50	100
Mean	52.58					
RANGE	18-78					

Table 2: Distribution of patients according to gender.

Gender	No. of patients	Percentage (%)
Male	19	38
Female	31	62
Total	50	100

Table 3: Serum lactate level in total population study of patients diagnosed as sepsis.

Serum lactate mmol/l	Mean	Standard Deviation	Standard Deviation ERROR	Min range	Max range	No. of patients
	4.01	3.35	0.47	1.2	15.42	50
Female	4.34	3.35	0.47	1.36	15.42	31
Male	3.57	3.87	0.88	1.2	13.53	19

Table 4: Range of Serum lactate value in total population of sepsis patients.

Serum lactate mmol/l	Male		Female		Total	
	No.	Percentage	No.	Percentage	No.	Percentage
1.2 - 2 mmol/l	7	14	4	8	11	22
2.1 - 4.0 mmol/l	9	18	17	34	26	52
4.1 - 8.0 mmol/l	1	2	6	12	7	14
8.1 - 12.0 mmol/l	1	2	2	4	3	6
>12.1 mmol/l	1	2	2	4	3	6
	19	38	31	62	50	100

Table 5: Range of SBP value in total population of sepsis patients.

Systolic blood pressure (SBP) mm Hg	Male		Female		Total	
	No.	Percentage	No.	Percentage	No.	Percentage
60-70	12	24	20	40	32	64
71-80	7	14	9	18	16	32
81-90	0	0	2	4	2	4
Total	19	38	31	62	50	100

Table 6: Altered mental status of sepsis patients with correlation different SBP range.

Systolic blood pressure (SBP) mm Hg	Female Altered Mental Status		Male Altered Mental Status	
	Yes	No	Yes	No
60-70	12	8	7	5
71-80	7	2	2	5
81-90	0	2	0	0
Total	19	12	9	10

Table 7: Range of RR value in total population of sepsis patients.

Respiratory rate (RR) breaths/min	Male		Female		Total	
	No.	Percentage	No.	Percentage	No.	Percentage
<21	2	4	3	6	5	10
22-25	8	16	16	32	24	48
26-30	9	18	12	24	21	42
Total	19	38	31	62	50	100

Table 8: Altered mental status of sepsis patients with correlation different RR range.

Respiratory rate (RR) breaths/min	Female Altered Mental Status		Male Altered Mental Status	
	Yes	No	Yes	No
<21	1	2	0	2
22-25	3	13	3	5
26-30	10	2	6	3
Total	14	17	9	10

Table 9: Analysis of qSOFA score with serum lactate as prognostic marker.

Serum lactate range	Systolic blood pressure (SBP)		Respiratory rate (RR)		Altered Mental Status		Total Score	
	≤ 100 mm Hg	> 100 mm Hg	≥ 22 breaths/min	< 22 breaths/min	Yes	No	score ≥ 2	score < 2
1.2 - 2 mmol/l	11	0	6	5	1	10	7	4
2.1 - 4.0 mmol/l	26	0	26	0	9	17	26	0
4.1 - 8.0 mmol/l	7	0	7	0	7	0	7	0
8.1 - 12.0 mmol/l	3	0	3	0	3	0	3	0
>12.1 mmol/l	3	0	3	0	3	0	3	0
Total	50	0	45	5	23	27	46	4
P value	0.0009		0.0001		0.0005		0.0009	

Table 10: Number of male and female patients with qSOFA score ≥ 2.

	Systolic blood pressure (SBP)		Respiratory rate (RR)		Altered Mental Status		Total Score		P Value
	≤ 100 mm Hg	> 100 mm Hg	≥ 22 breaths/min	< 22 breaths/min	Yes	No	score ≥ 2	score < 2	
Male	19	0	17	2	9	10	17	2	0.0004

Female	31	0	28	3	14	17	29	2	0.00023
Total	50	0	45	5	23	27	46	4	0.0015

DISCUSSION

The purpose of this study was to determine how the quick SOFA (qSOFA) score functions in sepsis early identification and the usage of serum lactate as a prognostic marker. In patients with suspected sepsis, we have compared the trend of serum lactate levels with several indicators, including SBP, RR, and impaired mental status, which are subsequently assessed for the rapid SOFA score computation. The Department of General Medicine at Darbhanga Medical College and Hospital (DMCH), Laheriasarai, Bihar, India, conducted this single-centered hospital based prospective study between July 2021 and January 2023 with approval from the hospital's Research Ethics Committee. 50 patients with a diagnosis of sepsis who were admitted to the intensive care unit from the emergency room and inpatient ward of the DMCH and who met the inclusion-exclusion criteria were included in this study to validate the qSOFA.

The Third International Consensus Definitions for Sepsis and Septic Shock ("Sepsis-3") established the fast Sequential Organ Failure Assessment (qSOFA) as a condensed version of the Sequential Organ Failure Assessment (SOFA).[26] The qSOFA was developed by Sepsis-3 to help identify patients with suspected infections who are at high risk for a poor outcome (defined as in-hospital mortality or an ICU stay of 3 days) outside of the ICU. By limiting the number of clinical criteria to 3, each of which can be quickly evaluated at the bedside, the qSOFA greatly simplifies the SOFA. If the clinical state of the patient changes, the qSOFA score calculation can be redone serially. When a patient has a suspected infection, a "positive" qSOFA score (≥ 2) indicates a high probability of unfavourable consequences. There should be a more thorough evaluation of these patients to look for signs of organ malfunction. Rather of causing clinicians to begin broad-spectrum antibiotic therapy or conduct additional research into the possibility of organ malfunction, a positive qSOFA score should urge them to enhance the frequency of patient monitoring.[27] Baseline demographic data, such as age and gender, along with various clinical characteristics and disease-scoring system scores, such as the Quick Sequential Organ Failure Assessment, were gathered (qSOFA).

Age and Gender

In our study, the study sample of 50 patients ranged in age from 18 years old to 78 years old, with the age group of 61 to 80 years having the largest percentage of patients (20 out of 50, or 40%), followed by the age range of 41 to 60 years, which had 18 (36%) patients. Only 6% of the patients in this study were under 20 years of age. However, 18 individuals, or 9% of all patients, fell into the study population's age range of 21 to 40 years. In our analysis, 19 patients, or 38% of the entire population, were male, while 31 patients, or 62%, were female. As a result, male patients with suspected sepsis outnumbered female patients by a large margin.

In a different retrospective cohort analysis, adult's ≥ 18 years old who had suspected infections were included. The UPMC health care system in southwest Pennsylvania's 12 community and academic hospitals served as the primary cohort from 2010 to 2012.[26,28] In research by, 156 patients with a median age of 88 years and a gender ratio of 60.6% were enrolled.[29] Sepsis-related deaths are on the rise, according to a recent retrospective population-based study, and they now account for more than one-third of all fatalities among patients 85 years of age and older.[30] For a better prognosis and survival, high-risk patients must be identified early. However, in older patients, both the diagnosis and prognosis of sepsis are difficult due to the wide range of clinical presentations with unique symptoms such as confusion state and delirium.[31,32] In a study by Tang et al., 51 patients were included in a cohort study with a median age of 60 and a gender split of 50/50.[33]

Serum lactate as prognostic marker

A realistic and appealing choice to increase the qSOFA score is lactate because it is frequently measured as part of routine screening and sepsis care in the ED.[34,35] Its potential for conjunction with qSOFA is further supported by the facts that lactate is a recognized indication of sickness severity and septic shock.[1,35]

Serum lactate level was studied in all the population study of 50 patients in which the mean SD value calculated was 4.01 ± 3.38 mmol/l. Out of 50 patients, the mean SD value of serum lactate in 31 females calculated was 4.34 ± 3.3 with the minimum and maximum range of serum lactate analyzed 1.36mmol/l and 15.42 mmol/l. Similarly, the mean SD value of serum lactate in 19 males calculated was 3.57 ± 3.8 with the minimum and maximum range of serum lactate analyzed 1.2 mmol/land 13.53 mmol/l. The highest number of patients were with range of Serum lactate value of 2.1 - 4.0 mmol/l were 52% (26) of total population, comprising 9 (18%) of male and 17 (34%) of female patients. However, there were only 1 male patient each in the range 4.1 - 8.0 mmol/l, 8.1 - 12.0 mmol/l and >12.1 mmol/l of Serum lactate comprising of 2% of total population study with p value of 0.0013.

A different study's discovery that the mean lactate levels on day one were significantly lower in the survivors than in the non-survivors group raises the possibility that early lactate levels in sepsis patients can serve as a prognostic indicator.[36] Bakker et al.[37] have previously stated that there was no significant decrease in the initial lactate levels among the study participants. It showed that lactate clearance had a greater impact on survival than

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starting lactate level. On days three and seven, non-survivors had significantly higher mean lactate levels. According to Daga et al. studies from 2021, survivors had mean lactate levels of 1 on days 1, 3, and 7 were 2.27±0.91, 1.72±0.77 and 1.14±0.48, respectively, while it was 4.32±2.35, 3.57±2.28 and 2.13±1.22, respectively, in the non-survivor group (P<0.001).[38]

A sensitive yet general measure of metabolic stress is the serum lactate level.[39] Lactate, a by-product of anaerobic glycolysis, is elevated during hypoxia, stress, and other life-threatening disorders.[40] According to recent studies, higher lactate levels are positively correlated with increased mortality.[41,42] the worse the outcome, the higher the lactate level.[42] In certain investigations, different lactate thresholds have been suggested as a predictor of early aggressive resuscitation.[42,43] On the basis of this, early detection of increased serum lactate levels may help to identify people at risk for negative consequences.

According to Liu et al. research from 2019 10, patients in lactate groups 1 and 2 have significantly different lactate levels (median 2.05 mmol/L vs. 4.95 mmol/L, p < 0.001). They found that patients with lower lactate levels experience better outcomes (30-day mortality, 33.88% vs. 59.23%; 90-day mortality, 43.57% vs. 67.81%; 1-year mortality, 51.46% vs. 71.39%; in-hospital mortality, 34.99% vs. 60.80%; overall mortality, 60.12% vs. 77.97%), and a smaller percentage of these patients have qSOFA scores of 2 or more Lactate levels in their research population don't correlate with the rate of severe sepsis (96.05% vs. 94.13%, p = 0.057). However, more patients (63.29% vs. 70.24%, p = 0.002) have septic shock when their lactate levels are greater. The relationship between lactate levels and prognosis in critically ill patients has been investigated in numerous publications. Sepsis severity has been linked to decreased lactate levels, even those in the normal range, according to one study.[44] In two cohorts, Wacharasint et al. showed that individuals with lactate levels in the normal range (between 1.4 and 2.3 mmol/L) had a significantly higher risk of organ failure and mortality than those with lactate levels less than 1.4 mmol/L. Serum lactate levels greater than 2 mmol/L were indicated by Sepsis-3 as a key indicator for the clinical diagnosis of septic shock 1. In non-hypertensive individuals, hospital mortality was predicted with a specificity of 96% by a lactate concentration greater than 4 mmol/L.[45]

Systolic blood pressure (SBP)

Septic shock is a potentially fatal illness that develops after an infection when your blood pressure drops to an unsafely low level. The infection might be brought on by any kind of bacterium. Although it is uncommon, viruses and fungi like *Candida* can potentially be the cause. The infection may first cause a condition known as sepsis. As a result, your blood pressure may drop and blood may not reach important organs like the liver and brain, which could have a serious impact on your health 46. Systolic blood pressure of less than 90 mmHg (or a fall in systolic blood pressure of more than 40 mmHg) or a mean arterial pressure of less than 65 mmHg following a crystalloid fluid challenge of 30 mL per kg body weight in a patient with severe sepsis are the two criteria that serve as the best indicators of septic shock.[47] The largest percentage of patients in our study with a measured SBP between 60- and 70- mm Hg was 32 (64%), with 24% (12) men and 40% (20) women. In contrast, 16 (32%) patients were found to have SBPs between 71- and 80- mm Hg, with 14% of patients being men and 18% being women.

In a different study by Pandey et al. (2014), additional analysis showed that the values of SBPV and DBPV in the APACHE II score >19 group were considerably greater than those in a different group. Additionally, they observed that other biomarkers, such as COR, had greater values in the APACHE II score >19 group. This finding suggests that both SBPV and DBPV levels rise in sepsis patients as the disease severity rises.[48,49]

As was also noted in our study, the effect of reduced blood pressure brought on by septic shock might affect the ability of other organs, such as the brain, to pump blood and lead to altered mental status in the patients. As a result, the rate of SBP below 100 mm Hg is directly correlated with changed mental status. In our study, the SBP range of 60-70 mm Hg was associated with the highest number of patients (19) with impaired mental status, of which 12 females and 7 males were affected. The range of SBP from 71 to 80 mm Hg was next, with a total of 9 individuals in this range having changed mental status (7 females and 2 males). However, there were no patients with impaired mental state whose SBP was between 81- and 90- mm Hg. As a result, it can be inferred that patients with disturbed mental status were more likely to exhibit lower SBP values than higher SBP values.

Respiratory Rate (RR)

Increased respiratory rate is one of sepsis's most typical symptoms. A primary respiratory alkalosis is frequently linked with tachypnoea, a symptom of adult respiratory distress syndrome brought on by sepsis. Respiratory muscle weariness, accompanying hypoxaemia, and/or accompanying hypercarbia may call for endotracheal intubation for treatment. Damage to alveolar capillary membranes brought on by inflammatory mediators is the aetiology of respiratory failure in sepsis.[49] This cytokine-mediated lung damage leads to noncardiogenic pulmonary oedema, which can be severe and hinder oxygen uptake and carbon dioxide elimination. It also results in decreased lung compliance. Tachypnoea is partially caused by increased breathing brought on by decreased lung compliance and juxta capillary receptor activation. Bilateral pulmonary infiltrates and increased lung water are typically visible on chest X-ray imaging. The pulmonary alterations must not be the result of

left ventricular heart failure. Although sepsis patients may have severe, life-threatening hypoxia, the majority of patients pass away through multiple organ failure rather than hypoxia.[9]The largest percentage of patients in our study who had RR values between 22 and 25 breaths per minute was 24, or 48 percent; among them, 16 percent of men and 16 percent of women. However, only 3 (6%) female patients were found in the same range, compared to 2 (4%) male patients. In contrast, 21 (42%) patients were seen with RRs between 26 and 30 breaths per minute, with 24% of patients being women and 18% being men. The changed mental state effect, however, can also be seen in sepsis patients' faster breathing rates. The RR range of 26–30 breaths per minute had the highest number of patients (16) with disturbed mental status; this group included 10 females and 6 males. The next range of RR was 22–25 breaths/min, with a total of 6 individuals experiencing changed mental status—3 females and 3 males. However, there was just 1 female patient with disturbed mental status in the range of 21 RR breaths/min. In a similar manner, in different research, a 48-year-old man with altered mental status and respiratory failure arrived to the emergency room with a respiratory rate of 30 breaths per minute.[50]

Analysis of qSOFA score with serum lactate as prognostic marker

According to recent concerns expressed by Simpson.[51], relying too much on qSOFA or SOFA criteria may delay the diagnosis and treatment of dangerous infections. In addition, a thorough research and meta-analysis showed that qSOFA had a poor sensitivity and a reasonable level of specificity for the risk of death.[52] qSOFA demonstrated a small potential to predict mortality in both septic and non-septic patients, according to Ho's 27 findings from a prospective research. When paired with serum lactate, qSOFA demonstrated a similar level of prognostic power to SOFA. The poor performance of qSOFA in predicting mortality was revealed by an observational cohort research that included patients with infection who were admitted in the emergency department.[53] As a result, we contrasted qSOFA's mortality prediction with serum lactate. First, we discovered a positive correlation between serum lactate and qSOFA scores as well as prognosis. Next, statistical research demonstrated that lactate is an independent predictive sign. Compared to qSOFA, serum lactate demonstrated improved predictive accuracy for both short- and long-term mortality.

In our study out of 50 patients with suspected infection observed that the qSOFA score of ≥ 2 were in total 46 (92%) patients while the remaining 4 (8%) patients had the score of <2, which showed 3-14-fold increase in mortality rate of (0.04) 4.6% (Confidence Level -95.0% 0.179). The highest number of total 26 patients having QSOFA score of ≥ 2 had the serum lactate range of 2.1 - 4.0 mmol/l. This result is comprised of 26 patients having ≤ 100

mm Hg of SBP, 26 patients with ≥ 22 breaths/min RR and 9 patients had altered mental status. Similarly, the lowest number of 3 patients in each were analyzed having the having QSOFA score of ≥ 2 with the serum lactate range of 8.1 - 12.0 mmol/l and >12.1 mmol/l. Also, the P value of 0.0009, 0.0001 and 00.0005 were calculated in SBP, RR and altered mental status respectively which shows the test is statistically significant. The p value of 0.0009 of QSOFA score ≥ 2 was also significant which indicates sepsis score is statistically significant with all the three above mentioned parameters using serum lactate as prognostic marker.

Our study indicated that there were total 17 male patients with qSOFA score of ≥ 2 in which 19, 17 and 9 patients had ≤ 100 mm Hg SBP, ≥ 22 breaths/min RR and Altered Mental Status. Similarly, there were total 29 male patients with qSOFA score of ≥ 2 in which 31, 28 and 14 patients had ≤ 100 mm Hg SBP, ≥ 22 breaths/min RR and Altered Mental Status (Table 10). The p value of correlation between male and female patients with sepsis was 0.002 indicating statistically significant result.

In a 2016 study that included 148,907 patients with suspected infections, either inside or outside of the ICU environment, Seymour et al retrospectively generated and internally validated the qSOFA. There was a 3-to-14-fold increase in the rate of in-hospital mortality for patients outside the ICU with a qSOFA score under 2. However, the SOFA's prognostic validity for in-hospital mortality among ICU patients was statistically higher than the qSOFA 26. In a 2017 study by Freund et al., the qSOFA was prospectively validated in an emergency department sample. According to the study, which involved 879 patients from 30 emergency rooms in 4 countries, using the qSOFA was more accurate at predicting in-hospital death than using SIRS or severe sepsis.[54] In an investigation of a retrospective cohort with 184,875 patients who had an infection-related admission diagnosis, Raith et al. externally validated the SOFA and the qSOFA. In comparison to the SIRS criteria or the qSOFA.[55] the study indicated that an increase in the SOFA score of 2 points had a higher predictive accuracy for in-hospital mortality in an ICU population.

CONCLUSION

In conclusion, serum lactate is a stronger predictive diagnostic than qSOFA in adult patients with sepsis due to its simplicity and accuracy. Given that this work is based on retrospective data and that the timing of lactate determination in this study may have an impact on the outcomes, more research is required. We discovered that qSOFA scores had a statistically significant relationship with every outcome we evaluated, including inpatient mortality. In this group, patients with and without a suspected

infection both fared well on the qSOFA score. Our results are consistent with those that Seymour et al. previously reported. The mortality rate predicted in our analysis is (0.04) 4.6% (95.0% CI 1.54 to 4.2), but in their sample of 148,907 patients with suspected infections, of whom 4% died, the predictive value for inpatient mortality among ICU visits was 0.66 (95% CI 0.64 to 0.68). A total of 50 patients who met the inclusion and exclusion criteria for sepsis and were diagnosed and admitted to the Intensive Care Unit of the DMCH Emergency Department and Inpatient Ward were included in the study. The qSOFA score-identified predictive mortality rate was examined along with patient age, gender, descriptive analysis, and serum lactate level. The following was used to determine the qSOFA score, which contains 1 point for each of the following three criteria: Respiratory rate $\geq$ 22 breaths/min, altered mental status, or Systolic blood pressure (SBP) $\leq$ 100 mm Hg. A qSOFA score $\geq$ 2 is suggestive of sepsis. Sepsis-3 recommends that, for a qSOFA score < 2, the full SOFA score, including laboratory results, should be used. The severity of SEPSIS has been reported to considerably increase the serum lactate level, which could increase the risk of morbidity and mortality. More research is required. Serum lactate levels and qSOFA are all trustworthy and effective prognostic indicators of sepsis. These are efficient, faster, and good bedside diagnostic tools.

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Declaration of Conflicting Interests

The Authors declare that there is no conflict of interest.

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