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Prognostic Value of Venous to Arterial Carbon Dioxide Difference and Mixed Venous Saturation during Early Resuscitation in Critically Ill Patients with Septic Shock

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ABSTRACT

Background: Sepsis, its severe form and septic shock are among major healthcare challenging problems. Each year, millions of people are affected all over the world, and the mortality rate is one in four [and often more].

Aim of the work: The study aimed to evaluate the prognostic value of venous to arterial carbon dioxide [CO2] difference and mixed venous saturation during early resuscitation of critically ill patients with septic shock.

Patients and methods: This prospective cohort study was carried out on 35 patients aged from 18 to 60 years old, both sexes, with septic shock. They were selected from intensive care units of Al Azhar University. Patients were divided into two groups: Group I for survivors [n=21], and Group II for non-survivors [n=14].

Results: The severity of illness, rather than demographic factors or comorbidities, is a critical predictor of outcomes in septic shock patients. Non-survivors when compared to survivors exhibited higher APACHE II scores and significant physiological differences [including elevated heart rate, respiratory rate, temperature, and lower mean arterial pressure at T6]. They also had worse acid-base balance, lower oxygenation, and higher serum lactate levels. Both partial pressure of carbon dioxide in venous blood [PvaCO2] and Mixed venous oxygen saturation [ScvO2] were significant predictors of mortality. With a PvaCO2 cutoff of 6.05 mmHg, the sensitivity was 58.5%, specificity was 81.5% at T6. However, at a cutoff of 67% of ScvO2, the sensitivity was 68%, specificity was 76% at T6.

Conclusion: Partial pressure of carbon dioxide in venous blood and Mixed venous oxygen saturation are valuable predictors of mortality, and emphasizes the importance of early identification, continuous monitoring, and aggressive management of high-risk patients to improve outcomes.

Keywords: Prognosis; Carbon Dioxide; Venous Saturation; Resuscitation; Septic Shock.

INTRODUCTION

Among the daily challenging health care problems, sepsis, severe sepsis, and septic shock are major instances. They affect millions of people all over the world each year, with higher mortality rate [up to 25.0% or more], with progressive increase of the incidence of the problem [1].

Sepsis is defined as a clinical syndrome resulting from a dys-regulated inflammatory response to an infectious agent [2, 3]. Septic shock however is diagnosed if there is a severe sepsis in addition to one or both of the following: reduced systemic mean blood pressure to <60 mmHg [or <80 mmHg if the patient has baseline hypertension] despite adequate resuscitation by intravenous fluids [4].

Preservation of the systemic mean blood pressure above 60 mmHg [or >80 mmHg if the patient has baseline hypertension] needs administration of dopamine [>5 µg/kg/min], norepinephrine [<0.25 µg/kg/min], or epinephrine [<0.25 µg/kg/min] event with adequate resuscitation by intravenous fluids [5].

The partial pressure of venous to arterial CO2 difference [V- a PCO_2] or PCO_2 gap was calculated as the different value between the Partial pressure of CO_2 in venous blood [$PaCO_2$] and the partial pressure of venous CO_2 [$PvCO_2$]. Under normal circumstances, the PCO_2 gap ranges from 4 to 6 mmHg [6].

In the recent years, the venous- to- arterial CO_2 difference [Pcv- aCO_2] or PCO_2 gap has been suggested as an alternative indicator of tissue hypoperfusion and has been used to lead the treatment intervention for septic shock. Actually, persistent elevation of Pv- aCO_2 predicts the adverse clinical outcomes independently of oxygen-derived parameters and it could anticipate the variations in lactate [7].

Mixed venous oxygen saturation [$ScvO_2$] is usually used for hemodynamics monitoring in for critically ill patients in the intensive care units [ICU]. $ScvO_2$ can predict sepsis-related mortality, although the evidences of its value as a treatment target are lacking. Instead of SvO_2, $ScvO_2$ had been suggested to monitor sepsis clinically with better results. This is mainly due to the fact that low $ScvO_2$ designates even lower SvO_2, and that the situations of $ScvO_2$ usually agree with those of SvO_2 [8].

THE AIM OF THE WORK

The aim of this work was to evaluate the prognostic value of venous to arterial carbon dioxide difference and mixed venous saturation during early resuscitation in critically ill patients with septic shock.

PATIENTS AND METHODS

This was a prospective cohort, which included 35 patients with septic shock. Their age extends between 18 and 60 years old. Bothe genders were included. The septic shock was defined according to the latest definitions. Patients with septic shock can be clinically recognized by a vasopressor need to preserve a mean arterial pressure of 65 mm Hg or greater and serum lactate level higher than 2 mmol/L [>18 mg/dL] in the absence of hypovolemia [i.e, adequate fluid resuscitation]. The septic shock is associated with an in-hospital mortality rates of 40% or higher [9].

The study was completed on the time from December 2022 to June 2024. It was approved by the Ethical Committee of Al-Azhar University. An informed consent was obtained from each patient or his/her legal guardians.

Exclusion criteria were 1] chronic obstructive pulmonary disease [COPD], 2] pregnant or lactating women, 3] bronchial asthma and 4] pneumonia.

According to mortality in ICU, patients were categorized into two categories. Survivors were assigned as Group I [n=21] and non- survivors assigned as Group II [n=14]. All patients were subjected to clinical evaluation and assessment by complete history review, physical examination, laboratory investigations [complete blood count [CBC], random blood sugar [RBS], liver function tests [aspartate amino-transferase [AST], alanine aminotransferase [ALT] and bilirubin [total and direct], coagulation profile tests [prothrombin time [PT], partial thromboplastin time [PTT] and international normalized ratio [INR]], kidney function tests [blood urea nitrogen [BUN] and creatinine], arterial blood gases [arterial blood gas [ABG] and venous blood gas [VBG]] and electrolytes include Serum Sodium [Na+] and Potassium [K+]]. Two blood samples for cultures from different sites were obtained for each patient on admission. Then, each patient was submitted to radiological investigations [Chest X-ray].

Central venous sample was collected on admission and 6 hours after admission. The hemodynamics and respiratory data were recorded at each measurement.

Each patient was equipped with a central venous pressure [CVP] catheter. The goal was to obtain mean arterial pressure [MAP] ≥65 mmHg; urine output ≥ 0.5 ml/kg/minute; normalized serum lactate; and ScvO2 ≥70% or SvO_2 ≥65%. The vasopressor [dopamine or nor-epinephrine] were used in a standard technique to preserve MAP ≥65 mmHg, and repeated fluid challenges using colloids or crystalloids were performed to keep the stroke volume optimized as well as to permit the lowest dose of vasopressors and maintain pulse-pressure variability [<12%].

Dobutamine was used when we there was a persistent $ScvO_2$ ≤70% or SvO_2 ≤65% after intravenous fluid resuscitation. Hydrocortisone in a lower dose was given within 6 hours of resuscitation when use of vasopressors persisted after an adequate fluid restitution. Mechanical ventilation [MV] was provided when required under light sedation [IV midazolam] and analgesia [IV fentanyl]; the tidal volume was limited to 6 to 8 ml/kg. Glycemic control was adjusted to preserve serum glucose levels <150 mg/dl.

Time 0 [T0] was defined at the CVP insertion. The total resuscitation fluid volume received and the time between the first hypotension episode and T0 were defined and documented. Complete hemodynamic profile and acquiring samples of blood for arterial and mixed-venous gases analysis [ABL 300, Radiometer Copenhagen, Denmark] were performed. In addition, arterial lactate at T0, and 6 h [T6] after admission were measured and registered. Doses of vasopressors and inotropic drugs, respiratory parameters, and total fluids were also recorded at each time of measurement. The ventilator-free days and 28-day survival rate were also documented.

Increased Pv-aCO_2 was measured as the difference between the venous CO_2 partial pressure and the arterial CO_2 partial pressure. $ScvO_2$ samples were collected for each patient unless the patient died before the time of collection or because of difficult technical issues. The PCO_2 gap was measured as the difference between the venous CO_2 partial pressure and the arterial CO_2 partial pressure. Pva- CO_2 difference was evaluated for every patient in the two groups. Lactate levels were measured on admission and 6 hours after admission, with calculation of lactate clearance.

Patients were treated according to the latest available surviving sepsis campaign guidelines. Immediate resuscitation of a septic patient was not

appreciably different from non-septic patients. Thus, adequate oxygen to maintain saturations of more than 95% was given.

Prompt and appropriate antimicrobial therapy were used. Urine output was recorded, together with all fluids administered. If there was an event of hyperglycemia, blood sugar was corrected to be kept <10 mM with intravenous insulin.

The primary outcome was the in hospital mortality and the predictive power of Venous to Arterial Carbon Dioxide Difference and Mixed Venous Saturation while secondary outcome includes factors associated with mortality.

Sample Size Calculation:

The sample size calculation was based on the study of **Helmy *et al.*[10]**. Epi Info STATCALC was used to determine the sample size, taking the following parameters into consideration: The 95% two-sided confidence level [CI], with 80% power and α error of 5%, odds ratio calculated to be 1.115. The final maximum sample size was 31. Thus, the sample size was increased to 35 subjects to guard against any drop out cases during follow up.

Statistical analysis:

Statistical analyses were performed using SPSS v26 [IBM Inc., Chicago, IL, USA]. Numerical variables were expressed by their mean [measure of central tendency] and standard deviation [SD] [measure of dispersion]. Both groups were compared between by the unpaired Student's t-test. Qualitative variables on the side were presented as relative frequency and percentage and the Chi-square or Fisher's exact test were used to examine the association between groups. ROC curve was used for evaluation of diagnostic performance sensitivity, specificity, positive predictive value [PPV] and negative predictive value [NPV]. A two-tailed P value < 0.05 was considered statistically significant.

RESULTS

The survivors group had an average age of 52.14 years [±12.07], while the non-survivors group had an average age of 54.5 years [±13.22]. In terms of sex distribution, 66.67% of the survivors group and 57.14% of the non-survivors group were males. There was no significant difference between groups regarding age or sex distribution. In addition, the presence of comorbidities such as diabetes mellitus [DM], hypertension [HTN], ischemic heart disease [IHD], cerebrovascular stroke [CVS], and chronic kidney disease [CKD] showed no significant differences between the groups. The sources of sepsis were also comparable between the groups [Table 1]

A significant difference was observed in the APACHE II scores, with the survivors group having an average score of 18 [±4] and the non-survivors group having a significantly higher average score of 26 [±5] [p < 0.001], indicating greater severity of illness in the non-survivor group [Table 1].

The vital signs showed some significant differences between the groups at various time points. Heart rate [HR] MAP, respiratory, and temperature at T0 were comparable between the groups, but at T6, the non-survivors group had a significantly higher HR, MAP, RR and temperature compared to the survivors group. However, when comparing central venous pressure [CVP] between the two groups, there was non-significant differences either at T0 or T6 [TABLE 1]

Regarding ABGs, the pH, HCO_3, and PaO_2, were significantly higher among survivors than non-survivors at T0 and T6, while PaCO2 was significantly higher at T6 only. However, oxygen saturation was significantly higher among survivors at T0 and T6 [Table 2].

As regard venous Blood Gas Analysis, At T0, the venous pH levels were similar between the groups. By T6, the survivors group had a significantly higher average pH compared to the non-survivors group. There was no significant difference in HCO_3 levels at T0 between the groups, but at T6, the survivors group had significantly higher HCO3 levels than the non-survivors group, reflecting better metabolic compensation in the survivors. $PvCO_2$ and PvO_2 showed no significant differences between groups at T0 and T6. At T0, SvO_2 was slightly higher in the survivors compared to the non-survivors. By T6, the survivors had a significantly higher SvO_2 compared to the non-survivors group, indicating better oxygen utilization in the survivors [Table 2].

Arterio-Venous Carbon Dioxide Difference [PCO2 Gap] showed significantly lower values in survivors than non survivors. By T6, the gap widened further, with significantly lower values in the survivors than the non-survivors group [Table 3]. In addition, mixed venous saturation [ScvO2] analysis showed that, at T0, the survivors group had a significantly higher ScvO2. By T6, the difference became more pronounced. These results in dicate better oxygen delivery and utilization in the survivors group [Table 3]

The ROC curve analysis for PvaCO2 to predict mortality provides the following insights:

At T0, with a PvaCO2 cutoff of 5.75 mmHg, the sensitivity was 56.5%, specificity was 80.5%, positive predictive value [PPV] was 70.0%, negative predictive value [NPV] was 68.0%, and the area under the curve [AUC] was 0.73 [p = 0.01]. While at T6, with a PvaCO2 cutoff of 6.05 mmHg, the sensitivity was 58.5%, specificity was 81.5%, PPV was 71.5%, NPV was 69.5%, and the AUC was 0.74 [p = 0.005] [table 4, figure 1].

The ROC curve analysis for ScvO2 to predict mortality provides the following insights:

At T0, with an ScvO2 cutoff of 66%, the sensitivity was 48%, specifi city was 75%, positive predictive value [PPV] was 57%, negative predict ive value [NPV] was 70%, and the area under the curve [AUC] was 0.78 [p = 0.005].

At T6, with an ScvO2 cutoff of 67%, the sensitivity was 68%, specificity was 76%, PPV was 73%, NPV was 68%, and the AUC was 0.80 [p = 0.003] [Table 4, figure]

The serum lactate levels between the survivors group and the non-survivors group reveal important metabolic differences. At T0, the serum lactate levels were comparable between the groups, with the survivors group having an average of 2.4 ± 0.5 mg/dl and the non-survivors group having an average of 2.5 ± 0.6 mg/dl [p = 0.67]. This indicates no significant difference in lactate levels at the initial measurement. However, by T6, a significant divergence in lactate levels was observed. The survivors group showed a marked reduction in serum lactate levels to 1.9 ± 0.4 mg/dl, indicating effective lactate clearance. In contrast, the non-survivors group had significantly higher serum lactate levels at 3.3 ± 0.7 mg/dl [p = 0.02] [Table 5].

As regard ICU Length of Stay, Mechanical Ventilation [MV], Vasopressors, and Renal Replacement Therapy [RRT], The analysis

reveals that the non-survivors group had a significantly longer ICU length of stay. In addition, MV was required in 100% of the non-survivors group compared to 85.71% of the survivors group. However, the, difference was not statistically significant. The duration of MV was significantly longer in the non-survivors than the survivors group. The use of vasopressors was similar between the groups, with the survivors group requiring 5.62 ± 1.88 days and the non-survivors group requiring 5.86 ± 3.18 days [p = 0.782]. The renal replacement therapy was needed in 28.57% of the survivors group and 35.71% of the non-survivors group, with no significant difference between the groups [Table 6].

Table [1]: Demographic data, comorbidities, source of sepsis, APACHE II score and vital signs of the studied groups

		Group I [n=21]	Group II [n=14]	P
Age [years]	Mean±SD	52.14±12.07	54.5±13.22	0.590
Sex	Male	14[66.67%]	8[57.14%]	0.568
	Female	7[33.33%]	6[42.86%]	
Comorbidities [n,%]	DM	8 [38%]	6 [43%]	0.75
	HTN	10 [48%]	7 [50%]	0.89
	IHD	5 [24%]	4 [29%]	0.72
	CVS	3 [14%]	2 [14%]	1.00
	CKD	4 [19%]	3 [21%]	0.85
Source of Sepsis [n,%]	Chest infection	8 [38%]	6 [43%]	0.75
	Bed sores	3 [14%]	2 [14%]	1.00
	UTI	5 [24%]	3 [21%]	0.84
	DFI	2 [10%]	2 [14%]	0.76
	Intra-abdominal sepsis	3 [14%]	1 [7%]	0.52
PACHE II Score	Mean ±SD	18 ± 4	26 ± 5	<0.001*
Vitals sign [mean±SD]				
HR [beats/min]	T 0	120.9±9.47	117.21±9.39	0.265
	T 6	111.48±11.36	125.71±12.87	**0.002***
MAP [mmHg]	T 0	54.29±12.18	53±12.05	0.761
	T 6	71.38±9.88	56.5±17.59	**0.003***
Respiratory rate [cycle/min]	T 0	34.81±7.35	31.57±5.85	0.177
	T 6	29.62±5.74	38.43±6.1	**<0.001***
Temperature [°]	T 0	37.9±1.04	38.24±1.16	0.367
	T 6	37.04±0.98	38.18±1.24	0.007*
CVP [cmH_2o]	T 0	4.86±3.07	5.5±4.67	0.626
	T 6	10.48±4.3	10.21±3.98	0.857

*: significant differences, DM: Diabetes mellitus, HTN: Hypertension, IHD: Ischemic heart disease, CVS: cerebrovascular stroke, CKD: Chronic kidney disease, UTI: Urinary tract infection, DFI: Diabetic foot infection, APACHE II: Acute physiology and chronic health evaluation II, HR: heart rate, MAP: mean arterial blood pressure, CVP: Central venous pressure.

Table [2]: ABG, venous blood gas and $PvaCO_2$ of the studied groups

		Group I [n=21]	Group II [n=14]	P
ABG				
pH	**T 0**	7.21±0.19	7.08±0.13	**0.020***
	T 6	7.26±0.15	7.1±0.2	**0.011***
$PaCO_2$	**T 0**	23.95±6.91	20.04±7.05	0.113
	T 6	29.89±6.75	23.41±3.03	**0.002***
HCO_3	**T 0**	10.33±3.37	9.09±4.51	0.358
	T 6	16.19±4.24	11.46±3.13	**0.001***
PaO_2	**T 0**	85 ± 10 mmHg	83 ± 12 mmHg	0.68
	T 6	92 ± 8 mmHg	78 ± 10 mmHg	**0.01***
Saturation [%]	**T 0**	92.3±2.75	88.84±6.27	**0.032***
	T 6	97.66±1.79	95.89±1.89	**0.008***
Venous blood gas				
Venous pH	**T 0**	7.02±0.29	6.94±0.16	0.371
	T 6	7.24±0.06	7.11±0.23	0.017*
$PvCO_2$	**T 0**	33.39±7.54	30.99±7.89	0.373
	T 6	35.14±6.14	31.13±8.01	0.103
HCO_3	**T 0**	10.59±4.81	8.9±3.6	0.241
	T 6	12.53±3.77	9.38±3.56	**0.019***
PvO_2	**T 0**	40.43±12.71	41.5±10.22	0.794
	T 6	50.14±8.29	52.29±9.89	0.493
SvO_2 [%]	**T 0**	64.95±5.51	63.36±10.61	0.565
	T 6	70.63±6.57	65.06±2.98	**0.006***

Data are presented as mean ± SD. * significant as P value ≤ 0.05. ABG: Arterial blood gas analysis, $PaCO_2$: Partial pressure of carbon dioxide, HCO_3: Bicarbonate, PaO_2: Partial pressure of oxygen, $PaCO_2$: Partial pressure of carbon dioxide, $vHCO_3$: Bicarbonate in venous blood, PvO_2: Partial pressure of oxygen in venous blood. SvO_2: Venous Oxygen Saturation, $PvaCO_2$: partial pressure of carbon dioxide in venous blood.

Table [3]: The arterio-venous carbon dioxide difference [PCO_2 gap] and the mixed venous saturation [$ScvO_2$] among study groups

		Group I	Group II	P value
[PCO2 gap]	**T 0**	5.8 ± 1.2 mmHg	9.2 ± 1.4 mmHg	0.004*
	T 6	5.5 ± 1.1 mmHg	10.1 ± 1.5 mmHg	0.003*
[ScvO2]	**T 0**	68 ± 6 %	62 ± 5 %	0.04*
	T 6	72 ± 5 %	58 ± 4 %	0.01*

*: Saturation [%]

Table [4]: ROC curve of $PvaCO_2$ and $ScvO_2$ to predict mortality

	Cutoff	Sensitivity	Specificity	PPV	NPV	AUC	P
$PvaCO_2$ [T0]	5.75	56.5	80.5	70.0	68.0	0.73	0.01
$PvaCO_2$ [T6]	6.05	58.5	81.5	71.5	69.5	0.74	0.005
$ScvO_2$ [T0]	66	64	82	75	71	0.78	0.005
$ScvO_2$ [T6]	67	66	83	76	73	0.80	0.003

PPV: positive predictive value, NPV: negative predictive value, AUC: area under the curve.

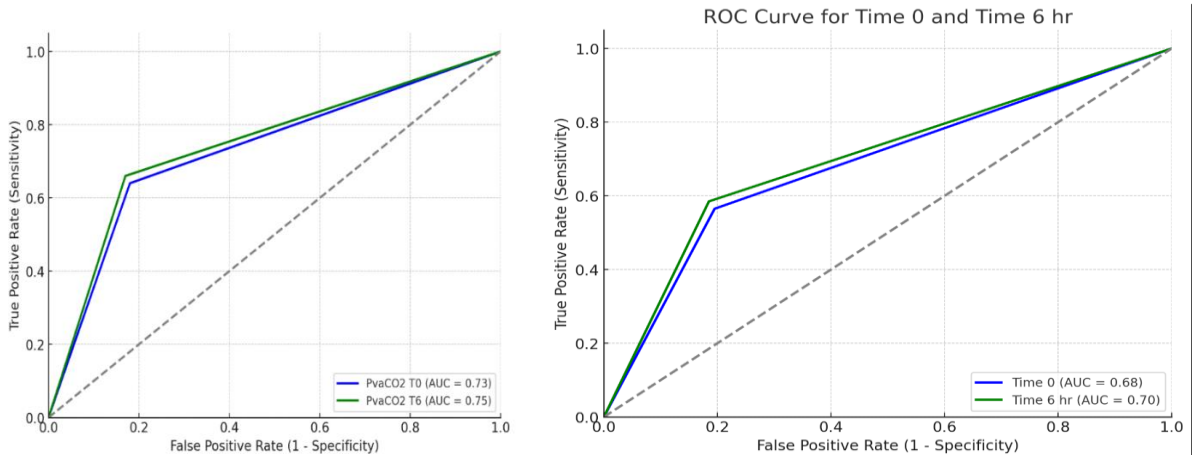

Figure [1]: ROC curve of [A] $PvaCO_2$, [B] $ScvO_2$.

Table [5]: Serum lactate of the studied groups

		Group I [n=21]	Group II [n=14]	P
Serum lactate [mg/dl]	**T 0**	2.4 ± 0.5	2.5 ± 0.6	0.67
	T 6	1.9 ± 0.4	3.3 ± 0.7	0.02

Data are presented as mean ± SD. * significant as P value ≤ 0.05.

Table [6]: ICU length of stay, MV and its duration, days of vasopressors and RRT of the studied groups

	Group I [n=21]	Group II [n=14]	P
ICU LOS [days]	12.5 ± 2.3	18.7 ± 3.1	0.03*
MV	18 [85.71%]	14 [100%]	0.139
MV duration [days]	6.2 ± 1.3	9.4 ± 1.7	0.01
Days of vasopressors [days]	5.62 ± 1.88	5.86 ± 3.18	0.782
RRT	6 [28.57%]	5 [35.71%]	0.656

Data are presented as mean ± SD or frequency [%]. * Significant p value <0.05. MV: Mechanical ventilation, ICU LOS: intensive care unit length of stay, RRT: Renal replacement therapy.

DISCUSSION

Sepsis, severe sepsis and septic shock are the main causes for ICU admission. This heterogeneous conditions are complex and are associated with a high rate of mortality [20-50%]. The mortality rate depends on the disease severity, which in turn is a reflection of the presence of organ dysfunction, due to different cell damage mechanisms [11]. Recognition and early detection of patients at high risk for mortality due to sepsis is of critical importance. This permits early monitoring and appropriate intervention to reduce the higher mortality. Thus, we carried this study to assess the prognostic value of venous to arterial CO_2 difference and mixed venous saturation during early resuscitation in critically ill patients with septic shock. We recruited 35 patients with a confirmed diagnosis of septic shock [21 survivors and 14 non-survivors].

Regarding patient demographics, sources of sepsis and APACHE II scores, and hemodynamics out results are strongly supported across the critical care community. For example, in a landmark study, there was significant differences in heart rate, MAP, respiratory rate, and temperature at T6 between the groups suggesting that these parameters are useful in monitoring the progression of septic shock and predicting outcomes. Non-survivors exhibited higher heart rate, respiratory rate, and

temperature, along with lower mean arterial pressure, reflecting a more severe and unstable condition [11].

Regarding $PvCO_2$ and PvO_2, our results are comparable to **Van Beest *et al.*** [12] who carried out a post hoc analysis for 53 patients presented with severe sepsis or septic shock. They were grouped into two groups on the basis PCO2 gap [cut off value 0.8 kPa or 6 mmHg]. The results showed significant differences between groups. In addition, **Narava *et al.*** [13] investigated the central venous to arterial carbon dioxide difference therapeutic and prognostic value during early resuscitation of 50 critically ill patients with nosocomial septic shock. They concluded that, persistent high values of the $Pv\text{-}aCO_2$ gap can be used and work as a prognostic indictor for prediction of the 28-day mortality in those patients. $Pv\text{-}aCO_2$ gap at 6 hours has the same discriminatory power as the Sequential Organ Failure Assessment [SOFA] score on days 1 and 2, and lactate clearance power to predict the 28-day mortality.

Our findings suggested that ScvO2 is a moderately good predictor of mortality in patients with septic shock, with lower values associated with poorer outcomes. The significant differences in $ScvO_2$ levels and the ROC curve analysis emphasize the importance of monitoring oxygen utilization and delivery in critically ill patients to improve outcomes. It was reported that, central venous oxygen saturation [$ScvO_2$] is a valuable predictor of mortality in septic shock patients, but its interpretation requires nuance. Both abnormally low [<70%] and high [≥90%] $ScvO_2$ levels are associated with increased mortality compared to normal levels [70-89%][14].

Combining $ScvO_2$ with other markers can improve prognostic accuracy. Pairing $ScvO_2$ with central venous-to-arterial PCO_2 difference [$\triangle Pco_2$] provides better outcome prediction than $ScvO_2$ alone [15]. In addition, high $ScvO_2$ levels [>85%] in later stages of septic shock may indicate impaired oxygen utilization and are linked to higher mortality [16].

Results of serum lactate is in line previous study of **Marty *et al.*** [17] who showed that there was a statistically significant differences between H0 and H6, H12, or H24 lactate values in survivor group. Mean concentrations of the blood lactate were lower in survivors than in non-survivors at H0 [5±3.1 mmol/L vs. 6.9±4.3 mmol; P = 0.049].

In the current study, the non-survivors had longer ICU stays and required prolonged mechanical ventilation, indicating greater severity and complications. This was explained by the aggressive course of sepsis caused by the poor prognosis.

Conclusions: This study provided valuable insights into the prognostic factors associated with septic shock outcomes in ICU patients. It emphasizes that age, sex, comorbidities, and sources of sepsis do not significantly impact survival rates. Instead, the severity of illness, as indicated by higher APACHE II scores and physiological parameters such as heart rate, MAP, respiratory rate, and temperature, plays a critical role in predicting mortality. Additionally, significant differences in acid-base balance, respiratory function, and oxygenation status between survivors and non-survivors underscore the importance of these factors in patient prognosis. The findings highlight that $PvaCO_2$ and $ScvO_2$ are moderately good predictors of mortality, with higher $PvaCO_2$ and lower $ScvO_2$ values associated with poorer outcomes. However, the study had some limitations. These include the relatively sample size, single center nature of the study and short duration of follow up.

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Conflict of Interest: Nil

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