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Original Article

Trace Elements and Sepsis: Is there a Correlation?

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ABSTRACT

Background: In critical illness blood levels of trace elements vary with the acute phase reaction. Quantitative estimation of it (Serum Selenium and Serum Zinc) can be used as prognostic markers. **Aim and Objective:** To evaluate the correlation between trace elements and sepsis and correlate it with various other prognostic markers with mortality in sepsis. **Materials and Methods:** It was a prospective, observational study. One hundred and fifty patients of sepsis were enrolled after using inclusion and exclusion criteria for study. Serum Selenium and Zinc were done by Perkin-Elmer Optima ICP spectrometer. **Results:** One hundred and fifty patients of sepsis due to various pathological causes included in study. Mortality was 37.34%. APACHE II (33.23±5.93) and SAPS II score (67.43±10.55) was found to statisticallysignificant in predicting the mortality ($p<0.001$). Serum selenium in expired group of patients was found to be lower (38.26±20.82) as compared to survivors (44.34±18.99). Similarly serum zinc also appears to be lower amongdeceased (65.90±54.72) as compared to survivors (71.94±54.29) but this difference was not statistically significant. **Conclusion:** Our study shows that the patients with sepsis with lower level of serum selenium and serum zinc have poor outcome, but levels fails to correlate with severity of illness and death statistically.

Key words: Trace elements, Sepsis, Selenium, Zinc.

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INTRODUCTION

According to recent reports, the incidence of sepsis has been rising at a rate of 1.5%-8% per year.[1] About 9% of the sepsis develops to serious sepsis and 3% to septic shock. Although great progress has been made in the treatment of sepsis, the mortality of patients with severe sepsis is still as high as 30%- 70%.[2-4] Therefore, how to estimate the severity of sepsis early and apply targeted therapies timely is very important in the treatment of sepsis.

Biomarkers can have an important place in this process because they can indicate the presence or absence or severity of sepsis.[5,6] Biochemical markers, such as interleukins, C-reactive protein (CRP) and procalcitonin (PCT), have Improved considerably the correct classification of infectious processes,[7,8] but an intensive research is still being carried out on new markers.[9-12]

In critical illness blood levels of trace elements vary with the acute phase reaction due to redistribution, changes in protein binding, as well as utilization. Serum concentrations of trace elements (Selenium, Zinc) can be used as biomarkers of inflammation and tissue reparation in severe sepsis and to examine their prognostic value regarding the clinical outcome of septic patients.[10]

Selenium is an essential trace element with antioxidant and immunological functions. It is predominantly incorporated into selenoproteins which are vital for normal health and reproduction. In critically ill patients, plasma selenium levels fall during periods of oxidative stress as occurs with severe sepsis and the systemic inflammatory response syndrome (SIRS). Several studies have demonstrated impaired selenium kinetics in situations of acute oxidative stress in the intensive care unit (ICU).[13-15]

The functions of zinc as an essential trace element include formation of metalloenzymes, protein metabolism, RNA conformation and membrane stabilization. The key metalloenzymes with zinc as a constituent are carbonic anhydrase, alkaline phosphatase, alcohol dehydrogenase and superoxide dismutase. It plays a crucial role in cellular growth and replication, rapid epithelialization, wound healing, cellular immunity and protection against oxidative stress.[16] Zinc as a component of superoxide dismutase protects against oxidative stress by interacting with catalase and glutathione peroxidase.

Humans, in response to sepsis experience an acute decrease in plasma zinc that occurs without a concomitant loss in whole body content.[17] Zinc deficiency rapidly diminishes antibody- and cell-mediated responses in both humans and animals resulting in increased risk of infection.[18] The features of zinc-mediated immunoparalysis are remarkably similar to the features of immunoparalysis that occur in sepsis patients.[19]

The aim of this study was to ascertain the performance of a new marker of sepsis (serum Se and

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Zn concentration) in a well-defined cohort of patients with sepsis and compared with those of other biomarkers, C-reactive protein and a physiological score (Acute Physiology and Chronic Health Evaluation [APACHE] II) in a heterogeneous group of intensive care unit (ICU) patients. And knowledge of these parameters would help us to set better protocols helping in the management and estimating the prognosis in such patients.

MATERIALS AND METHODS

Study Design and Setting

We conducted a single-centre prospective observational study between September 2013 to August 2014 at a tertiary care health centre of northern India. Those patients who fulfill the following criteria for sepsis as per Surviving Sepsis Campaign: International, Guidelines for Management of Severe Sepsis and Septic Shock: 2012, within a 24h time window, will be included after taking informed written consent.

SIRS defined by two or more of the following

1. Core temperature <36 degrees C or >38 degrees C
2. Tachycardia; heart rate > 90 beats/min.
3. Tachypnoea; respiratory rate > 20 breaths/min or mechanical ventilation
4. White blood count >12 x 109/l or <4 x 109/l
5. Arterial hypotension (SBP < 90 mm Hg, MAP < 70 mm Hg)

Exclusion Criteria

1. HIV positive patients
2. Post Cardiopulmonary Resuscitated patient.
3. Not giving consent
4. Taking multivitamin/ multimineral or food supplements which contain trace elements.

For de-identification, the samples were codified S (for sepsis) and C (for controls) followed by a codified number to protect the privacy of individuals during all the further study. The samples were processed under approval of the ethics committee (ethical approval no: 65th ECM IIC/P2).

Methods OF Measurement

Patients were evaluated in detailed with history, general physical examination an all routine and specialized investigations they required. For quantitative estimation of serum trace elements like selenium and zinc venous blood sample (5ml) collected from each patient by sterile syringe at the time of admission. Serum separated by centrifuge for 30 minute at 3000 rpm. Separated serum transferred to eppendorfs vial with help of micropipette and stored at -20°C in deep freezer till digestion/ estimation. 1.0 ml of serum sample was diluted to 5.0 ml by Mili-Q water and analyzed by ICP-OES. Blank prepare in same condition replacing serum by 1.0 ml of Mili-Q water. Each sample is analyzed in triplicate.

Statistical Analysis

Continuous data were summarized as Mean±SD while discrete (categorical) in number and percentage. Continuous variable of two independent groups were compared by parametric independent Student's t test and the significance of parametric t-test was also validated with nonparametric alternative Mann-Whitney U test, where appropriate. Discrete (categorical) groups were compared by chi-square (χ^2) test. Predictors of final outcome were evaluated by using multivariate logistic regression analysis. A two-sided p values less than 0.05 ($p<0.05$) was considered statistically significant. All analyses were performed on STATISTICA software (Windows version 6.0).

RESULTS

Demographic Characteristics: The Demographic characteristic of the study population was presented in Table 1. One hundred and fifty patients with sepsis were included in study (74 male and 76 female) with mean age at admission is (41.44±19.45 years). Duration of hospital stay in Group I (12.82±5.40 days) was lower than that of Group II (13.95±5.76 days) but this difference was not found to be statistically significant (p=0.230) Table 2.

Precipitating Factors: There are various different cause of sepsis was discovered. Out of them pneumonia was found to be most common cause followed by intra abdominal sepsis. Table 1 It was found that 59.37% of Group I and 53.37% of Group II patients did not suffer from any other chronic disease. Most common chronic disease reported by Group I (24.47%) and Group II (16.07%) was Type 2 diabetes mellitus. Difference in suffering from other chronic disease by both the groups was not found to be statistically significant (p=0.239) Table 1.

Clinical Characteristics: Heart rate of Group I (108.21±9.24 per min) was found to be lower than that of Group II (113.86±14.90 per min) and this difference was found to be statistically significant (p=0.005). Respiratory rate of Group I (43.70±7.21 per min) was found to be lower than that of Group II (47.23±6.67 per min) and this difference was found to be statistically significant (p=0.003). Table 3 GCS of Group I ranged between 6 to 15 with a mean of 14.00±1.76 (Median 15.00) and that of Group II ranged between 4 to 15 with a mean of 9.63±2.66. It was observed that GCS score of Group I was found to be of higher order as compared to that of Group II and no interquartile overlap of values of both the groups was seen. Some extreme and outlier values of Group I having lower score was found. Difference in GCS score of both the groups was found to be statistically significant Figure 1.

Sepsis Score: APACHE2 score of Group I (18.03±4.94) was found to be lower than that of Group II (33.23±5.93) and this difference was found to be statistically significant ($p<0.001$). SAP2 score of Group I (29.81±9.53) was found to be lower than that of Group II (67.43±10.55) and this difference was found to be statistically significant ($p<0.001$). Predicted mortality of Group I was 13.30±12.66% and that of Group II 77.00±15.55%. Difference in predicted mortality of both the groups was found to be statistically significant ($p<0.001$) Table 4.

Biochemical Profile: pH and pCO_2 levels of Group II were found to be raised as compared to that of Group I and these differences were found to be statistically significant. pO_2 and HCO_3 levels of Group I were found to be raised as compared to that of Group II but these differences were not found to be statistically significant Table 5. Difference in Serum lactate, Serum Potassium, S. Urea, S. Creatinine, S. Magnesium, Serum phosphate, Trop. T, Pro BNP, SGOT, Serum protein and Serum albumin of both the groups was found to be statistically significant other variables do not show any statistically significant difference Table 5.

Correlation between Trace Element and Sepsis: Serum selenium and serum zinc levels of 75 healthy controls was also done, no significant difference in S. selenium and S. zinc levels of Controls, discharged (Group I) and Expired (Group II) was found. The test result variable(s): Serum Selenium (µg/dl), SZinc (µg/dl) has at least one tie between the positive actual state group and the negative actual state group. Table 6 Area under curve was 0.593 and 0.579 which is close to the flip coin accuracy of 0.5, thus rendering the practical utility of S. Se and S. Zn as predictors of outcome to be of no use. Figure 2

Correlation between Different Biochemical Variable with Sepsis: Table 7 In a model where mortality was taken as a dependent variable and CRP, Pro BNP, DLC, APACHE II, SAP2, GCS, Serum Selenium levels and Serum zinc levels as independent variables, it was observed that none of these variables were significantly associated with the outcome. Hence,

Table 1: Demographic Characteristic of the Patients.

Demographic Variables	Group I (Discharged) (n=94)		Group II (Expired) (n=56)		Statistical Significance (χ^2 test)	
	No.	%	No.	%	χ^2	'p'
Age Group (years)						
Upto 20	14	14.89	10	17.86	2.609 (df=6)	0.856
21-30	20	21.28	12	21.43		
31-40	15	15.96	6	10.71		
41-50	15	15.96	6	10.71		
51-60	14	14.89	9	16.07		
61-70	7	7.45	7	12.50		
>=71	9	9.57	6	10.71		
Mean age (Range)	41.44+19.45 (14-95)		43.75+20.87 (14-85)		't'=0.686; p=0.494	
Gender	**No.**	**%**	**No.**	**%**	**χ2**	**'p'**
Female	47	50.00	29	51.79	0.045 (df=1)	0.832
Male	47	50.00	27	48.21		
PRECIPITATING FACTORS						
Pneumonia	37	39.36	25	44.64	2.633	0.621
Intra-abdominal sepsis	22	23.40	13	23.21		
Cellulitis	15	15.96	4	7.14		
UTI	8	8.51	6	10.71		
Neurosepsis	12	12.77	8	14.29		
PAST HISTORY OF ILLNESS						
No Chronic disease	56	59.57	30	53.57	7.982 (df=6)	0.239
Diabetes mellitus	23	24.47	9	16.07		
Chronic Liver Disease	0	0.00	2	3.57		
Coronary Artery Disease	4	4.26	5	8.93		
Neurological disorder	4	4.26	2	3.57		
COPD	6	6.38	6	10.71		
Other	1	1.06	2	3.57		

Table 2: Between Group Comparison of Duration of Stay (days) and Outcome of Treatment.

	Group I (Discharged)	Group II (Expired)
Number of patients	94	56
Minimum	4.00	6.00
Maximum	30.00	30.00
Mean duration	12.82	13.95
Standard deviation	5.40	5.76
Statistical significance	't' = –1.206; p=0.230	

this predictive model was rejected. Exploration for a suitable model was done using a stagewise reduction approach excluding the least significantly associated independent variable and thus assessing the suitability of model. Iterations were continued till maximum variables having significant association with outcome was achieved.

DISCUSSION

At final evaluation, 94 patients were discharged (62.67%) from the hospital i.e. favourable outcome was 62.67% and rest 56 patients were expired (37.33%) during the treatment, i.e. mortality was 37.33%. In other studies, by Nguyen HB, *et al.*[20] and Cinel I *et al.*[21] mortality ranges 30% - 70%. This may because various factors affected mortality including the severity of sepsis, timely intervention, specific treatment, proper nursing care ect. In another study Robert L *et al.*[22] shows Mortality rates from sepsis range between 25% to 30% for severe sepsis and 40% to 70% for septic shock**.** Our present study mortality is 37.33% which is correlating with other studies.

Among Demographic Profile Age of patients discharged, ranged 14-95 years (41.44+19.45 years) and that of expired ranged from 14-85 years (43.75+20.87 years) but difference in age and outcome of sepsis patients was not found to be statistically significant (p=0.494). In other study conducted by Greg S. Martin *et al.*[23] shows Case-fatality rates increased linearly by age; age was an independent predictor of mortality. While in another study by Chin-Ming Chen *et al.*[24] found that, Of the 254 patients included, 63.8% were aged 65 years. ICU and hospital mortality rates

Table 3: Clinical Characteristics.

Hemodynamic Variables	Group I (Discharged) (n=94)			Group II (Expired) (n=56)			Statistical Significance (Student 't' test)	
	No.	Mean	S.D.	No.	Mean	S.D.	't'	'p'
Systolic BP (mm Hg)	93	111.18	27.85	50	99.32	24.99	2.516	0.013
Diastolic BP (mm Hg)	85	66.71	13.28	42	63.24	13.41	1.380	0.170
MAP (mm Hg)	85	82.89	16.29	42	77.36	15.19	1.837	0.069
Heart Rate (per min)	94	108.21	9.24	56	113.86	14.90	-2.866	0.005
Respiratory Rate (per min)	94	43.70	7.21	56	47.23	6.67	-2.980	0.003
pH	94	7.31	0.17	56	7.22	0.17	3.033	0.003
pCO2 (mm Hg)	94	33.67	13.76	56	43.30	28.77	-2.763	0.006
pO2 (mm Hg)	94	92.44	42.85	56	88.80	38.11	0.523	0.602
HCO3 (mmol/L)	94	18.04	7.39	56	16.97	7.21	0.872	0.385

Table 4: Between Group Comparison of Outcome Predictors and Outcome of Treatment.

Variables	Group I (Discharged) (n=94)			Group II (Expired) (n=56)			Statistical Significance (Student 't' test)	
	No.	Mean	S.D.	No.	Mean	S.D.	't'	'p'
APACHE2	94	18.03	4.94	56	33.23	5.93	-16.889	<0.001
SAP2 score	94	29.81	9.53	56	67.43	10.55	-22.470	<0.001
Predicted Mortality (percent)	94	13.30	12.66	56	77.00	15.55	-27.330	<0.001

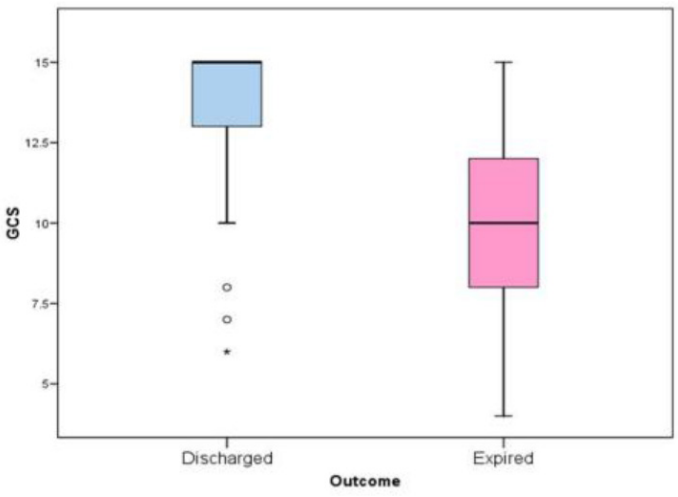

Figure 1: Difference in GCS score.

were 50.4% and 55.1%, respectively, for older and younger adult patients. Many other factors may also contribute to hospital mortality, severity of disease (APACHE II scores, hematologic failure, ARDS, septic shock), underlying risk factors and adequate drainage of the infection source.

In present study, most common cause of sepsis is pneumonia, discharged group comprise of 37 patients (39.36%) and expired Group had 25 patients (44.64%). Others sources of sepsis are intra-abdominal sepsis, cellulitis, UTI and neurosepsis. According to Chin-Ming Chen *et al.*[24] the main sources of infections were pulmonary (48.8%), abdominal (23.6%) and urinary tract (10.6%), which is comparable to our study. In other studies by Vesteinsdottir E, *et al.*[25] and Vincent JL *et al.*[26] results were comparable to our present study.

The patients those who had lower mean±SD systolic blood pressure 99.32± 24.99 mmHg has significant poor outcome (p=0.013) as compared to those having higher mean±SD (111.18±27.85) mmHg.Even Diastolic blood pressure were also found to be higher (66.71+13.28 mm Hg) in favourable outcome group then mortality group (63.24+13.41 mm Hg) but this difference was not found to be statistically significant (p=0.170). Which is correlating with study done by Balk RA[27] and concluded that Hypotension is the presenting abnormality in approximately 40% of patients with sepsis.

Patients who had lower in mean±SD HR and RR at presentation (108.21+9.24 per min HR) and (43.70+7.21 per min RR) respectively has significant (p=0.005) favourable outcome (discharged) as compared to those had higher mean±SD HR and RR (113.86+14.90 per min HR) and (47.23+6.67 per min RR) respectively. Similar correlation was also found in study done by Brun-Buisson C, *et al.*[28] "Incidence, Risk Factors and Outcome of Severe Sepsis and Septic Shock in Adults."

Patients with sepsis may present with altered sensorium. In present study GCS score was significantly associated with final outcome as p value is <0.001, it shows that favourable outcome if GCS is high, which is correlating with study of Bastos PG *et al.*[29] who find that The Glasgow Coma Scale score on ICU admission had a highly significant (p<0.0001) relationship with subsequent outcome in ICU patients without trauma.

The APACHE II score, which was calculated at the time of presentation was also found to be significantly associated (P<0.001) to the final outcome. The patients had higher mean±SD APACHE II score (33.23+5.93) had significantly increased mortality as compared to those who having lower mean± SD APACHE II score (18.03+4.94), where as in study Gupta R, *et al.*[30] evaluated the performance of APACHE II score in Indian sepsis patients. The overall mean APACHE II score was 12.87±8.25 with a range from 1 to 47; 282 (86%) survivor and 43 (13%) no survivor, whose mean APACHE II score were respectively 11.34±6.75 (range 1-37) and 3.09±10.01 (range 5-47) with a significant difference (P<0.001) between them. Whereas *Samir Desai, et al.*[31] were shows in his study that as the APACHE II score rises the percentage of non-survivors increases.

The SAP2 score which was calculate at the time of presentation was found to be significantly (p<0.001) associated with final outcomes. The patients who had higher mean ± SD SAP2 score (67.43+10.55) had

Table 5: Biochemical Profile.

Variables	Group I (Discharged) (n=94)			Group II (Expired) (n=56)			Statistical Significance (Student 't' test)	
	No.	Mean	S.D.	No.	Mean	S.D.	't'	'p'
S. Lactate	94	2.54	2.46	56	4.20	3.36	-3.488	0.001
AG	94	19.97	6.81	56	20.18	6.14	-0.190	0.850
RBS (mg/dL)	94	194.33	155.72	56	166.52	113.57	1.164	0.246
HBA1C (%)	94	6.91	2.93	56	6.28	2.11	1.402	0.163
Na (mmol/L)	94	140.76	8.55	56	140.14	11.33	0.375	0.708
K (mmol/L)	94	4.01	0.95	56	4.66	1.35	-3.458	0.001
S Urea (mg/dL)	94	72.26	57.92	56	94.37	60.24	-2.228	0.027
S Creatinine (mg/dL)	94	1.87	1.59	56	2.92	2.70	-3.007	0.003
S Calcium (mg/dL)	94	7.94	1.04	56	7.70	0.72	1.505	0.135
S Magnesium (mg/dL)	94	1.97	0.37	56	2.13	0.55	-2.057	0.041
S. PO4 (mg/dL)	94	4.65	2.31	56	6.07	3.21	-3.128	0.002
CRP (mg/L)	94	71.65	32.50	56	77.22	41.14	-0.918	0.360
Trop T (ng/rml)	94	0.15	0.44	56	0.43	0.95	-2.493	0.014
CPKMB (ng/ml)	94	6.60	10.01	56	158.43	1030.52	-1.432	0.154
Pro BNP (pg/ml)	94	10177.73	12758.10	56	18301.96	13663.63	-3.673	<0.001
S Bilirubin (mg/dL)	94	1.71	3.62	56	2.25	3.32	-0.915	0.362
SGOT (U/L)	94	190.70	473.92	56	438.07	703.44	-2.570	0.011
SGPT (U/L)	94	166.30	492.50	56	337.98	729.02	-1.719	0.088
SALP (U/L)	94	248.34	290.29	56	167.77	124.61	1.970	0.051
S Protein (g/dL)	94	5.82	1.04	56	5.34	0.76	2.972	0.003
S Albumin (g/dL)	94	2.78	0.68	56	2.48	0.55	2.868	0.005
S. Selenium (µgm/dL	94	44.34	18.99	56	38.26	20.82	1.829	0.069
S.Zinc (µgm/dL)	94	71.94	54.29	56	65.90	54.72	0.657	0.512

Table 6: Correlation between Trace Element and Sepsis.

	Controls (n=75)		Discharged (n=96)		Expired (n=64)		Statistical significance	
	Mean	SD	Mean	SD	Mean	SD	F	'p'
Selenium	43.33	3.55	44.34	18.99	38.26	20.82	2.621	0.075
Zinc	78.23	11.20	71.94	54.29	65.90	54.72	1.222	0.297

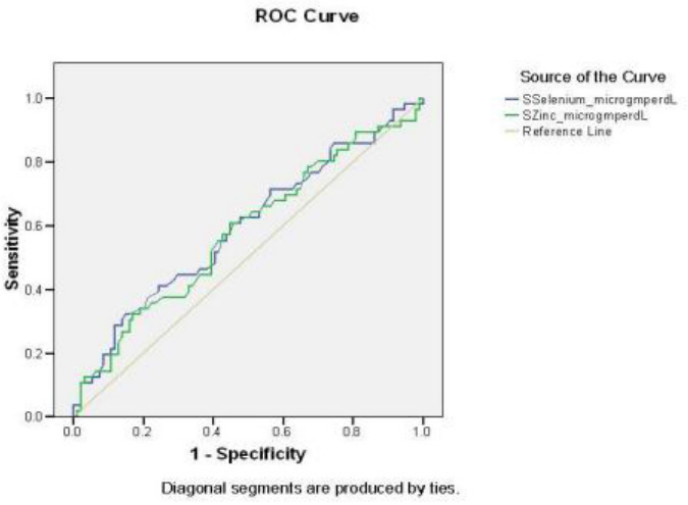

Figure 2: Area under curve.

significantly mortality as compared to lower mean (29.81+9.53. we are not able to find any study which shows direct correlation between SAP2 score and mortality in sepsis. In the present study low pH at the time of presentation is found be increased with mortality. Which is correlating with study done by Kellum JA[32] concluded that "Metabolic acidosis is common in patients with sepsis and other form of critical illness and is associated with poor outcome"

In the present study the association of S. Lactate level showed significant association with final outcomes. The patients who had s. Lactate level mean±SD (2.45±2.46) had better outcome as compared to patients with high mean±SD (4.20±3.36), who had poor outcome significantly (P<0.001). Various Landmark studies in this area support the use of serum lactate in both the diagnostic and treatment phases for septic shock. Shapiro, *et al.*[33] in a study with 1,278 patients with infection, demonstrated that increasing lactate levels were associated with increased mortality. Lactate levels less than 2.5mmol/L were associated with a 4.9% mortality rate compared to patients with lactate levels ≥4 mmol/L who had an in-hospital mortality of 28.4%.12 the present study is also correlating with the above study. In another study by Dellinger RP, *et al.*[34] concluded that, S. Lactate levels are a critical parameter indicating sepsis

Table 7: Multivarient logistic regression analysis.

		B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I.for EXP(B)	
		Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Step 1(a)	CRP mg/L	.010	.014	.482	1	.487	1.010	.982	1.038
	Pro BNP pg/ml	.000	.000	1.652	1	.199	1.000	1.000	1.001
	DLC_N	-.174	.153	1.288	1	.256	.841	.623	1.135
	APACHE II Score	.599	.328	3.330	1	.068	1.821	.957	3.465
	SAP2Score	.289	.143	4.057	1	.044	1.335	1.008	1.769
	GCS	-1.136	.693	2.687	1	.101	.321	.082	1.249
	S. Selenium µg/dl	-.061	.054	1.284	1	.257	.940	.846	1.046
	S. zinc µg/dl	.008	.012	.401	1	.526	1.008	.984	1.032
	Constant	-5.571	10.021	.309	1	.578	.004		

induced hypoperfusion and triggering guideline driven early goal directed therapy (EGDT) in the Surviving Sepsis Campaign. In a multivariate analysis by Poeze M, *et al.*[35] of over 20 hemodynamic (i.e. pulmonary artery pressures, total blood volume index) and regional variables of organ dysfunction (i.e. mucosal-arterial PCO_2, gastric intramucosal pH), S. Lactate was the only emergency department attainable parameter that was predictive of outcome.

Increased S. Urea, S. Creatinine, S. Potassium, at presentation were found significantly associated with increased mortality. According to Raghavan M, *et al.*[36] Development of acute renal failure during sepsis syndrome is common and portends a poor outcome. The same result was reproduced in present study also.

In present study increased level of S. Magnesium and S. Phosphate is at presentation were associated with increased mortality. Whereas According to Seyed Ali, *et al.*[37] Monitoring of serum magnesium levels may have prognostic and perhaps therapeutic, implications and physicians should be alert to the high incidence of magnesium deficiency in critically ill patients. According to Plantinga CL, *et al.*[38] al high levels of phosphate early in the course of dialysis were associated with increased risk for subsequent infection and sepsis.

On analysis of trace elements i.e. serum selenium and serum zinc at the time of presentation there were no significant association with final outcome is observed. However in present study we find lower serum levels of selenium and zinc [mean±SD of Se (38.26±20.82)] [mean±SD of Zn (65.90±54.72)] with high mortality group patients as compared with favourable outcome or discharged patients [mean ± SD of Se (44.34±18.99] [mean±SD of Zn (71.94±54.29)] and control [mean±SD of Se (43.33±3.55] [mean±SD of Zn (78.23±11.20)]. Whereas Manzanares W *et al.*[39] studied that in SIRS and MODS patients serum Se decreased significantly. After ICU admission S. Se had predictive value for mortality. In other study by W Graham Carlos *et al.*[40] studied prospective, observational study examined the role of selenium (Se) as a biomarker in sepsis. And examined the role of assessing serial Se concentrations in 30 septic patients upon admission to the intensive care unit and found statistically significant correlations between trends in Se concentrations and clinical course. In a similar study by Y. Sakr *et al.*[41] studied that Plasma selenium concentrations were below standard values for healthy subjects. Selenium concentrations decreased during the ICU stay in all groups, except controls. Lower plasma selenium concentrations are associated with organ dysfunction/failure and increased ICU mortality.

Beth Y Besecker *et al.*[42] studied that Plasma zinc concentrations were below normal in critically ill control patients and further reduced in the septic cohort (57.2 ± 18.2 compared with 45.5 ± 18.1 µg/dL). The alteration of zinc metabolism was more pronounced in septic patients than in noninfected critically ill patients. According to Srinivas U *et al.*[43] In bacterial infections (septicaemia, pneumonia, erysipelas and meningitis) the plasma concentrations of selenium, iron and zinc were decreased. The onset of change in trace elements occurred within a few days and persisted for several weeks. In another study Again Kh *et al.*[44] Hypozincemia and hypocupremia were found 11% and 14%, respectively. Increased CRP levels reflected presence systemic and pulmonary inflammation among stable COPD patients.

Thus further a need of large and prospective follow up study to show any significant correlation in trace elements and sepsis and to find the practical utility of serum selenium and serum zinc as a predictors of outcome and used as biomarker in future.

CONCLUSION

This study suggests that GCS score, SAP2 score and APACHE II score at presentation were the significant and independent predictor of the mortality in sepsis. Serum Lactate level showed statistical significant association with final outcomes. In study we find lower serum levels of selenium and zinc with high mortality group patients as compared with favourable outcome or discharged patients and control. But there were no statistical significant association with final outcome is observed.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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ABBREVIATIONS

CRP: C-reactive protein; **PCT:** Procalcitonin; **SIRS:** Systemic Inflammatory Response Syndrome; **ICU:** Intensive Care Unit; **APACHE** II**:** Acute Physiology and Chronic Health Evaluation; **SBP:** Systolic Blood Pressure; **MABP:** Mean Aertial Blood Pressure, **GCS** II**:** Glasgow Coma Scale; **SAPS:** Simplified Acute Physiology Score; **BNP:** B-type natriuretic peptide; **CRP:** C Reactive Protein, **HbA1c:** Glycated haemoglobin; **S. PO_4:** Serum Phosphate; **SGOT:** Serum Glutamic Oxaloacetic Transaminases; **SGPT:** Serum Glutamic Pyruvic Transaminases, **COPD:** Chronic obstructive pulmonary disease; **ROC curve:** Receiver Operating Characteristic curve.

SUMMARY

This study suggests that GCS score, SAP2 score and APACHE II score at presentation were the significant and independent predictor of the mortality in sepsis. Serum Lactate level showed statistical significant association with final outcomes. In study we find lower serum levels of selenium and zinc with high mortality group patients as compared with favourable outcome or discharged patients and control. But there were no statistical significant association with final outcome is observed.

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