Original Research Article

A HOSPITAL BASED PROSPECTIVE STUDY TO CORRELATE THE SERUM LACTATE, S. ALBUMIN AND OTHER OXYGEN INDICES AS A PREDICTOR OF OUTCOMES IN ICU PATIENTS REGARDING MORTALITY & LENGTH OF STAY IN ICU AT TERTIARY CARE CENTER

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Abstract

Background: Mortality was a moderator of the relationship between serum albumin trend and length of stay. There were no significant predictors of ICU delirium, but there was a relationship between mortality and ICU delirium. Minimum albumin was the best predictor of ICU readmission. The aim of this study to correlate the serum lactate, S. albumin and other oxygen indices as a predictor of outcomes in ICU patients regarding mortality & length of stay in ICU at tertiary care center. **Materials and Methods:** A hospital based prospective type study done on fifty critically ill patient more than 18 years of both sexes admitted to ICU in department of Respiratory Medicine, Government Medical College & Bangur Hospital, Pali, Rajasthan, India during one year period. The analysis of serum lactate, serum albumin on ICU admission to all cases (sample 1) then a sample after 12 h (sample 2) then after 24 h (sample 3), with correlation with the patients' clinical condition and progression of the case. Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Science) version 21.0v. **Result:** Our study showed that comparison of mean value of age, APACHE II Score & Glasgow coma scale (GCS) was statistically significant ($P<0.05**$ each respectively) in between survivors and non-survivors' group. Mean serum lactate & serum lactate albumin ratio was significantly lower in the survivors' group and serum albumin ratio was higher in survivor's group at admission, after 12 hours and after 24 hours. **Conclusion:** We conclude based on our observations that increased lactate levels and deceased albumin levels usually reflect poorer prognosis. Further studies can help in providing cut-off values for risk stratification and to familiarize the physicians with these parameters.

INTRODUCTION

Patients admitted to the hospital with sepsis are eight times more likely to die than patients with other diagnoses. Sepsis is associated with an intense and persistent stress response that can become dysfunctional, resulting in disease, organ failure, and death. Allostasis theory has emerged as an influential theory in describing the biological response to stress, focusing on individual differences. There is no diagnostic test that clearly identifies the presence of the dysregulated host response that is central to sepsis. Serum albumin is a protein produced by the liver that has been identified by researchers as a possible predictor of mortality in a number of critically ill patient populations. However, these studies primarily focus on the levels on admission, neglecting the clinically significant decrease that occurs subsequently.[1]

Serum albumin trend, admission, average, maximum, and minimum albumin levels were evaluated for association and predictive ability to each of the outcomes (mortality, length of stay, ICU length of stay, ventilator days, progression to a state of chronic critical illness, vasopressor use, presence of ICU delirium, and readmission to the ICU).[1]

Mortality was a moderator of the relationship between serum albumin trend and LOS. The

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combination of serum albumin trend and minimum albumin level significantly predicted ICU LOS. Minimum albumin level was a significant predictor of ventilator days. Minimum albumin was identified as the best predictor of progression to a state of chronic critical illness while controlling for mortality. Minimum albumin was found to be the best predictor of vasopressor use while controlling for mortality. There were no significant predictors of ICU delirium, but there was a relationship between mortality and ICU delirium. Minimum albumin was the best predictor of ICU readmission.[1]

Severe exacerbations requiring hospitalizations are responsible for a large share of these costs and among these, treatment cost for those who require intensive care unit (ICU) admission is highest. It is important to identify patients at the time of admission who are likely to have poor outcome, so that such patients can be managed aggressively. Many prognostic scoring systems have been devised for the same purpose. These scoring systems help to segregate patients who are the sickest and are likely to die from those who are expected to have better outcome and survive. Most of these scoring systems have been devised for a broad range of critically ill patients.[2] However, predicting the prognosis of critically ill patients whose condition fluctuates every other moment is challenging. Recently developed assessments based on physiologic variables have limitations due to requiring many variables which are not collected for all patients admitted to ICU.[3]

The critical condition of patients admitted to the ICU is vulnerable to oxidative stresses caused by reactive oxygen species which result in injuries to cells and tissues and activating extracellular antioxidant defense network consecutively.[4,5] Therefore, serum albumin as an indicator of the disease severity and the mortality is suggested and studied in adult patients,[6,7] and it has been found that the decrease in serum albumin concentration significantly raises the mortality.[8] The aim of this study to correlate the serum lactate, S. albumin and other oxygen indices as a predictor of outcomes in ICU patients regarding mortality & length of stay in ICU at tertiary care center.

MATERIALS AND METHODS

A hospital based prospective type study done on fifty critically ill patient more than 18 years of both sexes admitted to ICU in department of Respiratory Medicine, Government Medical College & Bangur Hospital, Pali, Rajasthan, India during one year period. Alcoholics or in Hepatic failure, systemic disease such as malignancy, epilepsy and acute renal failure and trauma patient were excluded in this study.

Serum Lactate, Serum Albumin
3 samples in the first 24 h of ICU admission in form of: 2 ml of venous blood was sent for analysis of serum lactate, serum albumin on ICU admission to all cases (sample 1) then a sample after 12 h (sample 2) then after 24 h (sample 3), with correlation with the patients' clinical condition and progression of the case.

The sample was centrifuged within 2 h and sent for lactate analysis, hemolyzed samples were repeated.

The normal reference values for lactate are traditionally considered 1 ± 0.5 mmol/L in normal patients and <2mmol/L critically ill patients.9

Acute physiology and chronic health evaluation (APACHEII score)10 as well as Glasgow coma score were calculated and recorded for all patients.

Need for Mechanical Ventilation: All the patients with decompensated ABGs that matched the indication of mechanical ventilation from the start or did not respond to conservative treatment were intubated and connected to the ventilator. Ventilator settings were tailored according to the clinical condition and the cause of respiratory failure.

Statistical Analysis: Data were coded and entered using the statistical package SPSS (Statistical Package for the Social Science) version 21.0v. Correlations between quantitative variables were done using Spearman correlation coefficient. P-values less than 0.05 were considered as statistically significant.

RESULTS

Our study showed that comparison of mean value of age, APACHE II Score & Glasgow coma scale (GCS) was statistically significant ($P<0.05**$ each respectively) in between survivors and non-survivors' group. But gender wise distribution was statistical non-significant ($p>0.05$). The mean value of hospital stay was 4.011 ± 1.34 in survivors and 6.34 ± 1.76 in non-survivors, which was statistically significant ($P<0.05**$). [Table 1] The comparison of mean value of serum albumin level, serum lactate and serum lactate albumin ratio at admission (sample 1), after 12 hours (sample 2) and after 24 hours (sample 3) was statistically significant in survivors and non-survivors group. Mean serum lactate & serum lactate albumin ratio was significantly lower in the survivors' group and serum albumin ratio was higher in survivor's group at admission, after 12 hours and after 24 hours. [Table 2]

Table 1: The comparison of various parameters in survivors and non-survivors group.

Parameters	Survivors (N=35)	Non-Survivors (N=15)	p-value
Age (yrs)			
Mean±SD	56.72±8.26	64.39±10.21	<0.05**
Gender			
Male	25 (71.42%)	9 (60%)	>0.05
Female	10 (28.58%)	6 (40%)	

APACHE II Score			
Mean±SD	12.84±3.315	23.20±5.11	<0.05**
Glasgow coma scale (GCS)			
Mean±SD	15.93±0.729	10.32±2.09	<0.05**
Hospital stay			
Mean±SD	4.011±1.34	6.34±1.76	<0.05**
MAP (Mean±SD)	77±9.12	60±8.24	<0.05**

Table 2: Comparison between survivors and non survivors regarding serum lactate, serum albumin and lactate albumin ratio in sample 1, sample 2 & sample 3

Biochemical analysis	Sample -1			Sample-2			Sample-3		
	Survivors	Non-survivors	p-value	Survivors	Non-survivors	p-value	Survivors	Non-survivors	p-value
Serum lactate	2.83±0.75	5.28±0.67	<0.05**	2.72±0.77	4.97±1.18	<0.05**	2.36±0.56	4.28±1.82	<0.05**
Serum albumin	4.47±0.80	2.62±0.58	<0.05**	4.16±0.72	2.76±0.75	<0.05**	4.10±0.52	2.59±1.15	<0.05**

DISCUSSION

Serum albumin level was the strongest predictor of morbidity and mortality and researchers concluded that serum albumin was a better predictor of surgical outcomes than many other variables. Albumin, which is produced by the liver, is the primary factor in the maintenance of colloid osmotic pressure. Ions such as calcium, zinc and copper are transported in the circulation by albumin. Albumin binds to molecules and drugs, having a significant effect on the action and half-life of these drugs. Toxic molecules, such as bilirubin, are carried to the liver by albumin for excretion.[11]

In today's clinical practice, lactate levels are usually used to detect tissue hypoxia; however, increased lactate levels reflect more than just this aspect. Albumin levels also reflect the severity of inflammation as albumin is a negative acute phase protein.

Alaa Shalaby et al,[12] founded mean age of 62.18 ±10.94, there were 21 (63.6%) males and 12 (36.4%) females and Wan-Ling Chen et al,[13] founded mean age was 69.2 years, which was correspondence with our results. The comparison of mean value of APACHE score& GCS score was statistical significance (P<0.05**, P<0.05** respectively). A study done by Alaa Shalaby et al,[12] APACHE II score was higher in non-survivors but did not reach statistical significance. GSC was significantly lower in non-survivors.

The comparison of mean value of serum albumin level, serum lactate and serum lactate albumin ratio at admission (sample 1), after 12 hours (sample 2) and after 24 hours (sample 3) was statistically significant in survivors and non-survivors group.[13] Mean serum lactate & serum lactate albumin ratio was significantly lower in the survivors' group and serum albumin ratio was higher in survivor's group at admission, after 12 hours and after 24 hours. Domínguez de Villota E et al,[14] found that mean serum albumin was 2.88 /+- 0.74 g/100 mg. Survivors had a mean serum albumin (3.18 /+- 0.60) higher than non-survivors (2.35 /+- 0.68 g/100 ml) (p < 0.05).

Nichol AD et al,[15] concluded in critically ill patients, relative hyperlactataemia is independently associated with increased hospital mortality. Blood lactate concentrations > 0.75 mmol.L-1 can be used by clinicians to identify patients at higher risk of death. The current reference range for lactate in the critically ill may need to be re-assessed. Jat et al,[16] enrolled 30 patients with septic shock and serum lactate was withdrawn on admission, at 12 h and after 24 h of admission. In agreement with our results the three different lactate levels were significantly higher among non survivors as compared to survivors.

Michael Lichtenauer et al,[17] found that the lactate/albumin ratio was elevated in non-survivors (p < 0.001). Patients with an increased lactate/albumin ratio were of similar age, but clinically in a poorer condition and had more pronounced laboratory signs of multi- organ failure.

H. Gunen et al,[18] found in-hospital mortality was significantly associated with lower arterial oxygen tension (Pa,O2), higher carbon dioxide arterial tension, lower arterial oxygen saturation and longer hospital stay. The overall 6-month mortality rate was 24%, with 1, 2and 3yr mortality rates of 33%, 39% and 49%, respectively.

CONCLUSION

We conclude based on our observations that increased lactate levels and deceased albumin levels usually reflect poorer prognosis. Further studies can help in providing cut-off values for risk stratification and to familiarize the physicians with these parameters.

REFERENCES

1. Cawcutt, K. A., & Peters, S. G. (2014). Severe sepsis and septic shock: clinical overview and update on management. Mayo Clinic Proceedings.2014; 89(11), 1572–1578.
2. GC Khilnani, Amit Banga and SK Sharma. Predictors of mortality of patients with acute respiratory failure secondary to chronic obstructive pulmonary disease admitted to an intensive care unit: A one-year study. BMC Pulmonary Medicine 2004;4:12.
3. Straney L, Clements A, Parslow RC, Pearson G, Shann F, Alexander J, et al. Paediatric index of mortality 3: an updated model for predicting mortality in pediatric intensive care. Pediatr Crit Care Med 2013;14:673-81.
4. Sitar ME, Aydin S, Cakatay U. Human serum albumin and its relation with oxidative stress. Clin Lab 2013;59:945-52.

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5. Abiles J, de la Cruz AP, Castano J, Rodriguez-Elvira M, Aguayo E, Moreno-Torres R, et al. Oxidative stress is increased in critically ill patients according to antioxidant vitamins intake, independent of severity: a cohort study. Crit Care 2006;10:R146.

6. Barchel D, Almoznino-Sarafian D, Shteinshnaider M, Tzur I, Cohen N, Gorelik O. Clinical characteristics and prognostic significance of serum albumin changes in an internal medicine ward. Eur J Intern Med 2013;24:772-8.

7. Jellinge ME, Henriksen DP, Hallas P, Brabrand M. Hypoalbuminemia is a strong predictor of 30-day allcause mortality in acutely admitted medical patients: a prospective, observational, cohort study. PLoS One 2014;9:e105983.

8. Nagumo K, Tanaka M, Chuang VT, Setoyama H, Watanabe H, Yamada N, et al. Cys34-cysteinylated human serum albumin is a sensitive plasma marker in oxidative stress-related chronic diseases. PLoS One 2014;9:e85216.

9. B.A. Mizock, Lactic acidosis, Dis. Mon. 1989;35(4):233–300.

10. W.A. Knaus, D.P. Wagner, E.A. Draper, J.E. Zimmerman, M. Bergner, et al, The APACHE III prognostic system. Risk prediction of hospital mortality for critically ill hospitalized adults, Chest 1991;100:1619–36.

11. Merlot, A. M., Kalinowski, D. S., & Richardson, D. R. (2014). Unraveling the mysteries of serum albumin—more than just a serum protein. Frontiers in Physiology, 5.

12. Alaa Shalaby, Osama Khalafallah, Mohamed Galal, Hebatallah Hany Assal, Nermeen Ahmed. Correlation between serum lactate and other oxygenation indices as a predictor of outcome in respiratory ICU patients. Egyptian Journal of Chest Diseases and Tuberculosis.2016;65:695–700.

13. Wan-Ling Chen, Wei-Ting Lin, Shu-Chen Kung, Chih-Cheng Lai and Chien-Ming Chao. The Value of Oxygenation Saturation Index in Predicting the Outcomes of Patients with Acute Respiratory Distress Syndrome. J. Clin. Med. 2018;7:205.

14. Dominguez de Villota, E.; Mosquera, J.M.; Rubio, J.J.; Galdos, P.; DiezBalda, V.; de la Serna, J.L.; Tomas, M.I. Association of a low serum albumin with infection and increased mortality in critically ill patients. Intensive Care Med. 1980;7:19–22.

15. Nichol AD, Egi M, Pettila V, Bellomo R, French C, Hart G, et al. Relative hyperlactatemia and hospital mortality in critically ill patients: a retrospective multi-centre study. Crit Care.2010;14:R25.

16. K.R. Jat, U. Jhamb, V. Gupta, Serum lactate levels as the predictor of outcome in pediatric septic shock, Indian J. Crit. Care Med. 2011;15:102–7.

17. Michael Lichtenauer, BernhardWernly, Bernhard Ohnewein, Marcus Franz, Bjoern Kabisch and Johanna Muessig et al. The Lactate/Albumin Ratio: A Valuable Tool for Risk Stratification in Septic Patients Admitted to ICU. Int. J. Mol. Sci. 2017;18:1893.

18. H. Gunen, S.S. Hacievliyagil, F. Kosar, L.C. Mutlu, G. Gulbas, E. Pehlivan I. Sahin and O. Kizkin. Factors affecting survival of hospitalized patients with COPD. Eur Respir J 2005;26:234–41.

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