



SERUM LACTATE/ALBUMIN RATIO AS A PREDICTOR OF ORGAN FAILURE AND MORTALITY IN SEVERE SEPSIS AND SEPTIC SHOCK

Anesthesiology

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ABSTRACT

Aim : The purpose of our study to examine the clinical utility of serum lactate/albumin as an indicator of multiple organ dysfunction (MODS) and mortality in severe sepsis and septic shock.

Methods : This study was conducted on total 80 patients, divided into two groups. Group A (46 Patients)- Patient with severe sepsis or septic shock who survived and get transferred from the intensive care unit. Group B (34 Patients)- Patient with severe sepsis or septic shock who expire during the course of treatment at the intensive care unit. All the patient were monitored with baseline vital parameter, complete haemogram, ABG, central venous pressure, serum lactate/albumin, serum bilirubin, serum urea/creatinine and electrolytes at T0, T24, T48, and urine output 24 hourly. All the patient were evaluated with APACHE-II (Acute Physiology And Chronic Health Evaluation II) and SOFA score in ICU within 24 hours.

Result : Serum lactate was high in group B and lactate clearance is lower in group B at T0, T24, T48 ($p < 0.05$). Serum albumin was lower in group B, serum lactate/albumin ratio were significantly higher in group B as compared to group A at T0, T24, T48 hours ($p < 0.05$).

Conclusion :- Lactate/Albumin ratio is an independent predictor for the development of MODS and mortality in patient with early severe sepsis and septic shock.

KEYWORDS

Serum lactate /albumin severe sepsis, multiple organ dysfunction, APACHE-II and SOFA score.

INTRODUCTION

Sepsis, a syndrome of physiologic, pathologic and biochemical abnormalities induced by infection, is a major public health concern. Severe sepsis & septic shock are frequently complicated by multiple organ dysfunction syndrome (MODS). When 2 or more organ are involved, MODS causes 60% to 98% death^{1,2}. So severity of organ dysfunction is an important determinant of prognosis in sepsis³.

In year 1991 and 2001 consensus conference developed initial definition that sepsis is due to systemic immune response syndrome (SIRS) which is characterised by two or more of the following manifestations- a)-Body temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$, b) Heart rate >90 beats/min; c) Respiratory rate >20 breath/min; d) WBC >12000 cells/mm³ or $>10\%$ immature neutrophils.

When SIRS is results of infectious process is termed as sepsis. Severe sepsis is defined as sepsis plus either organ dysfunction or evidence of hypoperfusion or hypotension. Septic shock is defined as systolic blood pressure <90 mmHg (fall in systolic blood pressure >40 mmHg) or mean arterial pressure (MAP) <65 mmHg after crystalloid fluid challenge of 3ml/kg body weight in patient with sepsis in absence of other cause of hypotension⁴.

Multiple Organ dysfunction syndrome (MODS) is defined as when two or more than two organ system involved in the body which are potentially life threatening.

Serum Lactate level is a diagnostic, therapeutic and prognostic marker of global tissue hypoxia in circulatory failure⁵. It is produced when deficiency of oxygen delivery due to global hypoxia leads to anaerobic metabolism and lactate production. Hyperlactatemia (normal 18-45mg/dl) is cordinal finding of sepsis and septic shock. Hyperlactatemia in sepsis indicates increased glycolytic flux due to hyper metabolism which is septic shock hyperlactatemia indicates increased glycolytic flux due to global hypoxia.

Serum albumin (normal 3.5-5.5 gm/dl) is a negative acute phase protein thus degree of hypoalbuminemia correlates with intensity of inflammatory response in critically ill patient⁶. Hyperlactatemia leads to microcirculatory dysfunction and increased capillary permeability due to sepsis leads to hypoalbuminemia. So use of Lactate/Albumin ratio would provide information into an index that correlates sepsis, septic shock and Multiple Organ dysfunction syndrome⁷ and provide

improvement prognostic marker and ultimately better outcome in human being.

Acute Physiology And Chronic Health Evaluation II (APACHE II)⁸ is a severity of disease classification system (Kraus et al, 1985), is one of several ICU scoring system. It is applied within 24 hours of admission in ICU. An integer score from 0 to >71 computed based on several measurement. High scores corresponds to more severe disease and a higher risk of death. It is not validated for use in children or young people <16 yrs of age.

Sequential Organ Failure Assessment score (SOFA score)⁹ is a scoring system to determine organ function or rate of failure. The score is based on six different score, one each for respiratory, cardiovascular, hepatic, coagulation, renal and neurological system. Higher SOFA score predict higher mortality rate like score <9 , predictive mortality at 33%, while >11 , predictive mortality $>95\%$.

MATERIAL & METHOD

After approval from ethical committee of institution, the study was conducted at Anaesthesiology Intensive Care Unit (AICU) of SRN hospital Prayagraj associated to Moti Lal Nehru Medical College Prayagraj (formerly Allahabad) over a period of one year. This prospective study was conducted in 80 adults patients of either sex belonging to ASA physical status 1-2, age more than 18 yrs, All patients were admitted in Anaesthesiology Intensive Care Unit with severe sepsis and septic shock was recruited in our study.

All patient were divided into 2 groups-

Group A- Patients with severe sepsis or septic shock who survived and get transferred from the ICU (Total 46 patient).

Group B- Patient with severe sepsis or septic shock who expire during the course of treatment at the ICU (Total 34 patient).

Immediately after admission in ICU all patient were placed central venous catheter by Modified Seldinger⁵ technique for fluid transfusion mainly crystalloid, vasopressors mainly Norepinephrine / Dobutamine, Packed Red Cell transfusion for protocol adapted from Surviving Sepsis Campaign 2012 in target¹⁰ a)-MAP >65 mmHg, b)-Urine output >0.5 ml/kg/min, c)-Normalization of lactate level, d)-Maintain CVP of 8-12 mmHg.

Machanical ventilation is provided (when needed) under light sedation (Midazolam) and analgesic (Fentanyl) with maintenance of blood glucose level <150 mg/dl. Finally stress ulcer and deep venous thrombosis prophylaxis provided according to international guide line.

Time duration were assessed as follows-

T0-Time at admission in ICU.

T24- Vital parameter, investigation(mainly lactate clearance, lactate, albumin) at 24 hours.

T48- Lactate clearance at 48 hours.

Following observations were assessed-

- 1- Baseline vital parameter like BP,PR, SPO2 ,urine output
- 2- Central venous pressure
- 3- Complete blood count
- 4- Arterial lactate at T0,T24,T48
- 5- Serum urea/creatinine
- 6- Serum bilirubin at T0,T24,T48
- 7- Serum Na, K & Ca
- 8- APACHE II and SOFA score for indication of organ dysfunction.

Observation

TABLE –1 Comparison of age in two groups

Demographic profile	Group A	Group B	P value(ANOVA)
Age yrs(mean±SD)	30.61±18.34	48.65±20.43	0.658
Range (yrs)	19-82	17-82	Not significant

TABLE 2- Pie chart showing group A % of SURVIVORS (57.5%) and group B NON- SURVIVORS (42.5%) out of all the patients included in the study

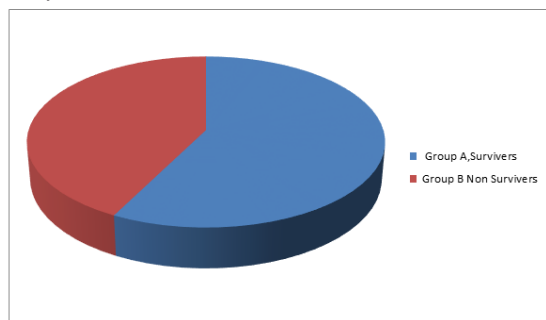


TABLE 3- Comparison and analysis of lactic acid level(mmol/l)

	Group A	Group B	P value
At the time of admission to icu(T0)	5.17±0.54	6.86±1.18	<0.05
Range	4.2-6.3	4.8-9.1	(Significant)
At the end of day1(T24)	3.89±0.51	6.83±1.41	<0.05
Range	3-5.2	4.4-9.2	(Significant)
At the end of day 2(T48)	3.04±0.49	7.84±0.78	<0.05
Range	2.2-4.	5.7-9.3	(Significant)

TABLE 4 Comparison and analysis of Serum Lactate clearance (%)

	Group A	Group B	P value(ANOVA)
At the end of day 1(T24)	26.16±8.4	8.32±2.47	<0.05
Range	0-38.6	0-11.8	(Significant)
At the end of day2 (T48)	21.88±6.9	4.1±0.67	<0.05
Range	5.42-32.7	0-5.1	(Significant)

TABLE 5-Comparison and analysis of Serum Albumin level (gm/dl)

	Group A	Group B	P value (ANOVA)
At time of admission to ICU(T0)	3.1±0.13	2.77±0.17	<0.05
Range	2.74-3.32	2.48-3.21	(Significant)
At the end of day 1 (T24)	3.13±0.11	2.73±0.19	<0.05
Range	2.86-3.32	2.27-3.16	(Significant)
At the end of day 2 (T48)	3.1±0.11	2.71±0.18	<0.05
Range	2.94-3.34	2.32-3.04	(Significant)

TABLE 6 - Comparison and analysis of Serum Lactate/Albumin ratio

	Group A	Group B	P value(ANOVA)
At the time of admission in icu(T0)	1.67±0.24	2.46±0.34	<0.05
Range	1.27-2.26	1.84-3.12	(Significant)
At the end of day 1 (T24)	1.24±0.17	2.49±0.42	<0.05
Range	0.95-1.68	1.67-3.24	(Significant)
At the end of day 2(T48)	0.96±0.16	2.91±0.29	<0.05
Range	0.67-1.32	2.13-3.78	(Significant)

TABLE 7- Comparison and analysis of APACHE II score

	Group A(survivors)	Group B (nonsurvivors)	P value (ANOVA)
At the time of admission to icu (T0)	22.0±41.21	26.18±2.54	<0.05
Range	19-25	21-31	(Significant)
At the end of day1 (T24)	20.72±1.94	28.18±1.76	<0.05
Range	17-25	24-31	(significant)

TABLE 8- Comparison and analysis of SOFA score

	Group A	Group B	P value (ANOVA)
At time of admission to icu(T0)	5.63±0.77	7.56±1.08	<0.05
Range	4-7		(Significant)
At the end of day1(T24)	4.52±0.75	8.61±1.09	<0.05
Range	3-6	7-11	(significant)
At the end of day2(T48)	3.52±0.78	9.37±0.81	<0.05
Range	2-5	8-11	significant

RESULT

- 1-The serum Lactic acid were significantly higher in group B than in group A at T0,T24,T48 (table 3)
- 2-The Lactate clearance (%) were significantly lower in group B than in group A at T24,T48 (table 4)
- 3-The serum Albumin level were significantly lower in group B than in group A at T0,T24,T48. (table 5)
- 4-Serum Lactate/Albumin ratio were significantly higher in group B than group A at T0,T24, T48. (table 6)
- 5-The APACHE II score were significantly higher in group B than group A at T0,T24. (table 7)
- 6-The SOFA were significantly higher in group B than in group A at T0,T24, T48. (table 8)

So serum Lactate, serum Albumin level, Lactate clearance and serum Lactate/Albumin can be used as predictor of mortality in patient with severe sepsis and septic shock.

Serum Lactate/Albumin ratio, APACHE II score, serum Lactate and Albumin level can be used to predict mortality in patient with severe sepsis and septic shock.

DISCUSSION-

Sepsis is a leading cause of mortality and critical illness world wide.

1-NguYen HB, River EP et al (2004)¹¹: found that survivors compared with non survivors had a lactate clearance of 38.1+ 34.6 Vs 12.0+ 51.6% respectively (p=0.005). Patient with lactate clearance >10% (as compared to<10%) had greater decrease in APACHE II score over 72 hours and lower mortality rate (p=0.007).

2-Krishna U, Joshi SP, Modh M et al (2009)¹² : Found that higher mean lactate level in non survivors as compared with survivors. Mean lactate level in non survivals did not attain normal level, while that of survivors reached normal level in 36 hrs in sepsis patients.

The lactate levels in the non survivors showed an increasing trends as the day progressed where as it showed decreasing trends in the survivors. Non survivors had a higher incidence as MODS as indicated by higher SOFA scores in survivors predicted mortality rate by lactate level >40 mg/dl at T12,T24,T36 hours were 52.6%,61.5%,83.3% and 100%.

3-Si Hyoung Lee, You Hwan Joe Hyuk Lee et al(2013)¹³ found that lactate/albumin ratio level was higher in MODS patients on day 1 and on day 2. They found that lactate /albumin ratio was an independent predictor as the development as MODS during ICU stay .

In our study shows that lactate/albumin level ratio was higher in patient who died during there stay in ICU on day 1 those who survived on day 2. The area under the ROC curve showed that lactate /albumin ratio was out on day 1. Patient with lactate/albumin ratio greater than 2.49+0.43 on day 1 had a higher chances of mortality during there ICU stay (table 6).

CONCLUSION-

Conclusion of this study is early Lactate measurement and early goal directed therapy should be started in sepsis patients with Lactate greater than 4 mmol/l. In most cases Albumin administration seems predictor to be used mainly for resuscitation and volume expansion along with correcting hypoalbuminemia. Lactate /Albumin ratio is an independent predictor for the development of MODS and mortality in patient with early severe sepsis and septic shock. Patient with lower Lactate clearance are counted as high risk group for mortality and organ dysfunction. Morbidity and mortality can be significantly reduced by following predictive measures and treatment protocol as per Survival Sepsis Campaign (2012) and there by bed turnover can be increased so reducing in turn of the ICU burden and improve the health care delivery system of whole nation.

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