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RESEARCH ARTICLE

CORRELATION OF SERUM LACTATE LEVELS WITH SURVIVAL IN PATIENTS WITH SEPSIS

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Abstract

Introduction: Sepsis is defined as a potentially fatal organ dysfunction caused by an unbalanced host response to infection. The primary objective of the study is to correlate serum lactate with the results of sepsis. The secondary objective of the study is to find associations of lactate in serum with the various etiological factors of sepsis and to correlate serum lactate with severity of sepsis.

Material and Methods: This prospective cross-sectional study was conducted in Intensive Care Unit (ICU) and EmergencyDepartment (ED) for sepsis in NRI institute of medical sciences. A sixty five patients of both genders were included in the study. The study period were around **18 months** from March 2021 to September 2022. Clinical examination and biochemical tests for blood levels of triglycerides, HDL and fasting blood glucose levels were done.Permission from Institutional Ethical Committee(IEC) were obtained. After getting permission from the Institutional Ethical Committee(IEC), information regarding the study were explained to the patients. Written and informed consent was obtained from them. Patients newly started on antidepressant treatment will be selected psychiatric department.

Results: In the present study about 69%were in the age of 25 to 50 years. About 28% were in the age of more than 50 years. Only 3% were in the age of less than 25 years.Mean age is 48.87 and standard deviation is 3.21.About 65% were males and 35% were females.About 12% of patients required ventilation. About 77% survived. The relationship between serum lactate levels and outcome is statistically significant (P=<0.05)

Conclusion: The fundamental goals of sepsis and septic shock care are early detection and immediate fluid resuscitation.

Introduction:-

Sepsis is defined as a potentially fatal organ dysfunction caused by an unbalanced host response to infection.[1] It has multiple symptoms disorder characterized by acute organ dysfunction and a high mortality rate. It has severe infection complication marked by a systemic inflammatory response with the highest mortality rate of 50%.[2] Sepsis is a condition of cumulative burden of organ failure and suggested as a strongest predictor of death, both in terms of the number of organs failing and the degree of organ dysfunction.[3]

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Awareness of risk factors, clinical signs and symptoms, pathophysiology, and updates in sepsis management can improve nursing care for patients with severe sepsis and promote best practises for sepsis care in the Intensive Care Unit(ICU).[4]The most commonly affected sites covering 80% of all cases of sepsis are respiratory, genitourinary, and gastrointestinal systems, as well as the skin and soft tissue. Pneumonia is the most common reason forsepsis.[2]

Sepsis pathophysiology is complex, as biochemical and cellular changes trigger a cascade of events that result in systemic inflammation and organ dysfunction.[4] In response to pathogen invasion, it involves a complex communication of pro-inflammatory and anti-inflammatory mediators. These mechanisms cause endothelial destruction, vascular permeability, microvascular dysfunction, coagulation pathway activation, and impaired tissue oxygenation, all of which contribute to the sepsis cascade.[2] Three mechanisms explain the pathogenesis of sepsis syndrome or Systemic Inflammatory Response Syndrome[SIRS], all of which involve the release of mediators that cause a systemic inflammatory response. The mechanisms are pro-inflammatory response, failure of the Compensatory Anti-inflammatory Response (CARS) to act, and immunoparalysis. SIRS pathogenesis was divided into three stages:[1] the release of bacterial toxins,[2] the release of mediators, and[3] the effects of excessive specific mediators.

In 1780, Karl Wilhelm Scheele made the discovery and described Sour milk contains lactic acid.In the 1843 and 1851, Johann Joseph Scherer, a German physician-chemist discovered Lactic acid in human blood in pathological conditions.[6] Lactic acid is one of the most important organic acids, and it is widely used in a variety of industrial and biotechnological applications all over the world.[7]

The first round of laboratory and radiographic testing is designed to pinpoint the source of the infection and identify signs of organ dysfunction. Common laboratory tests include a complete blood count, prothrombin time, chemistries(electrolytes, bicarbonate, creatinine, glucose), and cultures as clinically appropriate before starting antimicrobial therapy with no significant delay(>45 minutes). Before beginning antimicrobial therapy, at least two sets of blood cultures(both aerobic and anaerobic bottles) should be obtained.[8]General variables such as inflammatory variables, hemodynamic variables, organ dysfunction variables, and tissue perfusion variables are the various variables considered as diagnostic criteria for sepsis.[9]

Biomarkers are a valuable tool for facilitating early diagnosis, identifying patients at high risk of complications, and monitoring disease progression. These evaluations are critical for determining an appropriate therapy and improving patient outcomes. A perfect biomarker provides indirect but continuous information(determinations) about disease activity. Biomarkers have the potential to play an important role in this processbecause they can indicate the presence or absence or Sepsis severity and have the potential to play an important role in clinical guidance to a rapid treatment and diagnosis extension beyond standard therapy.[10]

Procalcitonin(PCT), C-reactive protein(CRP) are biomarkers of complement proteins in sepsis, biomarkers of the immunosuppressive phase of sepsis, and organ dysfunction biomarkers which are used in sepsis diagnosis.[11] Septic shock is a severe state of tissue hypoperfusion as a result of infectious-related systemic inflammatory response with impaired microcirculation and cytopathic hypoxia, characterized by severe hypovolemia, vasodilation, and cardiac dysfunction. Despite therapeutic advances, The mortality rate from septic shock remains high. The most common causes of death in these cases are refractory multi-organ failure and hypotension. Immediate treatment of septic shock is critical because a delay can result in multiple organ dysfunctions.[12]

The primary goals of sepsis and septic shock management are early detection and initial fluid resuscitation.[13] After initiating early, goal-directed therapy,Ventilation that protects the lungs should be considered.[14] Vasopressor therapy, inotropic therapy, antimicrobial therapy, hemodynamic support, immunomodulation, source control, blood product administration, glucose control, Replacement of renal function, and nutrition are available therapies in sepsis and septic shock management. The Sepsis-related Organ Failure Assessment(SOFA)score of 8 can be used to describe quantitatively and as objectively as possible the organ dysfunction degree failure overtime in patient groups or even individual patients.[16]The primary objective of the study is to correlate serum lactate with the results of sepsis. The secondary objective of the study is to find associations of lactate in serum with the various etiological factors of sepsis and to correlate serum lactate with severity of sepsis.

Methodology:-

This prospective cross-sectional study was conducted in Intensive Care Unit (ICU) and EmergencyDepartment (ED) for sepsis in NRI institute of medical sciences. A sixty five patients of both genders were included in the study. The study period were around **18 months** from March 2021 to September 2022. The study included age group from 18-80 years, both genders, who meets 2 or more criteria for Systemic Inflammatory Response Syndrome (SIRS), subjects with temperature >38^0C, pulse rate >100/min and respiratory rate >20/min. The study excluded subjects with chronic liver disease, chronic kidney disease, end stage cardiopulmonary disease and known retro viral cases. Based on the reference study done by Rupak Bhandari, R Bhandari, M Paudel, GB Malla sample size calculation for prospective cross sectional study was done using $N= 4PQ/d^2$, and the estimated sample size were about 69.

Clinical examination and biochemical tests for blood levels of triglycerides, HDL and fasting blood glucose levels were done.Permission from Institutional Ethical Committee(IEC) were obtained. After getting permission from the Institutional Ethical Committee(IEC), information regarding the study were explained to the patients. Written and informed consent was obtained from them. Patients newly started on antidepressant treatment will be selected psychiatric department.

After collection, the data were compiled and entered in Microsoft Excel sheet. SPSS statistical software (SPSS for Windows, version 20.0; SPSS, Inc., Chicago, IL, USA) was used for statistical calculation Continuous data were expressed as mean (±standard deviation) or Median (with interquartile range) according to distribution. Categorical variables were presented as frequency and percentages.P value of <0.05 Confidence Interval(CI).

Results:-

In the present study about 69%were in the age of 25 to 50 years. About 28% were in the age of more than 50 years. Only 3% were in the age of less than 25 years.Mean age is 48.87 and standard deviation is 3.21.About 65% were males and 35% were females.About 12% of patients required ventilation. About 77% survived (Table 1). Association of serum lactate levels with the survivors in elicited in Table 2.

Table 1:- Distribution of variables among the study participants (N=65).

Slno	Variable	Frequency	Percentage
1	**Age in years**		
	<25 years	2	3
	25 to 50 years	45	69
	>50 years	18	28
2	**Gender**		
	Male	42	65
	Female	23	35
3	**Requirement of ventilation**		
	Yes	8	12
	No	57	88
4	**Outcome**		
	Survived	50	77
	Not survived	15	23

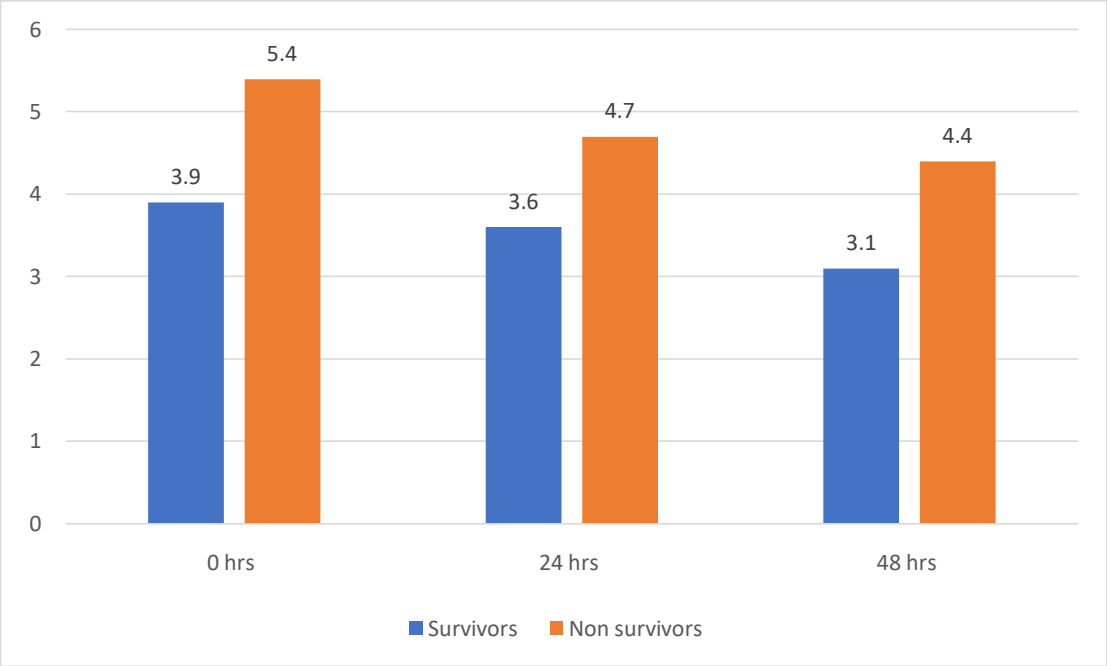
Table 2:- Distribution of variables among the study outcome (N=65).

Slno	Variable	Survivors	Non -survivors
1	Serum lactate levels mg/dl 0-3 hrs		
	>4.0	6	13
	≤4.0	44	2
2	Serum lactate levels 24 hours		
	>4.0	4	15
	≤4.0	46	0
3	Serum lactate levels 48 hours		
	>4.0	4	15
	≤4.0	46	0

Table 3:- Serum lactate levels and outcome are related(N=65).

Time	Survivors		Non survivors		P value
	Mean	SD	Mean	SD	
0 hrs	3.9	0.16	5.4	0.28	0.01
24 hrs	3.6	0.19	4.7	0.32	0.01
48 hrs	3.1	0.43	4.4	0.46	0.01

Figure 1:- The relationship between serum lactate levels and the outcome(N=65).



The relationship between serum lactate levels and outcome is statistically significant (P=<0.05) (Table 3, Figure 1).

Discussion:-

In trauma and sepsis patients, lactate levels are recognised to be predictive of survival or fatality. Others have demonstrated a positive outcome with vigorous treatment within 24 hours of the injury and a normalisation of serum lactate. Timely resuscitation, antibiotics, surgical control, vasopressor and inotropic medications, ventilatory support, and dialysis as appropriate are all parts of aggressive treatment. All interventions continue to focus on patient survival. The outcome of these interventions varies between patients because each patient has a unique set of pre-existing morbidity characteristics that influence how he reacts to an injury.

The current research on69%were in the age of 25 to 50 years. About 28% were in the age of more than 50 years. Only 3% were in the age of less than 25 years.Mean age is 48.87 and standard deviation is 3.21.About 65% were males and 35% were females.About 12% of patients required ventilation.About 77% survived.There is a statistically significant link between serum and lactate levels and outcome(P<0.05).

According to Kang YR et al[17], among patients with hepatic impairment who were in septic shock, The initial lactate level was determined independentlyrelated to in-hospital mortality. Due to decreased lactate clearance, the blood lactate level may be increased in people with chronic kidney disease (CKD). [18] However, there were not enough CKD or liver failure patients included in this analysis to mask the link between an elevated serum lactate level and mortality. The pulmonary and urogenital tracts were the other frequent sepsis foci identified in their investigation. The most common problems that occurred during the hospital stay were respiratory failure (39.3%) and acute renal failure (41.7%).

According to Mikkelson ME et al[19], the most common complications were renal (43.4%) and neurological (34.2%). In numerous investigations, it has been demonstrated that an increased lactate level has a negative correlation with the outcome. [20] However, several lactate cutoff ranges have been employed. Some studies identified a substantial

correlation between mortality in our group and a lactate cutoff range of 4 mmol/L, which is used to distinguish between sepsis and severe sepsis.

Lactate non-clearance was discovered to be an unrelated predictor of deathin 166 people with severe sepsis in a multicenter prospective research by Arnold RC, et al (odds ratio, 4.9 [confidence interval, 1.5-15.9]). The study came to the conclusion that there was a significant If lactate was not removed, there was a risk of death.during resuscitation. Previous studies have repeatedly shown that higher-than-normal serum lactate is linked to higher hospital and intensive care unit mortality. These findings have influenced management plans that are based on blood lactate levels, with recommendations for early assessment and certain studies showing the clinical advantageof a serum lactate-targeted strategy.[21]

Conclusion:-

The fundamental goals of sepsis and septic shock care are early detection and immediate fluid resuscitation.A recent comparison of patients with septic shock who had or did not have elevated lactate levels appears to support the idea that other factors may be responsible for lactate production in sepsis. Our study also favoured same result. More studies to be conducted in future to prove the prediction.

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