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"Lactate Clearance as a Predictor of Mortality in Sepsis: A Retrospective Study at Rama Medical College Hospital and Research Centre, Kanpur"

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Abstract: Sepsis remains a major cause of morbidity and mortality worldwide. Elevated serum lactate levels reflect tissue hypo perfusion and are associated with poor outcomes. Lactate clearance has emerged as an important prognostic marker in septic patients, Sepsis is a life-threatening medical emergency characterized by a dysregulated host response to infection, leading to organ dysfunction and high mortality. Early recognition, prompt fluid resuscitation, timely administration of antibiotics, and monitoring of lactate clearance are essential components of sepsis management. Lactate clearance has emerged as a valuable biomarker reflecting tissue perfusion and response to resuscitative efforts. **Objectives:** To evaluate lactate clearance as a predictor of mortality in patients with sepsis and assess associated risk factors and outcomes of early management. **Methods:** Data were collected from medical records, including demographics, time to treatment initiation, fluid resuscitation volume, organ dysfunction, and outcomes.A total of 100 randomly selected patients diagnosed with sepsis were included. Serial lactate measurements were obtained at admission and after 6 hours. Lactate clearance was calculated using the formula:

Lactate Clearance (%) = [(Initial Lactate − 6-hour Lactate) / Initial Lactate] × 100

Patients were divided into survivors and non-survivors. Demographic data, co morbidities, source of infection, management strategies, and outcomes were analyzed.Statistical analysis was performed using SPSS software.

Results: Overall mortality was 28%. Mean lactate clearance was significantly higher among survivors (32.4 ± 12.1%) compared to non-survivors (11.2 ± 8.5%) ($p<0.001$). Patients with lactate clearance ≥20% had significantly lower mortality (12%) than those with clearance <20% (48%). Major risk factors associated with mortality included diabetes mellitus, chronic kidney disease, delayed antibiotic administration, septic shock, and mechanical ventilation.

Conclusion: Lactate clearance is a reliable and cost-effective predictor of mortality in sepsis. Early resuscitation and achieving lactate clearance ≥20% significantly improve survival outcomes.
Keywords: Sepsis, Lactate Clearance, Mortality, Septic Shock, Early Goal-Directed Therapy.

Introduction

Sepsis is a life-threatening condition caused by a dysregulated host response to infection, leading to organ dysfunction and high mortality. Despite advances in critical care, it remains a major healthcare challenge worldwide. Early diagnosis and prompt management are essential to prevent progression to septic shock and multiple organ failure.

Serum lactate is an important biomarker of tissue hypoperfusion and disease severity in sepsis. Elevated lactate levels are associated with poor outcomes and increased mortality. Lactate clearance, defined as the reduction in serum lactate levels following treatment, has emerged as a useful indicator of response to resuscitation and restoration of tissue perfusion. Higher lactate clearance is associated with improved survival, whereas persistent hyperlactatemia predicts adverse outcomes.

Early fluid resuscitation, timely antibiotic administration, and correction of underlying risk factors play a vital role in improving patient outcomes. This retrospective study evaluates lactate clearance as a predictor of mortality and assesses the impact of early management and fluid therapy among 100 sepsis patients admitted to Rama Medical College Hospital and Research Centre, Kanpur.

Objectives

- To determine whether lactate clearance predicts mortality in septic patients.
- To identify risk factors associated with mortality.
- To assess the impact of early management on outcomes.
- To compare lactate clearance between survivors and non-survivors.

Materials and Methods

Study Design

Retrospective observational study

Study Duration

1 January 2025 to 1 June 2026.

Study Population

100 randomly selected patients admitted with sepsis.

Inclusion Criteria

- Age ≥18 years.
- Diagnosed sepsis according to Sepsis-3 criteria.
- Available serial lactate measurements.

Exclusion Criteria

- Pregnancy.
- Terminal malignancy.
- Missing lactate values.
- Cardiac arrest prior to admission.

Sample Size and Demographics

The study included 100 patients, randomly selected from hospital records:
- 64 Male patients (64%)
- 36 Female patients (36%)

Sample Size Calculation

A random selection of 100 patients diagnosed with sepsis was made, consisting of 64 males and 36 females.

Sample size was calculated using:

Sample Size Calculation

$n = Z^2 P (1 - P) / d^2$

Where:
$Z = 1.96$
$P = 0.50$
$d = 0.10$

Substituting the values:
$n = (1.96)^2 \times 0.5 \times (1 - 0.5) / (0.10)^2$

Calculated sample size ≈ 96.
Considering possible exclusions, 100 patients were included.

Data Collection

Patient data were collected from hospital records, including:

- Demographics (age, sex, co morbidities)
- Clinical parameters (SOFA score, lactate levels, blood cultures)
- Intervention data (time to antibiotic administration, volume of fluids given, vasopressor use)
- Outcomes (mortality, ICU stay, need for mechanical ventilation)

Statistical Analysis

Data were analyzed using SPSS Version 26.

- Mean ± SD for continuous variables.
- Frequency and percentage for categorical variables.
- Chi-square test for categorical comparisons.
- Independent t-test for continuous variables.
- P-value <0.05 considered statistically significant.

Risk Factors Associated with Mortality

Risk Factor	Survivors (n=72)	Non-Survivors (n=28)	p-value
Diabetes Mellitus	24	15	0.02
CKD	8	10	0.001
Hypertension	21	11	0.08
Septic Shock	12	20	<0.001
Mechanical Ventilation	15	18	<0.001
Delayed Antibiotics (>3 hrs)	10	16	<0.001

Gender Distribution

Gender	Number	Percentage
Male	64	64%
Female	36	36%
Total	100	100%

Male : Female Ratio
64 : 36 = 1.78 : 1

Lactate Clearance Categories

Lactate Clearance	Patients	Mortality
≥20%	58	12%
<20%	42	48%

Table 1.1: Table depicting Risk factors associated with Mortality ,Gender Distribution ,Lactate clearance categories.

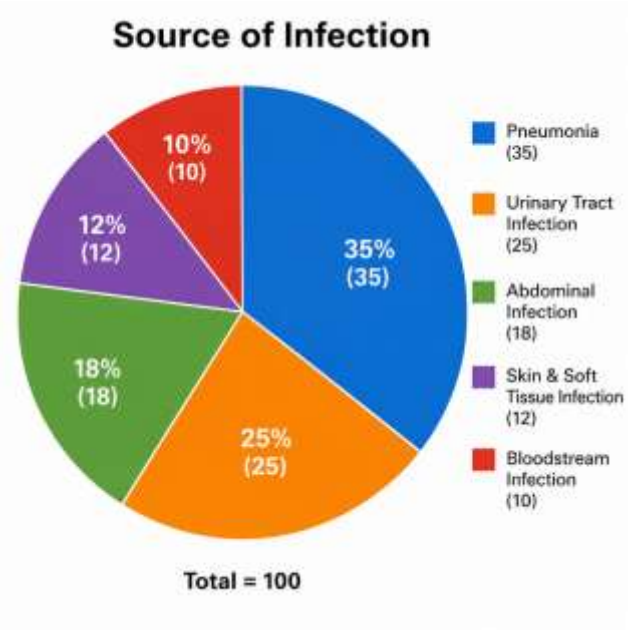

Figure 1.2: Pie Chart Image showing Source of infections in sepsis

Associated Risk Factors and Their Elimination

Risk Factor	Preventive Strategy
Delayed Antibiotics	Administration within 1 hour
Diabetes	Strict glycemic control
CKD	Early nephrology involvement
Septic Shock	Aggressive fluid resuscitation

Risk Factor	Preventive Strategy
Mechanical Ventilation	Early infection control and lung-protective ventilation
Nosocomial Infection	Hand hygiene and infection-control protocols

Outcomes of Early Management

Patients receiving:

- Antibiotics within 1 hour
- Fluid resuscitation within 3 hours
- Serial lactate monitoring
- Vasopressors when indicated showed:

Outcomes of Early vs Delayed Management

Outcome	Early Management	Delayed Management
Mortality	14%	42%
ICU Stay	5.6 days	10.4 days
Ventilator Days	2.8 days	7.1 days

Table 1.3 showing Outcomes of early vs. Delayed Management

Discussion

The present retrospective study evaluated the role of lactate clearance as a predictor of mortality in septic patients presenting to the Emergency Department of Rama Medical College Hospital and Research Centre, Kanpur. According to Tintinalli's Emergency Medicine, serum lactate is a valuable marker of tissue hypoperfusion and cellular stress in sepsis and should be measured early during emergency department resuscitation. Lactate elevation may occur even in normotensive patients and can identify occult shock before clinical deterioration becomes evident.

In our study, the overall mortality was 28%, with significantly lower mortality among patients achieving lactate clearance ≥20%. Survivors demonstrated a mean lactate clearance of 32.4%, compared with only 11.2% among non-survivors ($p<0.001$). These findings are consistent with previous studies by Nguyen et al. and Jones et al., which reported that early lactate clearance is strongly associated with improved survival and effective resuscitation.

The major risk factors associated with mortality included septic shock, chronic kidney disease, delayed antibiotic administration, and requirement of mechanical ventilation. Tintinalli emphasizes that prompt recognition of sepsis, administration of broad-spectrum antibiotics within one hour, aggressive crystalloid resuscitation, source control, and serial lactate monitoring are key components of emergency

department management. In the present study, patients receiving early management showed lower mortality (14% vs. 42%), shorter ICU stay, and fewer ventilator days.

These findings support the use of lactate clearance as a practical, inexpensive, and readily available bedside marker for monitoring response to therapy and predicting outcomes in septic patients. Early emergency department interventions aimed at improving lactate clearance may significantly reduce sepsis-related mortality and improve overall patient outcomes.

Conclusion

1. Lactate clearance is a significant predictor of mortality in sepsis.
2. Lactate clearance ≥20% is associated with improved survival.
3. Low lactate clearance correlates strongly with septic shock and organ dysfunction.
4. Early antibiotic therapy and aggressive resuscitation improve lactate clearance.
5. Serial lactate monitoring should be incorporated into standard sepsis management protocols.

Limitations

1. Single-center design limits generalizability to broader patient populations.
2. Retrospective methodology introduces potential selection and information biases.
3. Small sample size reduces statistical power and reliability.
4. Six-hour lactate assessment may miss later physiological changes.
5. Unmeasured confounders could influence mortality and lactate clearance.

Future scope:

1. Conduct multicenter studies to improve generalizability across diverse populations.
2. Evaluate serial lactate measurements beyond six hours for prognosis.
3. Compare lactate clearance with other biomarkers predicting sepsis outcomes.
4. Develop predictive models integrating lactate clearance and clinical variables.
5. Assess long-term survival and quality-of-life outcomes after sepsis.

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