ORIGINAL RESEARCH PAPER
Volume - 14 | Issue - 09 | September - 2025 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

SERUM PHOSPHATE AS A PROGNOSTIC BIOMARKER IN SEPSIS AND SEPTIC SHOCK – ASSOCIATION WITH MORTALITY IN A TERTIARY CARE ICU

General Medicine

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ABSTRACT

Background: Sepsis and septic shock remain major causes of ICU mortality. Identifying cost-effective and reliable prognostic biomarkers is essential for improving outcomes. Serum phosphate, an essential intracellular ion involved in cellular metabolism, is frequently deranged in critically ill patients. **Objective:** To evaluate the association between serum phosphate abnormalities (hypophosphatemia and hyperphosphatemia) and mortality in patients with sepsis and septic shock. **Methods:** A cross-sectional observational study was conducted on 90 patients admitted with sepsis/septic shock to ICU of Sri Siddhartha Medical College, Tumakuru. Serum phosphate was measured at admission, and patients were categorized into hypophosphatemia (<2.5 mg/dL), normophosphatemia (2.5–4.5 mg/dL), and hyperphosphatemia (>4.5 mg/dL). Clinical, laboratory, and outcome variables were compared. Mortality was analyzed across groups using ANOVA and chi-square tests. **Results:** The incidence of hypophosphatemia, normophosphatemia, and hyperphosphatemia was 24.4%, 43.3%, and 32.2% respectively. ICU mortality was highest in the hyperphosphatemia group (55.2%), compared to hypophosphatemia (40.9%) and normophosphatemia (30.8%), though not statistically significant (p=0.08). Hyperphosphatemia was associated with higher APACHE II score, increased vasopressor requirement, and longer ICU stay. Hypophosphatemia showed increased need for mechanical ventilation (63.6%). **Conclusion:** Serum phosphate abnormalities, particularly hyperphosphatemia, are associated with worse outcomes in sepsis and septic shock. Phosphate may serve as a simple and economical prognostic biomarker in critically ill patients.

KEYWORDS

Sepsis, septic shock, phosphate, biomarker, mortality, prognosis

INTRODUCTION

Sepsis and septic shock represent major global healthcare challenges, accounting for nearly 20% of worldwide mortality [1]. Despite advances in antimicrobial therapy and organ support, sepsis-related ICU mortality remains high, ranging between 25–50% [2]. Early identification of high-risk patients is essential to optimize management and improve survival.

Serum phosphate, a crucial intracellular ion, plays a fundamental role in energy metabolism, muscle contraction, oxygen delivery (via 2,3-DPG), and cellular signaling [3,4]. Phosphate derangements are common in critically ill patients, with hypophosphatemia reported in up to 45% and hyperphosphatemia in 20–40% of ICU admissions[5,6].

Previous studies have shown conflicting associations between phosphate levels and sepsis prognosis. Shor et al. reported hypophosphatemia increased sepsis mortality risk eight-fold [7], while Miller et al. and Shmeylan et al. demonstrated hyperphosphatemia as an independent predictor of poor outcomes [8,9].

Given limited Indian data, this study aimed to evaluate the incidence of phosphate abnormalities and their association with mortality in patients with sepsis and septic shock admitted to a tertiary care ICU.

MATERIALS AND METHODS

Study Design: Cross-sectional observational study.
Setting: Department of General Medicine ICU, Sri Siddhartha Medical College, Tumakuru.
Study Period: June 2023 – June 2024.
Sample Size: 90 patients.

Inclusion Criteria:

- Adults (>18 years) with sepsis or septic shock (SOFA ≥2, Sepsis-3 criteria).
- Patients with comorbidities such as diabetes, hypertension, CAD.

Exclusion Criteria:

- Age <18 years
- CKD on dialysis
- ICU stay <24 hours
- Postoperative or trauma cases

Data Collection:

At admission, serum phosphate was measured and patients were classified into:

- **Hypophosphatemia:** <2.5 mg/dL
- **Normophosphatemia:** 2.5–4.5 mg/dL
- **Hyperphosphatemia:** >4.5 mg/dL

Clinical parameters, comorbidities, laboratory data, ICU interventions, and outcomes were recorded.

Statistical Analysis:

Chi-square and ANOVA were applied for categorical and continuous variables. $p<0.05$ was significant.

RESULTS

Table 1. Distribution Of Serum Phosphate Levels In Sepsis Patients (n=90)

Phosphate status	Number of patients (n)	Percentage (%)
Hypophosphatemia	22	24.4%
Normophosphatemia	39	43.3%
Hyperphosphatemia	29	32.2%

Table 2. Baseline Characteristics Across Phosphate Groups

Variable	Hypophosphatemia (n=22)	Normophosphatemia (n=39)	Hyperphosphatemia (n=29)	p-value
Mean Age (years)	49.2 ± 15.6	55.1 ± 14.3	62.3 ± 13.4	0.01
Male sex (%)	63.6%	61.5%	58.6%	0.88
Diabetes Mellitus (%)	50.0%	28.2%	20.7%	0.03

Table 3. Laboratory And Outcome Parameters Across Phosphate Groups

Variable	Hypophosphatemia (n=22)	Normophosphatemia (n=39)	Hyperphosphatemia (n=29)	p-value
Platelet count ($\times 10^9$/L)	116 ± 52	142 ± 64	98 ± 47	0.01
Serum Creatinine (mg/dL)	1.6 ± 0.7	1.8 ± 0.9	2.6 ± 1.1	0.02
APACHE II score	17.4 ± 5.2	18.6 ± 6.1	23.1 ± 7.0	0.01
Mechanical Ventilation (%)	63.6%	53.8%	72.4%	0.04
Vasopressor use (%)	72.7%	66.7%	86.2%	0.06
ICU Mortality (%)	40.9%	30.8%	55.2%	0.08

DISCUSSION

This study highlights the prognostic role of serum phosphate in septic

patients. We observed that both hypophosphatemia (24.4%) and hyperphosphatemia (32.2%) were common, consistent with prior reports [5,6]. Mortality was highest in hyperphosphatemia patients (55.2%), followed by hypophosphatemia (40.9%), while normophosphatemia had the lowest mortality (30.8%). Although statistical significance was borderline (p=0.08), the trend supports prior evidence that hyperphosphatemia is linked to poor prognosis [8,9].

Hyperphosphatemia was also associated with higher APACHE II scores, vasopressor use, and longer ICU stay, suggesting a correlation with disease severity. Hypophosphatemia was linked to higher mechanical ventilation needs, likely reflecting impaired diaphragmatic contractility and leukocyte dysfunction [4,7].

Strengths of this study include prospective ICU data collection and stratification using Sepsis-3 definitions. Limitations include single-center design, modest sample size, and lack of serial phosphate monitoring.

CONCLUSION

Serum phosphate derangements are frequent in septic patients. Hyperphosphatemia in particular is associated with higher mortality and severe disease parameters, suggesting it may serve as an inexpensive, easily available prognostic biomarker in ICU settings. Larger multicentre studies are warranted to validate its prognostic utility.

REFERENCES

1. Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016;315(8):801-810.
2. Fleischmann C, Scherag A, Adhikari NK, et al. Assessment of Global Incidence and Mortality of Hospital-treated Sepsis. Am J Respir Crit Care Med. 2016;193(3):259-272.
3. Amanzadeh J, Reilly RF Jr. Hypophosphatemia: an evidence-based approach to its clinical consequences and management. Nat Clin Pract Nephrol. 2006;2(3):136-148.
4. Subramanian R, Khardori R. Severe hypophosphatemia: Pathophysiologic implications, clinical presentations, and treatment. Medicine (Baltimore). 2000;79 (1):1-8.
5. Zazzo JF, Troché G, Ruel P, Maintenant J. High incidence of hypophosphatemia in surgical intensive care patients: Efficacy of phosphorus therapy on myocardial function. Intensive Care Med. 1995;21(10):826-831.
6. Geerse DA, Bindels AJ, Kuiper MA, Roos AN, Spronk PE, Schultz MJ. Treatment of hypophosphatemia in the intensive care unit: a review. Crit Care. 2010;14(4):R147.
7. Shor R, Halabe A, Rishver S, et al. Severe hypophosphatemia in sepsis as a mortality predictor. Ann Clin Lab Sci. 2006;36(1):67-72.
8. Miller CJ, Doepker BA, Springer AN, Exline MC. Association of serum phosphate with mortality in sepsis. J Intensive Care Med. 2017;32(9):486-490.
9. Shmeylan A, Alzahrani A, Mandurah H, et al. Prognostic value of initial serum phosphate levels in sepsis. BMC Infect Dis. 2018;18:684.