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Original Research Article

A Study of Serum Phosphate Levels and its Correlation with Curb-65 Score in Community Acquired Pneumonia

Article History:

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Abstract:

Background: The CURB-65 score may be applied for risk stratification of community acquired pneumonia (CAP). Systemic abnormalities such as respiratory failure, hematological and neurological disorders, and arrhythmias are led by hypophosphatemia which may be correlated to CURB-65 score.

Objective: To determine the frequency of hypophosphatemia and correlation of serum phosphate levels with CURB-65 score in communicate CAP in ICU admitted patients in a tertiary care hospital.

Study Design: Observational study.

Place and Duration of Study: Pulmonology Department in Liaquat National Hospital.

Methodology: Suspected patients of CAP were admitted in critical care areas either from outpatient clinics or emergency department. Upon their admission to ICU, patients underwent a detailed physical examination and their laboratory examinations. CURB-65 score was computed after receiving laboratory reports. On day 3 their laboratory investigations were repeated as per hospital protocol and CURB-65 was recalculated.

Results: A total of 163 patients were studied with mean age of 39.6 ± 6.3 years. Around three-fourth of patients were males (72.4%). Out of 163 patients, 73 (44.7%) patients had hypophosphatemia. At day 1, there was significant moderate negative correlation between the two variables (r=-.46, p p<0.001). At day3, the two variables were significantly inversely related at day 3 but with weak correlation (r=-0.378, p<0.001).

Conclusion: A substantial proportion of patients had hypophosphatemia on admission. The correlation between phosphorous levels and CURB-65 score was significant more strong at day 1 than day 3 indicating improvement in patients' condition at day 3.

Keywords: Community-acquired pneumonia, Hypophosphatemia, CURB-65 score, Intensive care unit, Tertiary care.

INTRODUCTION

Hospital-acquired pneumonia (HAP) and community-acquired pneumonia (CAP) are the two classifications for acute respiratory diseases such as pneumonia (1). CAP, an acute sickness that raises the risk of major health problems, unplanned hospitalisation, and increased medical expenses due to morbidity and mortality, is brought on by a lung parenchymal infection that is acquired outside of a hospital (2,3). As disease presentation might vary from a minor condition that can be handled as an ambulatory to a serious illness that requires management in the high alert areas, prompt recognition and choosing the relevant care level are essential for enhancing outcomes (4,5). Season, region, and demographic features all influence the expected worldwide CAP varing between 1.5-14 cases per thousand person-years (6).

The CURB-65 score may be used to stratify vulnerable patients for CAP. The score utilises patient data that is often already available, is simple to compute, and provides a solid risk classification for CAP. It may also promote better use of resources and beginning of

treatment (7). The CURB-65 is a severity score for CAP, with one point given for each of the five variables including age of 65 years or above, respiration rate ≥30 mmHg, urea >7 mmol/L, systolic blood pressure <90 mmHg and/or diastolic blood pressure ≤60 mmHg, and sudden disorientation. The score also predicts 30-day death in CAP patients (8).

Phosphate is an essential electrolyte in humans, accounting for approximately 1% of body weight (9). Phosphate is necessary for a number of physiological functions, such as skeletal development and mineralisation, membrane composition, nucleotide structure, cellular signalling, energy storage and transfer, and the preservation of the acid-base balance (10). Hypophosphatemia (Hypop) affects approximately 5% of hospitalised patients with infections, regardless of sepsis (65–80%), and those admitted to intensive-care units (20–64%) (11,12).

Hypophosphatemia has been connected in the literature to morbidity, mortality, and the duration of mechanical ventilation, despite divergent findings and a failure to control for confounding factors (13–15). Because hypophosphatemia can be caused by lesser intestinal absorption, higher renal excretion, reduced intake, or intracellular shifts, it can result in Systemic abnormalities such as respiratory failure, digestive function, rhabdomyolysis, hematological and neurological disorders, and arrhythmias (16). As a result, it might be connected to the CURB-65 score.

Examining the relationship between serum phosphate levels and the CURB-65 score can help physicians anticipate patients' survival during the course of their illness. In the light of available literature, only one study has examined the relationship between CAP patients' serum phosphate levels and CURB-65 score. Therefore, in order to provide more proof of the relationship between the two variables in our local contexts, we designed the current study with the goal of determining the prevalence of hypophosphatemia and the correlation between serum phosphate levels and CURB-65 score in CAP in intensive care unit patients in a tertiary care hospital

METHODOLOGY

This observational study was executed by Pulmonology Department in Liaquat National Hospital. The study was commenced with the formal approval of the hospital ethics committee (IRB). The study included patients of either gender of age range 18-70 years, having pulmonary infiltrate on initial chest X ray at admission with any of the sign; cough with mucopurulent or hemoptic sputum, axillary temperature >37.5 degree Celsius, and providing consent to participate. Patients with ongoing pulmonary tuberculosis, malignancy, significantly immunocompromised, parathyroid disease, renal tubular acidosis, inosocomial infection, inon-infectious interstitial lung disease, ipulmonary embolism, and diabetic ketoacidosis were excluded.

Previously conducted study reported that hypophosphatemia was seen in 12% pneumonia patients (17). Using 95% confidence interval and 5% margin of error, a sample size came out to be 163. Open-Epi calculator was used to estimate sample size. An approach of inon-probability iconsecutive isampling iitechnique was used to enlist study subjects. iPatients were enlisted with their informed consent.

Patients suspected of having CAP were admitted from emergency rooms or outpatient clinics to critical care units. Patients had a thorough physical examination, laboratory testing (including serum phosphate levels), and imaging upon their admission. Following the receipt of laboratory reports, the CURB-65 score was calculated. On the third day, CURB-65 was recalculated and their laboratory tests were performed in accordance with hospital practice. The CAP severity was determined by the CURB-65 scores. The instrument evaluates five elements, each of which is assigned a binary score of one or zero. The sum of these scores yields an overall score ranging from 0 to 5. The five criteria are: iage ≥65 years, isystolic blood pressure <90 mm Hg or idiastolic blood pressure ≥60 mm Hg, iRR ≥30 breaths/min, iblood urea level >7 mmol/L, and the presence of disorientation. A score of > 2 indicates severe CAP, while a score of 0–1 indicates mild to moderate CAP (18). Normal range of serum phosphate levels was ≥3.5–<6.0 mg/dL.

Data was entered into SPSS version 27 for statistical analysis. Categorical variables were presented as frequency and percentages. Numerical variables were summarized as mean ± standard deviation after testing normality assumption with Shapiro-Wilk test. At day 1 and day 3 hypophosphatenia was compared using McNemar's test. Pearson correlation was computed to assess the correlation between CURB-65 score and phosphorous levels. P-value less than or equal to 0.05 was taken as statistically significant.

RESULTS

Mean age of 39.6 ± 6.3 years. Age range was 18-65 years. Around three-fourth of patients were males (72.4%). Nearly one-fifth were diabetic (22.1, n=36%) and quarter of them were hypertensive (25.1%, n=41). One-fifth were smokers (20.2%, n=33) (Table 1).

Table 1. Summary of sociodemographic and clinical features

Variables	Frequency	Percentage
Age (in years)		
18-19	18	11.0
20-29	25	15.3
30-39	36	22.1
40-49	47	28.8
50-59	22	13.5
60 and above	15	9.2

Gender		
Male	118	72.4
Female	45	27.6
Residence		
Urban	98	60.1
Rural	65	39.9
Smoking status		
Smoker	33	20.2
Non-smoker	130	79.8

Table below depicts laboratory and clinical parameters at baseline and day 3. TLC count (p=0.004), urea levels (p=0.046) and CURB-65score were significantly reduced at day 3 than at day 1 (Table 2).

Table 2. Laboratory and clinical parameters at baseline and day 3

Variables	Day 1	Day 3	p-value
Hemoglobin (g/dL)	11.5 ± 1.7	11.4 ± 1.2	0.213
Total leukocyte count (109/L)	13.4 ± 5.2	11.1 ± 4.7	0.004
Urea (mg/dL)	52.3 ± 28.6	48.5 ± 25.9	0.046
Serum phosphate (mg/dL)	2.6 ± 0.9	3.1 ± 0.8	<0.001
Curb-65 score	2.3 ± 0.9	1.9 ± 1.0	<0.001

Out of 163 patients, 73 (44.7%) patients had hypophosphatemia. At day 3, hypophosphatemia significantly decreased to almost 20% was seen in 41(25.1%) patients (p<0.001) (Table 3).

Table 3. Hypophosphatemia burden on day 1 and day 3

Phosphate level Day 3	Phosphate level Day 1	
	Hypophosphatemia	Normal
Hypophosphatemia	36	5
Normal	37	85

Table below outlines correlation of serum phosphate levels at CURB-65 score at day 1 and day 3. At day 1, there was significant moderate negative correlation between the two variables (r=-.46, p p<0.001). At day3, the two variables were significantly inversely related at day 3 but with weak correlation (r=--0.378, p<0.001) (Table 4).

Table 4 Correlation of serum phosphate levels at CURB-65 score at day 1 and day 3

Variables	Serum phosphate at day 1	Serum phosphate at day 3	CURB-65 score at day 1	Curb-65 score at day 3
Serum phosphate at day 1	1.00		r=-0.46, p<0.001	-
Serum phosphate at day 3	-	1.00	-	r=-0.378, p<0.001
CURB-65 score at day 1	r=-0.46, p<0.001	-	1.00	-
Curb-65 score at day 3	-	r=-0.378, p<0.001	-	1.00

DISCUSSION

Phosphate has pivotal role in the cellular metabolism, energy production and skeletal health (19). It has been established through researches that serum phosphate was related with the quantity and functional capability of the immune cells specifically the granulocytes. Low serum phosphate levels were found to have low number of granulocytes, impaired the phagocytic property, hence leading to compromised immune activity and delayed infection clearance (20). Patients with hypophosphatemia usually present due to intracellular redistribution (refeeding syndrome, drug reaction, respiratory alkalosis), chronic illness, increased renal excretion, and losses due to renal replacement therapies (RRT/CRRT) (21-24). In cancer patients the hypophosphatemia is due to malignancy, cancer therapies, and paraneoplastic syndrome (25). The hypophosphatemia prevalence among hospital-admitted patients varying from 45%-80% of patients having RRT/CRRT, 20-80% of ICU-admitted patients, 22.9-40% of cancer patients, and 19.7-49.2% of pediatrics. These patients were found to have increased hospital stays, respiratory failure, and high mortality (22,24-26). Our study included total of 163 patients among which more than half were adult males. This study we studied the serum phosphate levels and related them with the CRUB-65 score of patients having CAP. As we studied the serum phosphate level of first and third day of admission in hospital, we found that hypophosphatemia (< 3.5 mg/dL [< 1.13 mmol/L]), was significantly inversely connected with moderate regression on first day and weak regression on third day. There are various studies done to study its pathophysiology which in involves the inflammatory reaction, respiratory alkalosis from hyperventilation, sepsis and cytokine effects. As in acute inflammatory reaction like pneumonia involving various immune cells especially neutrophils and macrophage become highly

metabolically active consuming large amount of ATP, and phosphate causing extracellular potassium shift into the cells causing decrease in the extracellular phosphate levels (27). As the lung parenchyma is involved in the pneumonia causing altered ventilation leading to tachypnea which leads to respiratory alkalosis which stimulates phosphofructokinase, which drives glycolysis and intracellular phosphate uptake causing hypophosphatemia (28).Sepsis and cytokine effect is also presented a possible chain reaction as it is reported that up to 40 to 60 % of sepsis is originate from pneumonia (29).Release of various systemic inflammatory mediators and cytokines (especially cytokine 6) increases the renal excretion of phosphate (30).Sepsis also stimulates the release of PTH and growth factors like and fibroblast growth factor-23 (FGF-23) both causing phosphaturia leading to hypophosphatemia (31).Other minor causes include malnutrition secondary to illness and drug reactions (32,33). A study found that low phosphate levels were significantly associated with a high CURB-65 score and linked to poor immune function, which worsened infection outcomes and prognosis. Additionally, this study reported that high phosphate levels were also associated with poor prognosis because elevated serum phosphates react with free serum calcium, leading to precipitation in soft tissue, calcification of the lung parenchyma, and worsening symptoms. However, in our study, only patients reported hypophosphatemia (27). Another study, which included 1936 participants, found that the mortality rate for hypophosphatemia was 11.1% and hyperphosphatemia was 18%, which signifies the importance of serum phosphate levels as a predictor for poor mortality and morbidity (34).

A study from Indiarelated, the serum phosphate levels with the CURB-65 score on first and third day of hospital admission among CAP patients. Reported to have a significant difference between the high and low serum phosphate level and CURB-65 score, which further strengthens our results that the difference signifies that the decrease in phosphate was found to be significantly inversely associated with a high CURB-65 score and poor prognosis. However, in our study we found only hypophosphatemia among our patients. Secondly, we found that patients had a weak correlation among the variables on day 3, which is due to patients improving phosphate levels due to treatment (27). In our study majority were adult males with less comorbidities, which limits the various other cofounding variables. Future studies require to study CAP patients with multimorbidity to determine the disease presentation in it. Large multicentred cohort studies needed to be conducted to study the actual causal effect. Studies should have serial timings since the hospital admission like 24 hours and 72-hour sampling to have a generalize sampling. To including variables for intracellular storage and functional measure of phosphate like respiratory muscle strength, ABG, 2,3-BPG proxy to study the effects at the cellular level.

This study highlights the importance of serum phosphate level as a potential marker of prognosis and mortality in CAP patients, which warrants further studies to be conducted as multicenter large cohort studies to validate its predictive value and explore the underlying pathophysiology.

Limitations

This study was executed in a single center and on a small population, making it a non-generalizable study population. The sampling was random, and therefore did not reflect the dynamic change, unlike serial measurement. Serum phosphate levels were studied and only poorly reflect the intracellular storage and functional measures of phosphate levels. Various confounding variables (malnutrition disease, drug side effects, renal dysfunction, severity of sepsis, and comorbidities) were not highlighted, like which drugs the patients were on, as certain antibiotics like aminoglycosides cause hypophosphatemia, or whether any diabetic patients have taken insulin, which causes hypophosphatemia due to intracellular shift. We associated the phosphate levels with the CURB-65 score; however, ICU, ward and outpatient department patients should be studied separately, further analysing each patient with their duration, type of ventilator assistance, and patient response.

CONCLUSION

A substantial proportion of patients had hypophosphatemia on admission. The correlation between phosphorous levels and CURB-65 score was significant more strong at day 1 than day 3 indicating improvement in patients' condition at day 3.

REFERENCES

1. Torres A, Cilloniz C, Niederman MS, Menendez R, Chalmers JD, Wunderink RG, et al. Pneumonia. Nat Rev Dis Primers. 2021;7:25.
2. Cavallazzi R, Furmanek S, Arnold FW, Beavin LA, Wunderink RG, Niederman MS, et al. The Burden of Community-Acquired Pneumonia requiring admission to ICU in the United States. Chest. 2020;158:1008–16.
3. Regunath H, Oba Y. Community-Acquired Pneumonia. [Updated 2024 Jan 26]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK430749/
4. Lu H, Zeng N, Chen Q, Wu Y, Cai S, Li G, et al. Clinical prognostic significance of serum high mobility group box-1 protein in patients with community-acquired pneumonia. J Int Med Res. 2019;47(3):1232-40
5. Hassen M, Toma A, Tesfay M, Degafu E, Bekele S, Ayalew F, Gedefaw A, Tadesse BT. Radiologic Diagnosis and Hospitalization among Children with Severe Community Acquired Pneumonia: A Prospective Cohort Study. Biomed Res Int. 2019;2019:6202405.

6. Tsoumani E, Carter JA, Salomonsson S, Stephens JM, Bencina G. Clinical, economic, and humanistic burden of community acquired pneumonia in Europe: a systematic literature review. Expert Rev Vaccines. 2023;22(1):876-84.
7. Patel S. Calculated decisions: CURB-65 score for pneumonia severity. Emerg Med Pract. 2021;23(Suppl 2):CD1-CD2.
8. Lim WS, EerdenMM van der, Laing R, Boersma WG, Karalus N, Town GI. Defining community acquired pneumonia severity on presentation to hospital: an international derivation and validation study. Thorax. 2003;58(5):377–82.
9. Qadeer HA, Bashir K. Physiology, Phosphate. [Updated 2023 Aug 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560925/
10. Florenzano P, Cipriani C, Roszko KL, Fukumoto S, Collins MT, Minisola S, Pepe J. Approach to patients with hypophosphataemia. Lancet Diabetes Endocrinol. 2020;8(2):163-74.
11. Gaasbeek A, Meinders AE. Hypophosphatemia: an update on its etiology and treatment. Am J Med. 2005;118(10):1094-101.
12. ReintamBlaser A, Gunst J, Ichai C, Casaer MP, Benstoem C, Besch G, Dauger S, et al. Hypophosphatemia in critically ill adults and children—A systematic review. ClinNutr 2021;40(4):1744-54.
13. Sin JCK, King L, Ballard E, Llewellyn S, Laupland KB, Tabah A. Hypophosphatemia and outcomes in ICU: A systematic review and meta-analysis. J Intensive Care Med. 2021;36(9):1025-35.
14. Wang L, Xiao C, Chen L, Zhang X, Kou Q. Impact of hypophosphatemia on outcome of patients in intensive care unit: a retrospective cohort study. BMC Anesthesiol. 2019;19(1):86.
15. Broman M, Wilsson AMJ, Hansson F, Klarin B. Analysis of Hypo- and Hyperphosphatemia in an Intensive Care Unit Cohort. AnesthAnalg. 2017;124(6):1897-1905.
16. Wozniak H, Dos Santos Rocha A, Beckmann TS, Larpin C, Buetti N, Quintard H, et al. Hypophosphatemia on ICU admission is associated with an increased length of stay in the ICU and time under mechanical ventilation. J Clin Med. 2022;11(3):581.
17. United States Public Health Service Office of the Surgeon General; National Center for Chronic Disease Prevention and Health Promotion (US) Office on Smoking and Health. Smoking Cessation: A Report of the Surgeon General [Internet]. Washington (DC): US Department of Health and Human Services; 2020. Chapter 2, Patterns of Smoking Cessation Among U.S. Adults, Young Adults, and Youth. Available from: https://www.ncbi.nlm.nih.gov/books/NBK555598/
18. Jones BE, Jones J, Bewick T, Lim WS, Aronsky D, Brown SM, et al. CURB-65 pneumonia severity assessment adapted for electronic decision support. Chest. 2011;140(1):156-63.
19. Qadeer HA, Bashir K. Physiology, phosphate [Internet]. StatPearls - NCBI Bookshelf. 2023. Available from: https://www.ncbi.nlm.nih.gov/books/NBK560925/
20. Huang, W., Liu, H., Yang, S., Song, H., Cai, W., Tan, B., Zhang, S., Yang, Y., Zhang, H., & Dong, X. (2024). Impacts of dietary phosphorus level on growth, antioxidant capacity and immunity in juvenile hybrid grouper (Epinephelusfuscoguttatus♀× E. lanceolatus♂) fed with high-lipid diets. Aquaculture Reports, 35, 101958. https://doi.org/10.1016/j.aqrep.2024.101958
21. Seers, T., & Davenport, R. (2020). Phosphate metabolism and respiratory alkalosis: a forgotten lesson in COVID-19. Age and Ageing. https://doi.org/10.1093/ageing/afaa176
22. Bsar, A., El-Wakiel, S., El-Harrisi, M., &Elshafei, A. (2023). Frequency and Risk Factors of Hypophosphatemia in Patients Admitted to Emergency Intensive Care Unit in Zagazig University Hospitals. Indian Journal of Critical Care Medicine : Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine, 27, 277 - 282. https://doi.org/10.5005/jp-journals-10071-24431
23. Demirjian, S., Teo, B., Guzman, J., Heyka, R., Paganini, E., Fissell, W., Schold, J., & Schreiber, M. (2011). Hypophosphatemia during continuous hemodialysis is associated with prolonged respiratory failure in patients with acute kidney injury..Nephrology, dialysis, transplantation : official publication of the European Dialysis and Transplant Association - European Renal Association, 26 11, 3508-14. https://doi.org/10.1093/ndt/gfr075
24. Hendrix, R., Hastings, M., Samarin, M., & Hudson, J. (2020). Predictors of Hypophosphatemia and Outcomes during Continuous Renal Replacement Therapy. Blood Purification, 49, 700 - 707. https://doi.org/10.1159/000507421
25. Adhikari, S., Mamlouk, O., Rondon-Berrios, H., &Workeneh, B. (2021). Hypophosphatemia in cancer patients. Clinical Kidney Journal, 14, 2304 - 2315. https://doi.org/10.1093/ckj/sfab078
26. Milman, Y., Landau, D., Lebel, A., Levinsky, Y., Marcus, N., Chezana, A., & Ashkenazi-Hoffnung, L. (2024). Differential Serum Phosphate Levels in Pediatric Febrile Syndromes and Their Clinical Significance. The Pediatric Infectious Disease Journal, 43, 1100 - 1105. https://doi.org/10.1097/INF.0000000000004471
27. Gurav, N. A., Rajanna, A. H., Hoskera, S. B., & Kr, R. (2021). A study of serum phosphate levels and its correlation with curb-65 score in community acquired pneumonia. Asian Journal of Medical Sciences, 12(5), 58–64. https://doi.org/10.3126/ajms.v12i5.34108