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Correlation of Preoperative Inorganic Phosphates and Operative Findings in Patients of Intestinal Obstruction: A Preliminary Prospective Observational Study

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Abstract: ***Background: Identifying intestinal ischemia in small-bowel obstruction (SBO) remains a diagnostic challenge. We evaluated whether serum inorganic phosphate measured before surgery correlates with intraoperative evidence of bowel ischemia in a pilot cohort. Methods: This prospective observational study was conducted at a tertiary center in India over 18 months. Adults (18–70 years) with clinically diagnosed SBO were enrolled (n=54). Admission serum inorganic phosphate (mg/dL) was recorded. Ischemia was assessed intraoperatively based on visual inspection. Associations were examined using chi-square, t-tests, and ROC analysis. Results: Among 54 participants, ischemia was confirmed in 18.9% (n=10). Mean phosphate was significantly higher in patients with ischemia (4.75 mg/dL) than in those without (3.48 mg/dL). A threshold of >3.5 mg/dL provided the best separation in this cohort, with an ROC AUC of 0.727 (95% CI 0.589–0.840). However, false positives were noted, with elevated phosphate seen in some non-ischemic patients. Conclusions: Elevated preoperative inorganic phosphate is associated with operative ischemia in SBO and may assist triage and decision-making. Larger cohorts should validate cutoffs and clinical integration.***

Keywords: Small-bowel obstruction, Intestinal ischemia, Serum phosphate, Biomarker, Emergency surgery

1. Introduction

Acute intestinal ischemia complicating small-bowel obstruction (SBO) is a time-critical diagnosis linked with considerable mortality [1]. Mechanical obstruction accounts for a large fraction of emergency surgical admissions, and differentiating viable bowel from segments at risk of necrosis is central to management [2]. While computed tomography (CT) improves diagnostic confidence, it may miss evolving ischemic changes [3, 4]. Consequently, low-cost laboratory biomarkers have been investigated to complement clinical and imaging assessment [5].

Inorganic phosphate, a ubiquitous intracellular anion, may rise in the circulation with ischemic cellular injury and membrane breakdown, offering a potential signal of compromised bowel [6]. This pilot study examines whether admission serum inorganic phosphate levels are associated with intraoperative confirmation of bowel ischemia in adults presenting with SBO to determine its utility as a screening adjunct.

2. Methods

Design and Setting: A prospective observational study conducted over 18 months at a tertiary-care hospital in India.

Participants: Adults aged 18–70 years with clinical features of SBO persisting \ge6 hours were eligible. Exclusion criteria included pregnancy, age <18 years, severe physiological instability, lack of consent, or inability to adhere to follow-up. A convenience sample of 54 patients was enrolled.

Variables and Measurements:

- **Biochemical:** Admission serum inorganic phosphate (mg/dL) was measured using standard biochemical methods.
- **Outcome:** The primary outcome was intraoperative determination of bowel ischemia.
- **Grading:** Severity of obstruction and ischemia was categorized using the American Association for the Surgery of Trauma (AAST) grading system for SBO [7].

Statistical Analysis: Phosphate was analyzed as a continuous variable; ischemia was treated as a binary outcome. Group comparisons used chi-square and two-sample t-tests ($p<0.05$). ROC analysis with the Youden index identified potential cutoffs.

3. Results

Demographics: The cohort included 54 patients (54.7% male, 45.3% female). The most common age band was 51–65 years (48.1%).

Operative Findings: Bowel ischemia was identified in 10 patients (18.9%).

Phosphate Levels and Association: Patients with ischemia showed significantly higher mean serum phosphate (4.75 mg/dL) compared to those without (3.48 mg/dL) ($\chi^{2}=5.89$, $p=0.015$).

Diagnostic Performance & Thresholds: ROC analysis yielded an AUC of 0.727 (95% CI 0.589–0.840; p=0.0206), indicating moderate discrimination.

- **Cutoff Analysis:** A threshold near >3.5 mg/dL distinguished cases in this cohort.
- **High-Risk Category:** Using a stricter cutoff of >=4.5 mg/dL, logistic regression indicated higher odds of ischemia (adjusted OR 5.20; p=0.019). However, false positives were present; 6 out of 14 patients with phosphate >=4.5 mg/dL did not have ischemia.

Table 1: AAST grading framework for small-bowel obstruction

Grade	Summary description	Radiologic features	Operative features
I	Partial obstruction	Mild distension	Mild distension; no frank obstruction
II	Complete obstruction; bowel viable	Dilated loops with transition point; no compromise	Transition point without evidence of compromise
III	Complete obstruction with threatened but viable bowel	Dilated loops; absent distal contrast	Impending compromise noted intraoperatively
IV	Complete obstruction with non-viable bowel or perforation	Local perforation or free air evident	Perforation or free fluid with non-viable bowel
V	Perforation with diffuse peritoneal contamination	Free air and free fluid	Diffuse peritonitis with perforation and free fluid

Table 2: Distribution of presenting complaints

Presenting complaint	Count	% of cohort
Pain abdomen with distension	12	22.6%
Pain abdomen with vomiting	14	26.4%
Pain abdomen with constipation	18	34.0%
Abdominal distension only	9	17.0%

Table 3: Intraoperative ischemia frequency

Ischemia	Count	% of cohort
Yes	10	18.9%
No	44	81.1%

Area under the ROC curve (AUC)

AUC	0.727
Standard error	0.0981
95% confidence interval	0.589–0.840
z statistic	2.316
Significance (Area=0.5)	0.0206

Odds of ischemia by serum phosphorus category

Sr. phosphorus category	Ischemia (No)	Ischemia (Yes)	Total
<4.5	35 (87.50%)	5 (12.50%)	40 (100%)
≥4.5	8 (57.14%)	6 (42.86%)	14 (100%)
Total	44 (81.1%)	10 (18.9%)	54 (100%)

4. Discussion

This prospective pilot study demonstrates a statistically significant association between higher admission serum inorganic phosphate and intraoperative bowel ischemia. These findings support the concept that phosphate may leak into circulation during ischemic cell injury [1, 6, 8].

Clinical Utility:
Given the limitations of clinical examination and the imperfect sensitivity of imaging for early ischemia [3, 4, 9], a simple laboratory marker has practical appeal [10]. Our results align with reports suggesting improved discrimination when metabolic parameters are incorporated into evaluation pathways [5, 6]. However, the AUC of 0.727 indicates only moderate performance. Thus, phosphate should not be used in isolation but can raise suspicion and expedite decision-making [9].

5. Limitations

We did not observe significant effects of age or sex, consistent with the notion that demographic factors provide limited guidance [11]. However, this study has notable limitations:

1) **Confounding Factors:** Serum phosphate is influenced by renal function and dietary intake [12]. We did not control for baseline renal function, which is a significant confounder.
2) **Sample Size:** The modest sample size (n=54) limits generalizability.
3) **Subjectivity:** Intraoperative grading introduces inter-observer variability.

6. Conclusion

Admission serum inorganic phosphate is associated with intraoperative bowel ischemia. While not definitive, it may function as a practical red flag to prioritize advanced imaging or surgical review [5, 14]. Timely recognition dictates operative strategy [13], and integrating this inexpensive test may assist in triaging patients.

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Conflict of Interest
None declared.

Data Availability Statement
De-identified data can be shared on reasonable request to the corresponding author.

Author Contributions
Conceptualization: Dr. Mouni Vihanth Reddy; Methodology: Dr. Sudhir Shinde.

Declarations

Ethics approval and consent to participate- Prospective observational study at a tertiary center in India. Institutional Ethics Committee approval was obtained (Reference: BDUMC/IEC/23). Written informed consent was collected from all participants.

Consent for publication: Not applicable.

Availability of data and materials:
Datasets supporting this article are available from the corresponding author upon reasonable request.

Competing interests
The authors declare no competing interests.

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Authors' Contributions
Dr. Mouni Vihanth Reddy conceived the study, oversaw data collection and analysis, and drafted the manuscript.
Dr. Sudhir Shinde contributed to methodology and critical review. All authors read and approved the final version.

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