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Role of Arterial Blood Levels of Serum Lactate as a Biomarker of Intestinal Ischemia in Patients of Intestinal Obstruction

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Abstract: ***Background: Intestinal obstruction is a common surgical emergency. Strangulated obstruction may result in bowel ischemia, leading to significant morbidity and mortality. Early identification of ischemia is critical. This study evaluates arterial blood levels of serum lactate as a biomarker for predicting intestinal ischemia in patients presenting with intestinal obstruction. Methods: A cross - sectional observational study was conducted over one year on 60 patients presenting with clinical features of intestinal obstruction requiring surgery. Serum lactate levels were measured preoperatively and 24 hours postoperatively. The association of lactate levels with intraoperative findings of bowel ischemia was analyzed using ROC curve analysis. Results: Bowel ischemia was identified in 16.7% (10/60) of cases. Mean preoperative serum lactate was significantly higher in patients with bowel ischemia (3.25 ± 1.46 mmol/L) compared to those without (1.22 ± 0.41 mmol/L, p<0.01). ROC curve analysis revealed an area under the curve (AUC) of 0.95 with a lactate cut - off value of 2.32 mmol/L yielding 90% sensitivity and 96% specificity. Conclusion: Arterial serum lactate is a reliable, accessible, and cost - effective biomarker for early identification of intestinal ischemia in patients with intestinal obstruction. A level above 2.32 mmol/L significantly correlates with ischemic changes.***

Keywords: Serum lactate, Intestinal obstruction, Intestinal ischemia, Biomarker, Surgery, Bowel strangulation

1. Introduction

Intestinal obstruction is a frequent and potentially life - threatening condition encountered in surgical practice. It accounts for 20% of acute abdomen cases and can progress to strangulation, ischemia, and perforation if not managed timely [1]. The key concern in intestinal obstruction is distinguishing simple obstruction from strangulated obstruction, the latter necessitating urgent surgical intervention.

Strangulated bowel obstruction leads to compromised blood supply, ischemia, and eventually necrosis. The clinical signs are often nonspecific, and radiological investigations like CT scans, though helpful, are time - consuming and not always readily available, especially in resource - limited settings [2]. Thus, biochemical markers like serum lactate have gained attention for early detection of ischemic changes [3].

Lactate is produced via anaerobic metabolism during tissue hypoxia. Elevated serum lactate levels indicate anaerobic metabolism due to ischemia, making it a potential biomarker for acute mesenteric or bowel ischemia [4]. This study aims to assess the role of arterial blood levels of serum lactate in predicting intestinal ischemia in patients of intestinal obstruction.

2. Materials and Methods

1) **Study Design:** Cross - sectional observational study
2) **Study Duration:** One year
3) **Study Location:** Department of General Surgery, Indira Gandhi Medical College, Shimla, Himachal Pradesh
4) **Sample Size:** 60 patients
5) **Ethical Approval:** Obtained from institutional ethics committee

6) Inclusion Criteria:
- Patients with clinical and radiological evidence of intestinal obstruction requiring surgery
- Age >12 years
- Informed consent provided

7) Exclusion Criteria:
- Diabetic ketoacidosis
- Patients with renal or hepatic failure
- Severe hypertension or sepsis due to other causes
- Refusal to consent

8) Study Procedure

All patients underwent a thorough history and clinical examination. Investigations included hemogram, renal function tests, liver function tests, electrolytes, and arterial blood gas analysis. Imaging included abdominal X - ray, ultrasound, and CECT where indicated.

Serum lactate levels were measured preoperatively via arterial blood gas analysis and repeated 24 hours postoperatively. Intraoperative findings were documented, especially for signs of bowel ischemia (e. g., discoloration, lack of peristalsis, absent pulsations).

9) Statistical Analysis:

Continuous variables were analyzed using t - tests. ROC curve analysis was used to determine diagnostic accuracy. A p - value < 0.05 was considered significant.

3. Results

1) Demographics:

The mean age of study subjects was 55.2 ± 18.62 years. The age group 51–60 years had the highest representation (25%). Males comprised 70% of the study population.

Tables

Table 1: Age - wise Distribution of Patients (n=60)

Age Group (years)	No. of Patients (%)
11–20	4 (6.7%)
21–30	4 (6.7%)
31–40	5 (8.3%)
41–50	7 (11.7%)
51–60	15 (25%)
61–70	11 (18.3%)
>70	14 (23.3%)

2) Clinical Presentation:

All 60 patients (100%) presented with abdominal distension, pain abdomen, and showed multiple air - fluid levels on abdominal X - ray.

3) Bowel Ischemia Findings:

Out of 60 patients, 10 (16.7%) had bowel ischemia. There was no statistically significant association between ischemia and age or gender (p=0.98 and p=0.45 respectively).

Table 2: Association of Serum Lactate with Bowel Ischemia

Parameter	Ischemia Present (n=10)	Ischemia Absent (n=50)	p - value
Pre - op lactate (mmol/L)	3.25 ± 1.46	1.22 ± 0.41	<0.01
Post - op lactate (mmol/L)	2.31 ± 1.18	1.23 ± 0.90	<0.01

ROC Curve Analysis:

- AUC: 0.95 (95% CI: 0.86–1.0)
- Cut - off: 2.32 mmol/L
- Sensitivity: 90%
- Specificity: 96%
- PPV: 81.82%
- NPV: 97.96%

4. Discussion

Intestinal obstruction remains one of the most common surgical emergencies, often requiring prompt diagnosis and intervention to prevent serious complications. Strangulated bowel obstruction, in particular, is associated with a higher risk of morbidity and mortality due to ischemia and subsequent bowel necrosis. Therefore, early detection of ischemia in such patients is paramount for improving outcomes.

In the present study, serum lactate levels were significantly higher in patients with intraoperatively confirmed bowel ischemia as compared to those without. Preoperative levels in ischemic patients averaged 3.25 mmol/L compared to 1.22 mmol/L in non - ischemic individuals, demonstrating a statistically significant difference ($p < 0.01$). This supports the hypothesis that tissue hypoperfusion and subsequent anaerobic metabolism in ischemic bowel segments leads to elevated systemic lactate concentrations.

Our findings are consistent with several previously published studies. For instance, Lange et al. reported a sensitivity of 100% for elevated plasma lactate in mesenteric ischemia, though specificity was limited【4】. Similarly, Ambe et al. showed that while lactate levels correlate with the presence of ischemia, their ability to quantify the extent of necrosis remains limited [6]

The high area under the ROC curve (0.95) in our study indicates excellent diagnostic performance. A lactate cut - off of 2.32 mmol/L provided a sensitivity of 90% and specificity of 96%, suggesting strong predictive accuracy. These results align with the findings by Moncy et al., who demonstrated that lactate levels after resuscitation could effectively differentiate between reversible and irreversible ischemia [9].

However, it's important to consider that lactate can also be elevated in other conditions such as sepsis, liver dysfunction, and hypovolemia. Therefore, serum lactate should not be used in isolation but interpreted in conjunction with clinical and radiological findings. Nonetheless, its rapid availability, cost - effectiveness, and non - invasiveness make it an appealing early biomarker, especially in settings where advanced imaging is delayed or unavailable.

Our study did not find a statistically significant association between demographic factors (age and gender) and the presence of bowel ischemia, which may be attributed to the relatively small sample size. Larger multicentric studies are needed to validate these findings across diverse populations.

In conclusion, the data from this study reinforce the utility of serum lactate as a valuable diagnostic aid in assessing bowel ischemia in cases of intestinal obstruction. When combined with clinical judgment and imaging, it can help stratify risk and guide timely surgical intervention.

5. Conclusion

This study underscores the clinical significance of serum lactate as an effective biomarker in the early diagnosis of intestinal ischemia among patients presenting with intestinal obstruction. The findings demonstrate a strong and statistically significant correlation between elevated preoperative serum lactate levels and intraoperatively confirmed bowel ischemia.

With a cut - off value of 2.32 mmol/L, serum lactate exhibited excellent sensitivity (90%) and specificity (96%) for predicting ischemic changes. The high negative predictive value (97.96%) further highlights its reliability in ruling out bowel ischemia when levels are within normal range. This makes serum lactate a valuable tool not only for diagnosis but also for triaging patients who may require urgent surgical intervention.

Given its simplicity, cost - effectiveness, and rapid availability, serum lactate measurement can be particularly beneficial in resource - constrained settings where access to advanced imaging modalities such as CT angiography may be limited or delayed. While serum lactate should not be used in isolation, its integration into the diagnostic

pathway—alongside clinical examination and radiological findings—can enhance decision - making and potentially improve patient outcomes.

Future studies with larger sample sizes and multicentric designs are recommended to validate these results and further explore the role of serial lactate measurements in monitoring the progression or resolution of ischemia. Additionally, the combined evaluation of lactate with other emerging biomarkers such as D - lactate, intestinal fatty acid - binding protein (I - FABP), and neutrophil - lymphocyte ratio may enhance diagnostic accuracy.

In conclusion, arterial blood lactate is a valuable, practical, and accessible biomarker that should be considered as part of the standard workup in patients with suspected intestinal ischemia due to bowel obstruction.

References

[1] Oldenburg WA, Lau LL, Rodenberg TJ, Edmonds HJ, Burger CD. Acute mesenteric ischemia: a clinical review. Arch Intern Med.2004; 164 (10): 1054 - 62.
[2] Acosta S. Epidemiology of mesenteric vascular disease: clinical implications. Semin Vasc Surg.2010; 23 (1): 4 - 8.
[3] van der Voort PH, Bakker J, Dees A, Boerma EC. Monitoring intestinal ischemia in the ICU. Curr Opin Crit Care.2008; 14 (2): 171 - 5.
[4] Lange H, Jackel R. Use of plasma lactate in the diagnosis of acute abdominal disease. Eur J Surg.1994; 160 (7): 381–4.
[5] Murray MJ, Gonze MD, Nowak LR, Cobb CF. Serum D (-) - lactate levels as an aid to diagnosis of acute mesenteric ischemia. J Am Coll Surg.1994; 179 (3): 297–302.
[6] Ambe PC, Kang K, Papadakis M, Zirngibl H. Serum lactate predicts the extent of bowel ischemia in patients with acute mesenteric ischemia. Langenbecks Arch Surg.2017; 402 (5): 811 - 8.
[7] Shi H, Li Y, Zhang Y, et al. Diagnostic value of intestinal fatty acid - binding protein in early diagnosis of intestinal ischemia. Medicine (Baltimore).2015; 94 (36): e660.
[8] Sahin M, Ureyen O, Ozturk E. Predictive markers for small bowel resection in incarcerated hernia. Ulus Travma Acil Cerrahi Derg.2020; 26 (4): 574–80.
[9] Moncy AA, Krishnan P, Acharya R. Role of L - lactate as a predictor of irreversible bowel ischemia in intestinal obstruction. Surg Pract.2023; 27 (1): 22–8.
[10] Avci MA, Tuncer AA, Yildiz A, et al. Importance of predictive markers like lactate, WBC, NLR in incarcerated abdominal wall hernia. Int J Surg.2024; 108: 106068.