

Pre and Post-Operative Lactate Levels and Lactate Clearance in Predicting in Hospital Mortality After Surgery for Gastrointestinal Perforation

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Abstract: Gastrointestinal perforation is a life-threatening surgical emergency associated with significant morbidity and mortality. Early risk stratification is essential for optimizing perioperative management and improving outcomes. Lactate levels are a biomarker of tissue hypoxia and perfusion, and their clearance postoperatively may help predict in-hospital mortality. **Objective:** The objective of this study is to evaluate the prognostic significance of preoperative and postoperative lactate levels and lactate clearance in predicting in-hospital mortality following surgery for gastrointestinal perforation. **Methods:** After the ethical approval from the institutional review board, this retrospective observational study was conducted at Department of general surgery in Dr Ruth KM PFAO civil hospital Karachi, from 1st October 2024 to 30th December 2024. Through non-probability consecutive sampling, 100 patients aged 18 and above, both genders, undergoing emergency surgery for gastrointestinal perforation, and availability of preoperative and postoperative lactate measurements. **Results:** Survivors had a significantly lower preoperative lactate level (3.17 ± 1.7 mmol/L) compared to non-survivors (6.7 ± 1.9 mmol/L), $p < 0.0001$. Similarly, postoperative lactate levels were markedly lower in survivors (2.6 ± 0.8 mmol/L) than in non-survivors (6.8 ± 2.3 mmol/L), also with a p -value < 0.0001 . The area under the curve (AUC) for preoperative lactate was 0.905 (95% CI: 0.843–0.967, $p < 0.0001$), while postoperative lactate had an AUC of 1.0 (95% CI: 1.0–1.0, $p < 0.0001$), indicating perfect predictive ability. **Conclusion:** Hospital mortality rates of patients undergoing gastrointestinal perforation surgeries can best be predicted through lactate assessments performed before and after surgery.

Keywords: postoperative lactate levels, lactate clearance, in-hospital mortality, gastrointestinal perforation

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Introduction

Gastrointestinal (GI) perforation requires urgent surgery since the condition results in high mortality rates. The mortality rates for critically ill patients with GI perforation-induced peritonitis fall between 15% and 33% according to available research studies (1). Medical professionals need exact, timely prognostic assessments to maximize patient success while making appropriate treatment choices and properly distribute healthcare funds. Lactate measurement in serum has become a vital diagnostic indicator for clinical purposes. During tissue hypoxia and systemic stress situations with sepsis and septic shock from GI perforations, the body produces lactate as a waste product from anaerobic metabolism, which builds up in bloodstream concentrations (2, 3). Medical research demonstrates that elevated patient lactate measurements lead to higher mortality figures throughout multiple clinical environments (4). The blood test results show that emergency patients with lactate levels above 4.0 mmol/L face poor health outcomes no matter what their infection status is (5). The surgical management of GI perforations uses preoperative and postoperative lactate measurements and clearance rates to predict patient outcomes. The retrospective cohort study analyzed patients who experienced GI perforation from 2013 to 2017. Among these patients, 16.3% passed away from hospital-based fatalities. Patients who died within the hospital setting showed higher preoperative lactate measurement results with 6.3 ± 5.1 mmol/L compared to survivors who had 3.5 ± 3.2 mmol/L. The mortality group displayed higher postoperative lactate measurements at 7.9 ± 4.9 mmol/L than the survivors who maintained levels at 3.6 ± 3.0 mmol/L. Post-operative lactate measurement showed more substantial independence from other variables as a predictor of hospital death according to area under curve (AUC)

analysis which produced a value of 0.781 (6). It proved better than preoperative lactate levels or clearance rates as a prognostic tool. The assessment of postoperative lactate levels represents an effective way to forecast clinical results after GI perforation surgery. Postoperative medical interventions need aggressive treatment strategies when lactate concentration remains elevated because it indicates continued tissue hypoxia and suboptimal resuscitation or ongoing septic state. Perioperative care protocols should include regular lactate monitoring because this practice allows clinicians to find high-risk patients early and start life-saving therapies to decrease mortality from this fatal illness (7). The objective of this study is to evaluate the prognostic significance of preoperative and postoperative lactate levels and lactate clearance in predicting in-hospital mortality following surgery for gastrointestinal perforation.

Methodology

After the ethical approval from the institutional review board, this retrospective observational study was conducted at the Department of General Surgery in Dr Ruth KM PFAO Civil Hospital Karachi, from 1st October 2024 to 30th December 2024. Through non-probability consecutive sampling, 100 patients aged 18 and above, both genders, undergoing emergency surgery for gastrointestinal perforation, and availability of preoperative and postoperative lactate measurements. Patients with incomplete lactate data or lost to follow-up before postoperative assessment, and those with chronic liver disease or metabolic disorders affecting lactate metabolism were excluded from the present study. GI perforation patients were evaluated through clinical examination, imaging modalities, and intraoperative tests. After the



informed consent from the recruited patients, personal and medical information of patients with GI perforation along with their surgical

$$\text{Lactate Clearance (\%)} = \frac{\text{Pre-op Lactate} - \text{Post-op Lactate}}{\text{Pre-op Lactate}} \times 100$$

interventions and clinical outcomes were documented. Doctors measured blood lactate content right before surgery within two hours and later during the first six hours of the post-operative period. The formula used to determine lactate clearance featured the following structure:

The research divided participants into groups of hospital survivors who received discharge and patients who passed away before hospital release. Data were analyzed using SPSS version 26. Continuous variables were presented as mean with standard deviation (SD) for statistical comparison using independent t-tests. The chi-square method analyzed all categorical data points. Mortality risk analysis based on lactate levels required Pearson or Spearman correlation tests. ROC testing helped identify proper lactate threshold measurements for predicting mortality outcomes. Statistical significance required p values less than 0.05 for the study.

Results

The study included 100 patients with a mean age of 52.87 ± 21.9 years. The gender distribution showed a higher proportion of males (56%) compared to females (44%) (Table 1).

Regarding the lactate profile, the mean preoperative lactate level was 5.4 ± 2.56 mmol/L, while the postoperative lactate level was slightly lower at 5.2 ± 2.7 mmol/L. The mean lactate clearance was $1.45 \pm 30.11\%$, indicating a wide variation in lactate reduction among patients (Table 2). Out of 100 patients included in the study, 63 (63%) did not survive, while 37 (37%) survived and were discharged from the hospital.

A comparison of lactate levels between survivors and non-survivors revealed significant differences. Survivors had a significantly lower preoperative lactate level (3.17 ± 1.7 mmol/L) compared to non-survivors (6.7 ± 1.9 mmol/L), $p < 0.0001$. Similarly, postoperative lactate levels were markedly lower in survivors (2.6 ± 0.8 mmol/L) than in non-survivors (6.8 ± 2.3 mmol/L), also with a p -value < 0.0001 . Lactate clearance was higher in survivors ($3.8 \pm 31.3\%$) compared to non-survivors ($-4.5 \pm 29.2\%$), but the difference was not statistically significant ($p = 0.097$) (Table 3).

Pearson correlation analysis demonstrated a strong positive correlation between preoperative lactate and mortality ($r = 0.723$, $p < 0.0001$), as well as between postoperative lactate and mortality ($r = 0.68$, $p < 0.0001$). However, the correlation between lactate clearance and mortality was weak ($r = -0.135$, $p = 0.18$), suggesting that lactate clearance alone may not be a strong predictor of mortality (Table 4).

ROC curve analysis further supported the predictive value of lactate levels. The area under the curve (AUC) for preoperative lactate was 0.905 (95% CI: 0.843–0.967, $p < 0.0001$) (Figure 1), while postoperative lactate had an AUC of 1.0 (95% CI: 1.0–1.0, $p < 0.0001$), indicating perfect predictive ability (Figure 2). In contrast, lactate clearance had a lower AUC of 0.416 (95% CI: 0.298–0.534, $p = 0.164$), reinforcing its limited prognostic value (Table 5) (Figure 3).

These findings highlight that both preoperative and postoperative lactate levels are strong predictors of in-hospital mortality in patients undergoing surgery for gastrointestinal perforation, with postoperative lactate being the most accurate predictor.

Table 1: Demographic Profile

Variables	Mean and Frequency (n=100)
Age	52.87±21.9
Gender	
Male	56 (56%)
Female	44 (44%)

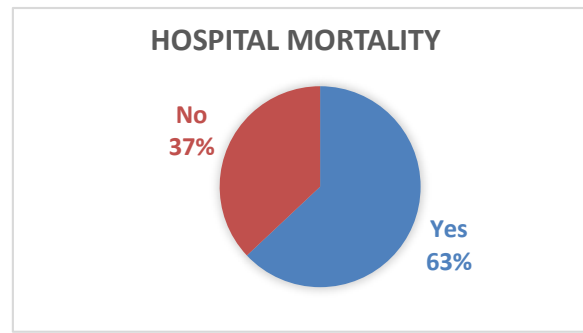


Figure 1: Hospital mortality in study population

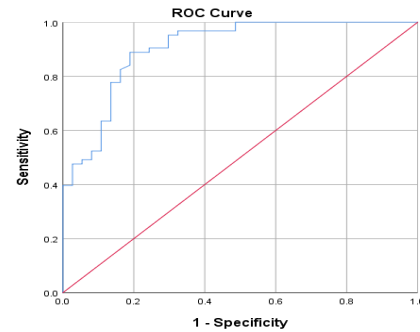


Figure 2: Pre Lactate vs. Mortality ROC curve

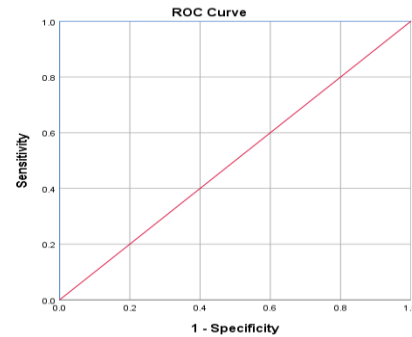


Figure 3: Post Lactate vs. Mortality ROC curve

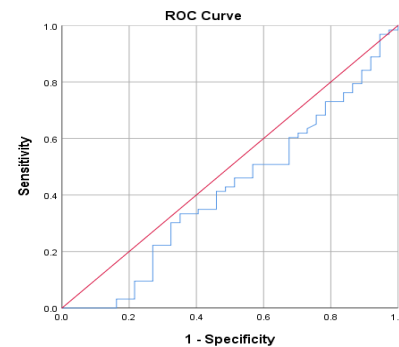


Figure 4: Lactate clearance vs. Mortality ROC Curve

Table 2: Lactate profile

Variables	Mean ± S. D
	Pre-op Lactate (mmol/L)
Post-op Lactate (mmol/L)	5.2±2.7
Lactate Clearance (%)	1.45±30.11

Table 3: Lactate profile of survivors and non-survivors

Variables	Survivors (N=37)	Non-survivors (n=63)	P Value
Pre-op Lactate (mmol/L)	3.17±1.7	6.7±1.9	<0.0001
Post-op Lactate (mmol/L)	2.6±0.8	6.8±2.3	<0.0001
Lactate Clearance (%)	3.8±31.3	-4.5±29.2	0.097

Table 4: Pearson correlation of lactate profile with mortality

Variables	Pearson correlation	Significance
Pre Lactate vs. Mortality	0.723	<0.0001
Post Lactate vs. Mortality	0.68	<0.0001
Lactate level vs. Mortality	-0.135	0.18

Table 5: ROC curve analysis of lactate profile in predicting Mortality

Variables	AUC	Lower Limit	Upper Limit	P Value
Pre Lactate vs. Mortality	0.905	0.843	0.967	<0.0001
Post Lactate vs. Mortality	1	1	1	<0.0001
Lactate level vs. Mortality	0.416	0.298	0.534	0.164

Discussion

Perioperative lactate measurement in patients undergoing gastrointestinal (GI) perforation surgical intervention has received thorough research analysis regarding its predictive importance. The presence of elevated lactate levels, which indicate tissue hypoxia and anaerobic metabolism, has proved to increase mortality risks across various critical conditions such as sepsis and postoperative states (8). According to recent research, the predictive power of preoperative and postoperative lactate tests and lactate clearance are important for assessing mortality risk following hospital admission in these patients (9). The research published by Kang et al. (2022) showed that 16.3% of patients who received GI perforation surgery died within the hospital. Patients who died within the hospital had preoperative lactate levels that averaged 6.3 ± 5.1 mmol/L while survivors maintained lower preoperative levels at 3.5 ± 3.2 mmol/L during the study. The mortality group presented higher postoperative lactate levels at 7.9 ± 4.9 mmol/L compared to survivors with 3.6 ± 3.0 mmol/L. Through multivariate analysis, postoperative lactate measurements showed superior diagnostic potential regarding in-hospital mortality risk. Their area under the curve value reached 0.771 above preoperative lactate levels and postoperative lactate clearance trends (10). A total of 33.3% mortality rate was reported by Jobin et al. (2019) during their study of 42 patients who required emergency colorectal perforation surgery. Survivors who underwent emergency colorectal surgery had lower postoperative arterial blood lactate levels at 23.8 ± 12.7 mg/dL compared to patients with mortality who measured 43.1 ± 14.1 mg/dL. The results of multivariate logistic regression analysis proved that high postoperative lactate levels function as a risk factor for death among this patient population (11). Research findings about lactate clearance as a predictive marker are not entirely established. The study by Klemm et al. showed lactate clearance performed better for survivors at -30.7 ± 89.4% versus -50.0 ± 63.8% in non-survivors although this data was not statistically significant (p = 0.096). The results indicate postoperative lactate clearance might be less adequate than absolute lactate measurements when predicting death outcomes (12). Research evidence demonstrates that medical practitioners must evaluate perioperative

lactate levels in patients undergoing GI perforation surgery. The measurement of lactate either before surgery or after surgery serves as valuable prognostic information where postoperative levels specifically connect to in-hospital mortality outcomes. The inclusion of regular lactate tests during surgical operations can help discover high-risk patients before they become unstable through proper care interventions (13).

Conclusion

According to this research, hospital mortality rates of patients undergoing gastrointestinal perforation surgeries can best be predicted through lactate assessments performed before and after surgery. Perioperative lactate assessment, as a routine procedure, does not affect mortality numbers but can enable medical staff to identify patients at high risk so they can initiate appropriate interventions, resulting in better treatment results.

Declarations

Data Availability statement

All data generated or analysed during the study are included in the manuscript.

Ethics approval and consent to participate

Approved by the department concerned. (IRBEC-MKPOAF-045-24)

Consent for publication

Approved

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Conflict of interest

The authors declared the absence of a conflict of interest.

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All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.



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References

1. Neupane S, Koirala DP, Kharel S, Silwal S, Yadav KK. Clinical profile and management of perforation peritonitis in Bharatpur hospital, Nepal: A prospective study. *Annals of medicine and surgery* (2012). 2022; 82:104528.
2. Pouli S, Kozana A, Papakitsou I, Daskalogiannaki M, Raissaki M. Gastrointestinal perforation: clinical and MDCT clues for identification of aetiology. *Insights into Imaging*. 2020; 11(1):31.
3. Lee J, Im C. Time-to-surgery paradigms: wait time and surgical outcomes in critically ill patients who underwent emergency surgery for gastrointestinal perforation. *BMC Surgery*. 2024; 24(1):159.
4. Bernhard M, Döll S, Kramer A, Weidhase L, Hartwig T, Petros S, et al. Elevated admission lactate levels in the emergency department are associated with increased 30-day mortality in non-trauma critically ill patients. *Scandinavian journal of trauma, resuscitation and emergency medicine*. 2020; 28(1):82.
5. Marikar D, Babu P, Fine-Goulden M. How to interpret lactate. *Archives of disease in childhood - Education & practice edition*. 2021; 106(3):167-71.
6. Sugita S, Ishikawa M, Sakuma T, Iizuka M, Hanai S, Sakamoto A. Intraoperative serum lactate levels as a prognostic predictor of outcome for emergency abdominal surgery: a retrospective study. *BMC Surg*. 2023; 23(1):162.
7. Deulkar P, Singam A, Mudiganti V, Jain A. Lactate Monitoring in Intensive Care: A Comprehensive Review of Its Utility and Interpretation. *Cureus*. 2024; 16(8):e66356.
8. Darwen C, Bryan A, Quraishi-Akhtar T, Moore J. Postoperative hyperlactataemia and preoperative cardiopulmonary exercise testing in an elective noncardiac surgical cohort: a retrospective observational study. *BJA Open*. 2023; 5:100124.
9. Baris O, Holat CM, Tosun ME, Yaman US, Durmaz A, Canikoglu M, et al. Assessing the Predictive Impact of Preoperative Lactate Dehydrogenase to Albumin Ratio on Outcomes Following Coronary Artery Bypass Graft Surgery. *Journal of clinical medicine*. 2025; 14(2):554.
10. Kang MK, Oh S-Y, Lee H, Ryu HG. Pre- and postoperative lactate levels and lactate clearance are used to predict in-hospital mortality after surgery for gastrointestinal perforation. *BMC Surgery*. 2022; 22(1):93.
11. Jobin SP, Maitra S, Baidya DK, Subramaniam R, Prasad G, Seenu V. Role of serial lactate measurement to predict 28-day mortality in patients undergoing emergency laparotomy for perforation peritonitis: prospective observational study. *Journal of Intensive Care*. 2019; 7(1):58.
12. Klemm G, Markart S, Hermann A, Staudinger T, Hengstenberg C, Heinz G, et al. Lactate as a Predictor of 30-Day Mortality in Cardiogenic Shock. *Journal of clinical medicine*. 2024; 13(7):1932.
13. Nishida Y, Yamamoto R, Ono S, Sasaki J. Association between preoperative lactate level and early complications after surgery for isolated extremity fracture. *BMC Musculoskeletal Disorders*. 2024; 25(1):314.