

Preoperative Predictability of Bowel Resection in Incarcerated Inguinal Hernias

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Abstract

Background: Incarcerated inguinal hernias are among the most frequently performed surgeries in emergency settings. In cases of strangulation, bowel and omentum resection may be necessary, which alters the nature of the surgery. This study aimed to investigate whether bowel resection in incarcerated inguinal hernias can be predicted using preoperative laboratory tests

Methods: This single-center, retrospective study reviewed patients who underwent surgery for incarcerated inguinal hernias at Ankara Bilkent City Hospital between 2019 and 2023. The patients' demographic characteristics, laboratory parameters, and operative notes were examined. Patients who underwent bowel resection were classified as Group 1, while those who did not undergo bowel resection were classified as Group 2. Differences in laboratory parameters between Group 1 and Group 2 were analyzed.

Results: Out of 154 patients included in the study, 32 (20.8%) were in Group 1, and 122 (79.2%) were in Group 2. There was no statistically significant difference in preoperative evaluations of WBC, NLR, LUC, LUC%, lactate, and RDW values for predicting strangulation and bowel resection ($p=0.278$; $p=0.053$; $p=0.163$; $p=0.073$; $p=0.494$; $p=0.973$). However, LDH levels were significantly higher in the group requiring bowel resection ($p=0.033$).

Conclusion: LDH levels can predict bowel resection in patients with incarcerated inguinal hernias preoperatively. Normal levels of other parameters do not rule out strangulation. This should be particularly noted in patients undergoing manual reduction.

Key words: Inguinal Hernia, Strangulation, LDH, Bowel Resection

INTRODUCTION

Incarcerated inguinal hernias account for 9% of all inguinal hernias (1). An incarcerated inguinal hernia is a condition requiring emergency surgery, and the incarceration it causes can lead to obstruction and perforation, which may become life-threatening (2). Although elective inguinal hernia surgeries are performed with very low mortality rates (0.07%) (3), the mortality rate in emergency surgeries can rise up to 5% (3). The most significant factor contributing to this is the resection of incarcerated abdominal organs (2,3).

In incarcerated inguinal hernias, the reduction or absence of blood supply to the organ within the hernia sac is termed "strangulation," which may necessitate organ resection (4). The diagnosis of strangulation can be determined through physical examination, laboratory tests, and the presence of sonographic findings (5). During surgery, the decision for organ resection is based on the reversibility of ischemic conditions affecting the bowel or omentum. Laboratory tests used to predict the need for organ resection include white blood cell count (WBC), lactate, C-reactive protein (CRP), lymphocyte/CRP ratio, platelet/CRP ratio, neutrophil/lymphocyte ratio (NLR), and lactate dehydrogenase (LDH) (6–9). LDH is present in many cells throughout the body and is an enzyme essential for energy production. It is one of the parameters used to indicate tissue damage (10). Since tissue damage occurs in incarcerated hernias, LDH is utilized as a marker for tissue ischemia (10).

This study aimed to evaluate the predictability of organ resection in incarcerated inguinal hernias using preoperative laboratory tests. Specifically, it assessed whether the number and percentage of large unstained cell (LUC), a newly used inflammatory marker(11), are beneficial for this purpose, and investigated the success rates of other parameters in our series.

MATERIALS AND METHODS

Method

From April 2019 to December 2023, patients diagnosed with incarcerated hernia who underwent emergency surgery at the General Surgery Clinic of Ankara Bilkent City Hospital were retrospectively reviewed. Totally 179

patients reviewed but 25 patients were excluded due to the inaccessibility of electronic data or insufficient information in their medical records. The study included 154 patients who were admitted to the clinic and underwent surgical intervention for incarcerated hernia, all of whom were over 18 years old. Data was collected from the patients' medical records, including demographic and clinical characteristics, operation notes (presence of organ resection), and laboratory parameters (WBC, Neutrophil count, Lymphocyte count, NLR, LDH, LUC, LUC%, Red Cell Distribution Width - RDW, Lactate). Based on the surgical notes (intraoperative exploration), patients were categorized into two groups: Group 1, consisting of those with strangulation and organ resection, and Group 2, consisting of those with incarceration but with a viable intestine showing signs of normal/edematous/warm application and no organ resection.

Patients with malignancies, rheumatological diseases, pregnant women, those under 18 years of age, and those with inaccessible electronic records were excluded from the study. Additionally, those with any organ other than the bowel (omentum, ovary, etc.) in the incarcerated hernia sac were not included in the study.

The medical research and ethics committee of Ankara Bilkent City Hospital approved the study (reference number: TABED 2-24-554).

Statistics

Statistical analyses were performed using IBM Statistical Package for the Social Sciences version 26 (IBM SPSS Corp.; Armonk, NY, USA). Numerical data were presented as percentages (%). The normality of data distribution was assessed using the Kolmogorov-Smirnov test. Continuous variables showing normal distribution were described using mean \pm standard deviation, while data not following a normal distribution were expressed as median (range). For continuous variables with normal distribution, the Student's T test was used; for those without normal distribution, the Mann-Whitney U test was employed. To compare categorical variables, Pearson's chi-square test or Fisher's exact test was applied. The area under the curve (AUC) analysis was conducted for LDH values. A p-value of <0.05 was considered statistically significant.

RESULTS

The study included 154 patients, with a mean age of 68 ± 15 years. Among these, 30 (19.5%) were female and 124 (80.5%) were male. According to the surgical notes, strangulation was observed in 32 (20.8%) patients, who underwent organ resection, while no strangulation was detected in 122 (79.2%) patients, who did not undergo organ resection.

In Group 1 the mean age was 72 ± 13 years, with 11 (34.4%) females and 21 (65.6%) males. In Group 2, the mean age was 67 ± 16 years, with 19 (15.6%) females and 103 (84.4%) males. Laboratory values for both groups are shown in Table 1. No statistically significant differences were found in the preoperative evaluation of WBC, NLR, LUC, LUC%, lactate, and RDW in relation to strangulation or organ resection ($p = 0.278$; $p = 0.053$; $p = 0.163$; $p = 0.073$; $p = 0.494$; $p = 0.973$). However, the LDH value was found to be significantly higher in the group undergoing organ resection ($p = 0.033$) (Table 1).

In the receiver operating characteristic (ROC) analysis for LDH to identify patients requiring organ resection, the area under the curve (AUC) was found to be 0.626 (95% confidence interval: 0.517-0.735, $p < 0.024$) [Figure 1] [Table 2]. The test's sensitivity was 84.38%, and spec-

ificity was 33.61%, with a positive predictive value of 25.0% and a negative predictive value of 89.13%.

DISCUSSION

Incarcerated hernia surgeries are performed almost as frequently as appendectomies (12). Inguinal hernia surgeries account for 75% of these emergency hernia operations (13). As expected, the mortality rates of patients operated under emergency conditions are high (3), and organ resection plays a significant role in this. Therefore, predicting organ resection in incarcerated inguinal hernias in advance is important both for selecting patients suitable for the reduction procedure and for perioperative management. In our series, a significant relationship was found between only elevated preoperative LDH levels and organ resection.

In patients presenting with incarcerated inguinal hernia where bowel ischemia is not suspected, manual reduction is one of the recommended treatment options (14). However, differentiating between pain due to bowel ischemia and hernia-related pain is not always possible. Additionally, there are several laboratory parameters thought to predict ischemia in inguinal hernias, but there is no consensus, and numerous studies have been

Table 1. Comparison of Demographic and Laboratory Characteristics Between Groups

Characteristics	Group 1 N (%) *	Group 2 N (%) *	p-value
Age	72±13	67±16	0.088§
Gender			0.017£
- Female	11 (34.4)	19 (15.6)	
- Male	21 (65.6)	103 (84.4)	
WBC (x10 ⁹ /L)	11.91 (32.6-4.35)	9.83 (31.53-4.24)	0.278§
RDW (%)	14.5 (61.1-12.5)	14.0 (60.6-1.6)	0.973§
NLR	6.95 (129.2-1.33)	5.3 (60.9-0.1)	0.053§
LUC (x10 ⁹ /L)	0.1 (0.26-0.0)	0.12 (0.9-0.0)	0.163§
LUC %	1.0 (2.6-0.2)	1.2 (25.9-0.3)	0.073§
Lactate	1.69 (5.96-0.85)	1.65 (4.83-0.55)	0.494§
LDH (U/L)	252 (409-170)	230 (753-146)	0.033§

* Minimum and maximum values are shown for continuous variables. § Mann Whitney U test; £ Chi-Square Test

(WBC: White Blood Cell, RDW: Red Cell Distribution Width, NLR: Neutrophil Lymphocyte Ratio, LUC: Large Unstained Cells, LDH: Lactate Dehydrogenase)

Table 2. Diagnostic Performance of Risk Factor (LDH)					
Risk Factor	AUC (%95 CI)	Cut-off Value	p-value	Sensitivity	Specificity
LDH	0.626 (0.517-0.735)	204	<0.024	84.38	33.61

(LDH: Lactate Dehydrogenase, AUC: Area Under Curve, CI: Confidence Interval)

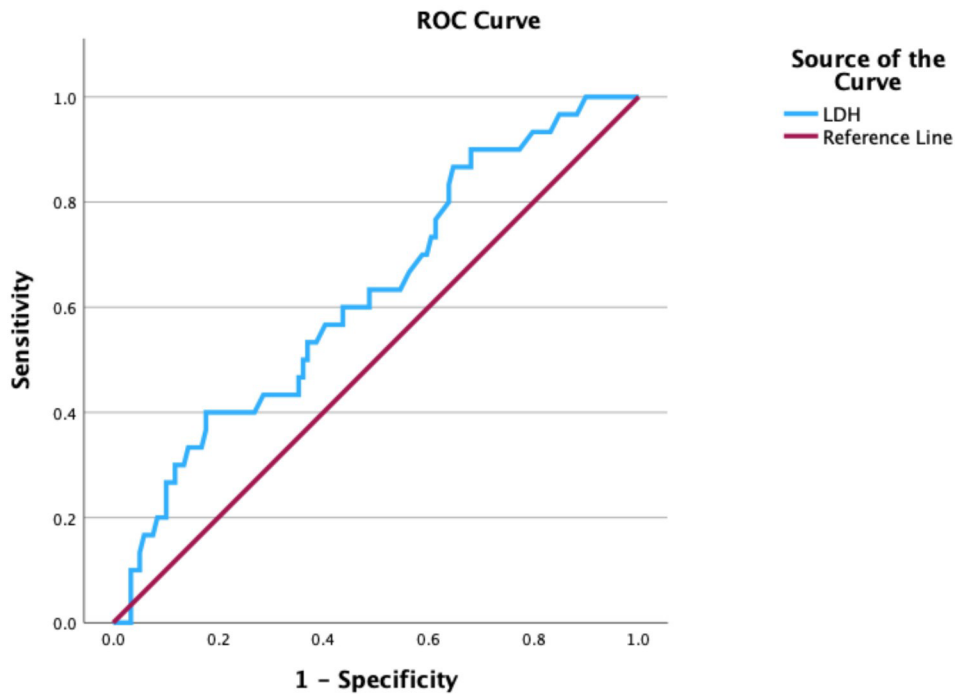


Figure 1: ROC Analysis for Small Bowel Resection

published on the subject (10). As in our study, LDH has previously been reported to predict bowel resection by Xie et al. (15). However, in this study, WBC and NLR, which were not significant in our study, were shown to predict organ resection. In another study, Kadioğlu et al. (16) reported a relationship between ischemia-modified albumin and organ resection. In a further study by Peksöz et al. (17), WBC, NLR, C-reactive protein (CRP), and the lymphocyte-CRP ratio (LCR) were found to be associated with organ resection. Overall, as seen in the aforementioned studies, there is a relationship between elevated inflammatory markers and organ resection. This can be attributed to the progression of ischemia,

leading to bacterial translocation and the onset of an infectious process. The insignificance of these parameters in our study could be related to the clinical approach of avoiding manual reduction in incarcerated hernias and performing surgery as soon as possible from the time of diagnosis.

Another laboratory parameter frequently used to detect bowel ischemia and indicative of impaired tissue oxygenation is lactate. Lactate is the final product of anaerobic glycolysis, and its elevation indicates inadequate oxygen utilization in the tissue (18). It is commonly used in daily practice for conditions such as myocardial infarction, shock, and critically ill patients in intensive care

units (10). Additionally, lactate has been reported to predict mortality in septic patients (19). Given this, it would not be incorrect to consider lactate as an inflammatory marker. Indeed, in a study by Şahin et al. (10), which examined 67 patients with incarcerated hernias, elevated lactate, along with WBC and NLR, was observed in cases requiring small bowel resection. Therefore, these parameters not only indicate intestinal ischemia but, as mentioned above, may also reflect bacterial translocation. In connection with this, Xie et al. (15) demonstrated that inflammatory parameters and lactate did not rise in patients with strangulated omentum who underwent omentum resection, likely due to the absence of bacterial translocation caused by omental infarction.

In patients presenting with incarcerated inguinal hernia, the rate of bowel resection is 14% within the first 12 hours, rising to 50% after 12 hours (16). Considering the complications caused by bacterial translocation in addition to bowel ischemia in strangulated cases, early intervention is crucial. Particularly in patients who undergo manual reduction, low levels of lactate, WBC, and CRP should not be assumed to rule out strangulation. In this patient group, routine assessment of LDH in addition to these parameters could be beneficial.

LUC has recently been used as an inflammatory parameter. A high LUC rate indicates bone marrow activation (11). In our study, the LUC value was expected to be high in strangulated patients because the inflammatory process was greater in non-strangulated patients, but it was not found to be statistically significant. This suggests that LUC may be a marker of inflammation and does not indicate the severity of infection.

The most significant limitation of this study is its retrospective nature, as data were obtained from the electronic information system, which may result in incomplete or insufficient information. Another limitation is that, in our study, the prediction of small bowel resection was based on laboratory parameters, while radiological imaging is frequently used to assess ischemia in these patients.

In conclusion, LDH levels predict bowel resection in incarcerated inguinal hernias. Due to NPV of LDH; low LDH value is ruled out from strangulation. In particular, the absence of high lactate, WBC, and CRP values in jailed individuals who undergo manual reduction should not be interpreted as a lack of bowel ischemia.

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Abbreviations list

WBC: White blood cell count
 NLR: Neutrophil-lymphocyte ratio
 LUC: Large unstained cells
 LUC%: Percentage of large unstained cells
 RDW: Red cell distribution width
 LDH: Lactate dehydrogenase
 CRP: C-reactive protein
 AUC: Area under the curve
 CI: Confidence interval
 NPV: Negative Predictive Value

Ethics approval and consent to participate

This study was approved by Ankara Bilkent City Hospital Hospital approved the study (Date: 02.10.2024 Number: TABED 2-24-554).

Consent for publication

Our study is based on content analysis of the document. It does not contain any personal data.

Availability of data and materials

Data from the study were not stored digitally or physically.

Competing interests

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Authors' contributions

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