

# Transhernial laparoscopy for assessment of bowel viability in incarcerated indirect inguinal hernia: A single-center retrospective study

Denizhan Kılıç,<sup>1</sup> Erhan Kızılkaya,<sup>2</sup> Nizamettin Kutluer<sup>3</sup>

<sup>1</sup>Department of General Surgery, Malatya Training and Research Hospital, Malatya, Türkiye

<sup>2</sup>Department of General Surgery, Malatya Turgut Özal University Faculty of Medicine, Malatya, Türkiye

<sup>3</sup>Department of General Surgery, Elazığ Fethi Sekin City Hospital, Elazığ, Türkiye

## ABSTRACT

**Introduction:** Assessment of bowel viability in incarcerated inguinal hernia remains challenging, often leading to exploratory laparotomy due to uncertainty. Hernia sac laparoscopy (transhernial laparoscopy) has been proposed as a minimally invasive adjunct to guide intraoperative decision-making. This study evaluates the safety and diagnostic performance of hernia sac laparoscopy in patients with incarcerated indirect inguinal hernia.

**Materials and Methods:** A retrospective single-center analysis was conducted on 48 consecutive patients undergoing emergency surgery for incarcerated indirect inguinal hernia. In all cases, bowel viability was assessed via insertion of an 11-mm trocar through the hernia sac prior to definitive repair. Laparotomy was performed when ischemia was suspected. All patients underwent open Lichtenstein repair. Diagnostic performance parameters were calculated using bowel resection as confirmation of ischemia.

**Results:** Midline laparotomy was required in 6 patients (12.5%). Five patients had confirmed bowel ischemia requiring resection with primary anastomosis. One patient underwent non-therapeutic laparotomy without resection. No bowel perforation or intra-abdominal contamination was observed. There were no cases of missed ischemia. Hernia sac laparoscopy demonstrated a sensitivity of 100%, specificity of 97.7%, positive predictive value of 83.3%, and negative predictive value of 100% for detecting bowel ischemia.

**Conclusions:** Hernia sac laparoscopy is a safe and effective decision-guiding tool in incarcerated indirect inguinal hernia, demonstrating excellent sensitivity and negative predictive value for bowel ischemia. This technique may help avoid unnecessary laparotomy while maintaining surgical safety.

**Keywords:** Incarcerated inguinal hernia, hernia sac laparoscopy, bowel ischemia, bowel viability, emergency surgery



Received: 04.03.2026 Revision: 12.03.2026 Accepted: 14.03.2026  
Correspondence: Denizhan Kılıç M.D., Department of General Surgery, Malatya Training and Research Hospital, Malatya, Türkiye  
e-mail: denzhankilic93@gmail.com



## Introduction

Incarcerated inguinal hernia is a common surgical emergency that may progress to strangulation and bowel ischemia if not promptly managed.<sup>[1]</sup> Early operative intervention is strongly recommended to prevent irreversible intestinal injury and systemic complications.<sup>[2]</sup> Determining bowel viability intraoperatively remains one of the most critical challenges in these patients.<sup>[3]</sup> Clinical findings and laboratory parameters are often nonspecific in predicting intestinal ischemia.<sup>[4]</sup> Although computed tomography may provide supportive information, its sensitivity in detecting early or reversible ischemia remains limited, particularly when spontaneous reduction occurs or when the incarcerated bowel segment cannot be fully evaluated through the hernia sac.<sup>[5]</sup> Traditionally, when bowel viability is uncertain, surgeons perform exploratory midline laparotomy for direct inspection of the intestine. While effective, non-therapeutic laparotomy is associated with increased operative trauma, postoperative pain, prolonged hospital stay, and higher morbidity rates.<sup>[6]</sup> Therefore, a reliable and minimally invasive method to assess bowel viability while avoiding unnecessary laparotomy is desirable.<sup>[7]</sup> Emergency inguinal hernia repair presents distinct technical challenges compared to elective surgery. Edematous tissues, venous congestion, and restricted exposure through the inguinal incision may hinder adequate visualization of the incarcerated bowel segment.<sup>[8]</sup> Furthermore, intraoperative assessment based solely on bowel color and peristalsis is subjective and may be misleading, especially in cases of reversible venous ischemia.<sup>[9]</sup> Misjudgment may lead either to unnecessary laparotomy or to missed bowel necrosis with serious consequences. Minimally invasive laparoscopic techniques have increasingly been applied in the management of incarcerated inguinal hernias, allowing intraperitoneal evaluation and facilitating surgical decision-making.<sup>[10]</sup> By providing panoramic visualization of the incarcerated bowel and adjacent mesentery, this approach may improve decision-making regarding the need for laparotomy. Beyond intraoperative assessment, hernia sac handling and preservation of peritoneal integrity have also been shown to influence early postoperative outcomes in open Lichtenstein repair, particularly postoperative pain.<sup>[11]</sup> However, its structured use as a standardized decision-guiding adjunct in incarcerated indirect inguinal hernia has not been sufficiently evaluated in contemporary emergency surgical practice.<sup>[12]</sup>

The aim of this study was to assess the safety and diagnostic performance of hernia sac laparoscopy in determining bowel viability and guiding the need for laparotomy in patients undergoing emergency surgery for incarcerated indirect inguinal hernia.

## Materials and Methods

### Study Design and Ethical Approval

This retrospective observational study included consecutive adult patients who underwent emergency surgery for incarcerated indirect inguinal hernia between January 2021 and December 2025 at Malatya Turgut Özal University. The study protocol was approved by the Malatya Turgut Özal University Health Sciences Scientific Research Ethics Committee (Approval No: E-30785963-020-370843). Owing to the retrospective design of the study, the requirement for informed consent was waived. It has been conducted in accordance with the Helsinki Declaration.

### Patient Selection

All patients diagnosed with incarcerated indirect inguinal hernia requiring urgent surgical intervention were considered eligible for inclusion. Patients presenting with generalized peritonitis, hemodynamic instability, or preoperatively evident bowel perforation were excluded. Demographic characteristics, laboratory parameters including white blood cell count, C-reactive protein, and serum albumin levels, operative findings, need for laparotomy, bowel resection, postoperative complications, and length of hospital stay were retrieved from institutional electronic medical records.

### Surgical Technique

All operations were performed under general anesthesia according to a standardized surgical protocol. Following inguinal incision and careful dissection of the hernia sac, the sac was opened and an 11-mm trocar was inserted directly into the peritoneal cavity under direct visualization to accommodate a standard 10-mm laparoscope and allow adequate intraperitoneal inspection. Pneumoperitoneum was established at low intra-abdominal pressure (8–10 mmHg) to allow safe intraperitoneal inspection. Bowel viability was evaluated based on color, peristalsis, mesenteric vascularity, and the presence of venous congestion. If the bowel was considered viable, no additional abdominal exploration was undertaken and definitive

repair was completed using open Lichtenstein mesh repair. When bowel ischemia was suspected based on laparoscopic findings, a midline laparotomy was performed for direct assessment. Irreversible ischemia was defined as persistent discoloration, absence of peristalsis, and compromised mesenteric circulation necessitating bowel resection. In such cases, bowel resection with primary anastomosis was performed. Non-therapeutic laparotomy was defined as laparotomy without subsequent bowel resection.

### Outcomes

The primary outcome of the study was the requirement for midline laparotomy. Secondary outcomes included bowel resection rate, postoperative complications classified according to the Clavien–Dindo classification, and length of hospital stay. Bowel resection was accepted as confirmation of true ischemia. Diagnostic performance of hernia sac laparoscopy in detecting bowel ischemia was calculated accordingly.

### Statistical Analysis

Normality of continuous variables was assessed using the Shapiro–Wilk test. Continuous variables were expressed as mean  $\pm$  standard deviation or median with interquartile range depending on distribution, while categorical variables were presented as frequencies and percentages. Patients were categorized according to the need for laparotomy, and comparisons between groups were performed using the Mann–Whitney U test for continuous variables and Fisher’s exact test for categorical variables. Diagnostic performance parameters including sensitivity, spec-

ificity, positive predictive value, and negative predictive value were calculated with 95% confidence intervals. Statistical analyses were conducted using SPSS version 26.0 (IBM Corp., Armonk, NY, USA), and a two-tailed p-value less than 0.05 was considered statistically significant.

### Results

A total of 48 patients underwent emergency surgery for incarcerated indirect inguinal hernia during the study period. The median age was 59 years (IQR 53.5–71.8). The cohort demonstrated a median white blood cell count of  $10.68 \times 10^3/\mu\text{L}$  (IQR 7.86–13.78), median CRP level of 0.7 mg/L (IQR 0.3–3.6), median serum albumin of 4.1 g/dL (IQR 3.78–4.4), and median symptom duration of 4 hours (IQR 3–6) (Table 1). Patients requiring laparotomy had markedly prolonged symptom duration compared to those managed conservatively (median 19 vs 4 hours,  $p=0.0001$ ). CRP levels were substantially elevated in the laparotomy group (median 16.34 vs 0.5 mg/L,  $p=0.0019$ ), while serum albumin levels were significantly lower (median 3.75 vs 4.15 g/dL,  $p=0.0489$ ). No statistically significant differences were observed in age ( $p=1.000$ ) or WBC levels ( $p=0.938$ ). Length of hospital stay was significantly longer in the laparotomy group (median 4.5 vs 1 day,  $p<0.001$ ) (Table 1).

Midline laparotomy was required in 6 patients (12.5%). Among these patients, 5 (83.3%) had confirmed irreversible bowel ischemia requiring resection, whereas 1 patient (16.7%) underwent non-therapeutic laparotomy. In contrast, none of the 42 patients managed without laparotomy developed delayed ischemia. All resections were followed by primary anastomosis. No bowel perforation, intra-abdominal contamination,

**Table 1. Baseline characteristics of the study population**

Variable	Overall (n=48)	No Laparotomy (n=42)	Laparotomy (n=6)	p
Age, years	59 (53.5–71.8)	59 (54–70.8)	62.5 (52.5–72.5)	1.000
Sex, male/female	29 / 19	25 / 17	4 / 2	1.000
WBC ( $\times 10^3/\mu\text{L}$ )	10.68 (7.86–13.78)	10.68 (7.77–13.96)	11.42 (8.38–13.43)	0.938
CRP (mg/L)	0.7 (0.3–3.6)	0.5 (0.23–2.24)	16.35 (8.25–23.93)	0.0019
Albumin (g/dL)	4.1 (3.78–4.4)	4.15 (3.8–4.48)	3.75 (3.3–3.98)	0.0489
Symptom duration (hours)	4 (3–6)	4 (2.25–5)	19 (18–21.5)	0.0001
Hernia defect size (mm)	18 (15–20.25)	18 (15–20.75)	14.5 (14–15)	0.076
Length of hospital stay (days)	1 (1–1)	1 (1–1)	4.5 (2.5–5)	<0.001

Data are presented as median (interquartile range) unless otherwise indicated. WBC: white blood cell count; CRP: C-reactive protein; IQR: Interquartile range. Most patients were discharged on postoperative day 1, resulting in a narrow interquartile range for length of hospital stay.

or anastomotic leakage occurred. Postoperative complications were observed in 3 patients (6.25%), all of which were minor bleeding events that were managed conservatively without the need for re-operation or blood transfusion. No Clavien–Dindo grade III or higher complications were recorded, and there was no mortality (Table 2).

Diagnostic evaluation based on bowel resection as confirmation of ischemia yielded a sensitivity of 100% and specificity of 97.7%. The positive predictive value was 83.3%, and the negative predictive value was 100%. The false-positive rate was 2.1%, and no false-negative cases were identified (Table 3).

**Table 2. Operative and postoperative outcomes**

Variable	Overall (n=48)
Hernia sac laparoscopy attempted	48 (100%)
Midline laparotomy	6 (12.5%)
Bowel resection	5 (10.4%)
Non-therapeutic laparotomy	1 (2.1%)
Primary anastomosis performed	5 (10.4%)
Bowel perforation	0 (0%)
Intra-abdominal contamination	0 (0%)
Postoperative bleeding	3 (6.25%)
Other complications	0 (0%)
Clavien–Dindo $\geq$ III	0 (0%)
Mortality	0 (0%)
Length of stay (days), median (IQR)	1 (1–1)

IQR: Interquartile range. Values are presented as number (%) unless otherwise indicated. Postoperative complications were classified according to the Clavien–Dindo system. Non-therapeutic laparotomy was defined as laparotomy without bowel resection.

**Table 3. Diagnostic performance of hernia sac laparoscopy**

Parameter	Value	95% CI
Sensitivity	100%	47.8–100
Specificity	97.7%	87.7–99.9
Positive predictive value	83.3%	35.9–99.6
Negative predictive value	100%	91.6–100

Sensitivity, specificity, positive predictive value, and negative predictive value were calculated using bowel resection as the reference standard. Confidence intervals were calculated at the 95% level.

## Discussion

Incarcerated inguinal hernia represents a frequent surgical emergency in which timely and accurate assessment of bowel viability is critical.<sup>[13]</sup> The major intraoperative dilemma is distinguishing reversible venous congestion from irreversible ischemia, a challenge well recognized in emergency abdominal surgery.<sup>[14]</sup> In many centers, uncertainty regarding intestinal viability leads to exploratory laparotomy, potentially increasing operative trauma and postoperative morbidity.<sup>[15]</sup> In this study, hernia sac laparoscopy demonstrated high diagnostic accuracy and effectively guided the decision to perform laparotomy. The most important finding of our study is the absence of missed bowel ischemia. Among 48 patients, five had confirmed irreversible ischemia requiring resection, and all were correctly identified intraoperatively. Although one patient underwent non-therapeutic laparotomy, no false-negative cases were observed. This resulted in a sensitivity and negative predictive value of 100%, suggesting that transhernial laparoscopic evaluation may be particularly reliable in ruling out bowel ischemia. From a surgical safety perspective, avoiding missed ischemia is more critical than preventing occasional non-therapeutic exploration, as delayed diagnosis of intestinal necrosis is associated with significantly increased morbidity and mortality.<sup>[16]</sup> Another notable finding is that laparotomy was required in only 12.5% of patients. In routine emergency practice, incarcerated hernias may prompt liberal use of exploratory laparotomy due to concern for strangulation.<sup>[17]</sup> The use of hernia sac laparoscopy in our series allowed selective laparotomy only in patients with suspicious findings. Among the six patients who underwent laparotomy, one case (16.7%) was non-therapeutic, corresponding to an overall rate of 2.1% in the study population. This low rate reflects a cautious yet safe decision-making strategy consistent with contemporary minimally invasive emergency surgery principles. The laparotomy rate observed in our study (12.5%) appears to be relatively low compared with previously reported rates in patients with incarcerated inguinal hernia, where laparotomy or bowel resection rates ranging between 15% and 30% have been reported in the literature. Our comparative analysis further demonstrated that prolonged symptom duration, elevated CRP levels, and lower serum albumin were significantly associated with the need for laparotomy. Prolonged ischemic time is a well-established predictor of bowel necrosis.<sup>[18]</sup> Elevated CRP may reflect systemic inflammatory response secondary to ischemia, while hypoalbuminemia has been associated with

impaired physiological reserve and worse surgical outcomes in emergency settings.<sup>[19]</sup> These findings suggest that clinical and laboratory parameters may complement intraoperative assessment in predicting bowel compromise. Although the difference in hernia defect size did not reach statistical significance, a trend toward smaller defect size was observed in patients requiring laparotomy. Smaller defects may theoretically lead to tighter constriction of the incarcerated bowel segment and earlier ischemic compromise, a hypothesis that warrants further investigation in larger studies. All definitive repairs were performed using the open Lichtenstein technique, and no intra-abdominal contamination or bowel perforation was observed. Resections were followed by primary anastomosis without postoperative leakage. The absence of mortality and the low complication rate further support the safety of this approach when applied in appropriately selected patients. Contemporary evidence continues to support the Lichtenstein technique as a reliable and reproducible method in inguinal hernia repair, including in emergency contexts when contamination is absent. Ongoing refinements in mesh technology and perioperative management aim to further improve postoperative outcomes and patient comfort.<sup>[20]</sup> Although laparoscopic techniques such as TAPP and TEP are widely used in elective inguinal hernia repair, their application in emergency incarcerated hernia cases remains limited in many centers. Bowel distension, edematous tissues, and the potential need for bowel resection may increase technical difficulty and operative time. Therefore, open Lichtenstein repair was preferred in our cohort as a reliable and reproducible technique in the emergency setting. The present study has several limitations. Its retrospective design and single-center nature limit generalizability. No formal sample size or power calculation was performed due to the retrospective design of the study. The relatively small number of patients requiring laparotomy may affect the precision of diagnostic performance estimates. Additionally, bowel viability assessment remains partly subjective despite laparoscopic visualization. Additionally, long-term follow-up data regarding hernia recurrence and mesh-related outcomes were not available in this retrospective analysis. Larger prospective studies are needed to validate these findings and to determine whether standardized viability criteria could further enhance intraoperative decision-making.

## Conclusion

Hernia sac laparoscopy appears to be a safe and practical adjunct in the management of incarcerated indirect inguinal hernia. By allowing direct intraperitoneal assessment

of bowel viability, this technique may help guide intraoperative decision-making and reduce unnecessary laparotomy. Larger prospective studies are needed to further validate these findings and determine its role in emergency hernia surgery.

## Disclosures

**Ethics Committee Approval:** This study was approved by the Malatya Turgut Özal University Health Sciences Scientific Research Ethics Committee (Date: 19.01.2025, No: E-30785963-020-370843).

**Informed Consent:** Written informed consent was obtained.

**Conflict of Interest:** None declared.

**Financial Disclosure:** The author declared that this study has received no financial support.

**Use of AI for Writing Assistance:** None declared.

**Authorship Contributions:** Concept – D.K.; Design – D.K.; Supervision – N.K.; Materials – E.K.; Data collection and/or processing – D.K., E.K.; Analysis and/or interpretation – D.K., N.K.; Literature review – E.K.; Writing – D.K., E.K., N.K.; Critical review – D.K.

**Peer-review:** Externally peer-reviewed.

## References

1. Stabilini C, van Veenendaal N, Aasvang E, Agresta F, Aufenacker T, Berrevoet F, et al. Update of the international Hernia-Surge guidelines for groin hernia management. *BJS Open* 2023;7(5):zrad080. Erratum in: *BJS Open* 2024;8(2):zrae034.
2. De Simone B, Birindelli A, Ansaloni L, Sartelli M, Coccolini F, Di Saverio S, et al. Emergency repair of complicated abdominal wall hernias: WSES guidelines. *Hernia* 2020;24(2):359–68.
3. Tolonen M, Vikatmaa P. Diagnosis and management of acute mesenteric ischemia: What you need to know. *J Trauma Acute Care Surg* 2025;99(2):151–61.
4. Zafirovski A, Zafirovska M, Kuhelj D, Pintar T. The impact of biomarkers on the early detection of acute mesenteric ischemia. *Biomedicines* 2023;12(1):85.
5. Bala M, Catena F, Kashuk J, De Simone B, Gomes CA, Weber D, et al. Acute mesenteric ischemia: Updated guidelines of the World Society of Emergency Surgery. *World J Emerg Surg* 2022;17(1):54.
6. Anand E, Rahman SA, Tomlinson C, Mercer SJ, Pucher PH. Comparison of major abdominal emergency surgery outcomes across organizational models of emergency surgical care: Analysis of the UK NELA national database. *J Trauma Acute Care Surg* 2024;96(2):305–12.

7. Reinke CE, Lim R. What is the Use of Minimally Invasive Surgery in Emergency General Surgery Procedures? *Adv Surg* 2025;59(1):259–83.
8. Köckerling F, Heine T, Adolf D, Zarras K, Weyhe D, Lammers B, et al. Trends in emergent groin hernia repair-an analysis from the herniated registry. *Front Surg* 2021;8:655755.
9. Clair DG, Beach JM. Mesenteric Ischemia. *N Engl J Med* 2016;374(10):959–68.
10. Thanh Xuan N, Huu Son N. Laparoscopic Transabdominal Preperitoneal Technique for Inguinal Hernia Repair in Adults. *Cureus* 2020;12(6):e8692.
11. Öndeş B, Gökdere OG, Kızılkaya E, Kurt F. The effects of high ligation versus peritoneal reduction on postoperative pain in Lichtenstein repair: A randomised trial. *Eastern J Med* 2026;31(1):152–6.
12. Bittner R, Bain K, Bansal VK, Berrevoet F, Bingener-Casey J, Chen D, et al. Update of Guidelines for laparoscopic treatment of ventral and incisional abdominal wall hernias (International Endohernia Society (IEHS))-Part A. *Surg Endosc*. 2019;33(10):3069–139. Erratum in: *Surg Endosc*. 2019;33(10):3140–2.
13. Park WM, Gloviczki P, Cherry KJ Jr, Hallett JW Jr, Bower TC, Panneton JM, et al. Contemporary management of acute mesenteric ischemia: Factors associated with survival. *J Vasc Surg* 2002;35(3):445–52.
14. Kılınç Tuncer G, Tuncer K, Sağlam B, Üstün M. Risk factors for bowel resection and postoperative complications in incarcerated abdominal wall hernia. *Turk J Surg* 2025;41(4):363–8.
15. Chen N, Lv M, Chen Y, Yao D, Yin W, Liu J, et al. Investigation of risk factors and predictive model development for the progression of incarcerated inguinal hernia to strangulation. *Hernia* 2025;29(1):301.
16. Scott MJ, Aggarwal G, Aitken RJ, Anderson ID, Balfour A, Foss NB, et al. Consensus guidelines for perioperative care for emergency laparotomy enhanced recovery after surgery (ERAS®) society recommendations part 2-emergency laparotomy: Intra- and postoperative care. *World J Surg* 2023;47(8):1850–80.
17. Renna MS, Grzeda MT, Bailey J, Hainsworth A, Ourselin S, Ebner M, et al. Intraoperative bowel perfusion assessment methods and their effects on anastomotic leak rates: Meta-analysis. *Br J Surg* 2023;110(9):1131–42.
18. Agresta F, Ansaloni L, Baiocchi GL, Bergamini C, Campanile FC, Carlucci M, et al. Laparoscopic approach to acute abdomen from the Consensus Development Conference of the Società Italiana di Chirurgia Endoscopica e nuove tecnologie (SICE), Associazione Chirurghi Ospedalieri Italiani (ACOI), Società Italiana di Chirurgia (SIC), Società Italiana di Chirurgia d'Urgenza e del Trauma (SICUT), Società Italiana di Chirurgia nell'Ospedalità Privata (SICOP), and the European Association for Endoscopic Surgery (EAES). *Surg Endosc* 2012;26(8):2134–64.
19. Tan SBT, Lin X, Rosley MF, Lamparelli M. Pre-operative serum albumin as a predictor of adverse outcomes in open abdominal surgery: A retrospective study in central queensland. *Cureus* 2025;17(2):e79681.
20. Zhang W, Zhao Y, Shao X, Cheng T, Ji Z, Li J. Long-term follow-up of lichtenstein repair of inguinal hernia in the morbid patients with self-gripping mesh (Progrip™). *Front Surg* 2021;8:748880.