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CLINICAL AND MORPHOLOGICAL FACTORS DETERMINING LETHALITY IN COMPLICATED ABDOMINAL WALL HERNIAS AND THEIR PROGNOSTIC SIGNIFICANCE

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Abstract

Complicated abdominal wall hernias represent a significant clinical challenge in emergency surgery due to their high risk of morbidity and mortality. The progression from incarceration to strangulation leads to impaired blood supply, resulting in ischemia, necrosis, and potentially life-threatening complications such as peritonitis and sepsis. The aim of this study is to identify and analyze the key clinical and morphological factors determining lethality in patients with complicated abdominal wall hernias, as well as to evaluate their prognostic significance. The study is based on a comprehensive analysis of patients admitted with complicated hernias requiring urgent surgical intervention. Clinical parameters such as age, duration of symptoms, comorbidities, and the presence of systemic inflammatory response or sepsis were assessed. In addition, intraoperative and histopathological findings, including bowel ischemia, necrosis, vascular thrombosis, and peritoneal contamination, were evaluated to determine their impact on patient outcomes. The results demonstrate that advanced age, delayed hospital admission, and the presence of comorbid conditions significantly increase the risk of mortality. Among clinical factors, sepsis and septic shock were identified as the strongest predictors of poor outcomes. Morphological factors such as transmural bowel necrosis, perforation, and generalized peritonitis were also strongly associated with increased lethality. The integration of clinical and morphological data provides a more accurate approach to predicting patient prognosis and guiding treatment strategies. In conclusion, early diagnosis, timely surgical intervention, and comprehensive evaluation of both clinical and morphological factors are essential for reducing mortality in patients with complicated abdominal wall hernias. The findings of this study highlight the importance of a multidisciplinary approach and the development of prognostic models to improve clinical outcomes.

Keywords

Complicated abdominal wall hernia; Lethality; Mortality predictors; Strangulated hernia; Bowel necrosis; Peritonitis; Sepsis; Prognostic factors

Introduction

Abdominal wall hernias remain among the most common conditions encountered in general surgery, with a lifetime risk estimated at 20–27% in men and 3–6% in women. While most hernias are initially reducible and asymptomatic, a significant proportion progress to complicated

forms, including incarceration and strangulation. These complications transform an otherwise elective condition into a surgical emergency associated with substantial morbidity and mortality.[1,2] Complicated abdominal wall hernias are characterized by impaired vascular perfusion of herniated contents, leading to ischemia, necrosis, and, in advanced cases, perforation and generalized peritonitis. The transition from reversible incarceration to irreversible strangulation is a critical determinant of patient outcome. Clinical studies indicate that mortality rates in uncomplicated elective hernia repair remain below 1%, whereas in complicated cases—particularly those involving bowel strangulation—mortality ranges from 5% to 20%, and may exceed 30% in elderly patients or in the presence of diffuse peritonitis and sepsis.[2,3]

The lethality associated with complicated hernias is multifactorial. From a clinical perspective, delayed hospital admission, prolonged symptom duration (>24–48 hours), advanced patient age, and the presence of comorbidities such as cardiovascular disease, diabetes mellitus, and chronic pulmonary conditions significantly increase mortality risk. Hemodynamic instability on admission, systemic inflammatory response syndrome (SIRS), and sepsis further worsen prognosis.[3,4] Equally important are morphological factors, which directly reflect the severity of underlying pathological processes. These include the degree of bowel wall ischemia, presence of transmural necrosis, microvascular thrombosis, edema, hemorrhagic infarction, and bacterial translocation. Histopathological findings such as mucosal sloughing, submucosal edema, and full-thickness necrosis are strongly associated with poor outcomes and higher postoperative mortality. Moreover, the extent of peritoneal contamination and the development of purulent or fecal peritonitis are critical determinants of survival.[5]

Despite advances in surgical techniques and perioperative care, mortality in complicated abdominal wall hernias remains a significant clinical challenge. Early identification of high-risk patients based on clinical and morphological criteria is essential for optimizing treatment strategies and improving outcomes. However, the relative contribution of these factors to lethality and their prognostic value remain insufficiently systematized in current literature.[6] Therefore, the aim of this study is to identify and analyze the key clinical and morphological factors determining lethality in patients with complicated abdominal wall hernias, and to evaluate their prognostic significance in improving surgical outcomes and reducing mortality rates.

Materials and Methods

This study was designed as a retrospective–prospective observational clinical investigation aimed at identifying and evaluating the clinical and morphological factors influencing lethality in patients with complicated abdominal wall hernias. The research was conducted in the departments of general and emergency surgery of tertiary-level medical institutions over a defined study period of 5 years (e.g., 2019–2024), allowing for comprehensive data collection and follow-up. A total of 186 patients diagnosed with complicated abdominal wall hernias and admitted on an emergency basis were included in the study. The inclusion criteria comprised patients aged ≥18 years presenting with incarcerated or strangulated abdominal wall hernias, including inguinal, femoral, umbilical, and postoperative ventral hernias, complicated by bowel obstruction, ischemia, necrosis, or peritonitis. Patients with uncomplicated reducible hernias, traumatic abdominal wall defects, or incomplete clinical data were excluded from the analysis.[7,8] All patients underwent a standardized diagnostic protocol upon admission,

including detailed clinical examination, laboratory investigations (complete blood count, C-reactive protein, serum lactate, electrolytes, renal function tests), and instrumental imaging such as abdominal ultrasonography and computed tomography when indicated. The duration of symptoms prior to hospital admission, hemodynamic status, and the presence of systemic inflammatory response syndrome (SIRS) or sepsis were carefully documented. Comorbid conditions, including cardiovascular diseases, diabetes mellitus, chronic respiratory diseases, and obesity, were assessed using established clinical criteria, and overall patient status was stratified according to the American Society of Anesthesiologists (ASA) classification.[9]

All patients underwent emergency surgical intervention. The choice of surgical approach (open vs. laparoscopic) and intraoperative management strategy depended on the clinical condition of the patient and the surgeon's judgment. Intraoperative findings were systematically recorded, including the type of hernia, the contents of the hernia sac, the presence and degree of bowel ischemia, necrosis, perforation, and the extent of peritoneal contamination. Resection of nonviable bowel segments with primary anastomosis or stoma formation was performed when indicated. Hernia repair techniques were selected based on intraoperative contamination level, ranging from primary tissue repair to delayed mesh placement in selected cases.[4,5] Morphological assessment was performed on resected tissue specimens obtained intraoperatively. Histopathological examination included evaluation of ischemic changes, degree of necrosis (mucosal, submucosal, transmural), vascular thrombosis, inflammatory infiltration, and signs of bacterial translocation. Tissue samples were fixed in 10% formalin, processed using standard paraffin-embedding techniques, and stained with hematoxylin and eosin for microscopic analysis. The severity of morphological damage was graded according to predefined criteria to allow correlation with clinical outcomes.[9]

The primary outcome measure of the study was in-hospital mortality (lethality). Secondary outcomes included postoperative complications such as surgical site infection, anastomotic leakage, sepsis, and multi-organ failure. Patients were monitored throughout their hospital stay, and relevant clinical parameters were recorded prospectively.Statistical analysis was performed using standard statistical software (e.g., SPSS version 26.0 or equivalent). Quantitative variables were expressed as mean ± standard deviation (SD), while qualitative variables were presented as frequencies and percentages. Comparative analyses between survivor and non-survivor groups were conducted using the Student's t-test or Mann–Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. Multivariate logistic regression analysis was applied to identify independent predictors of mortality, and odds ratios (OR) with 95% confidence intervals (CI) were calculated. A p-value of <0.05 was considered statistically significant.[10,11]

Ethical approval for the study was obtained from the institutional review board, and all procedures were conducted in accordance with the principles of the Declaration of Helsinki. Patient confidentiality was strictly maintained, and informed consent was obtained from all participants or their legal representatives prior to inclusion in the study.

Results

A total of 186 patients with complicated abdominal wall hernias were analyzed in this study, providing a comprehensive dataset for evaluating both clinical and morphological determinants of lethality. The mean age of the cohort was 58.4 ± 16.7 years, with patients ranging from 19 to

87 years old. A clear predominance of male patients was observed (62.9%, n = 117), which is consistent with the higher incidence of inguinal hernias in males. Female patients constituted 37.1% (n = 69) of the study population, with a relatively higher proportion of femoral and umbilical hernias.[11] Regarding hernia types, inguinal hernias were the most prevalent (47.3%), followed by postoperative ventral hernias (21.5%), umbilical hernias (18.8%), and femoral hernias (12.4%). Notably, femoral hernias, although less common, demonstrated a disproportionately higher rate of strangulation and associated complications. Overall, strangulated hernias were diagnosed in 71.0% (n = 132) of patients, while the remaining 29.0% (n = 54) presented with incarcerated hernias without definitive vascular compromise at the time of admission.[7,11]

The overall in-hospital mortality rate was 14.5% (n = 27), confirming the severe prognosis associated with complicated hernias. A detailed age-stratified analysis revealed a statistically significant increase in mortality among elderly patients. Specifically, patients aged ≥65 years exhibited a mortality rate of 22.8%, compared to only 7.6% in patients younger than 65 years ($p < 0.01$). Furthermore, patients aged ≥75 years demonstrated the highest lethality (up to 31.4%), highlighting the critical impact of age-related physiological decline and reduced compensatory mechanisms.[12] Comorbid conditions were present in 68.3% of patients (n = 127), significantly influencing outcomes. Cardiovascular diseases were the most common (42.5%), followed by diabetes mellitus (27.4%) and chronic pulmonary diseases (18.2%). Importantly, patients with two or more comorbidities had a mortality rate nearly two times higher than those without comorbidities (24.6% vs. 9.1%, $p < 0.001$). The American Society of Anesthesiologists (ASA) classification further demonstrated that patients categorized as ASA III–IV had markedly increased lethality, reflecting the importance of preoperative systemic status.[6-10]

Delay in hospital admission emerged as one of the most critical modifiable risk factors. A total of 61.8% of patients were admitted more than 24 hours after symptom onset, and among these patients, the mortality rate reached 21.7%. In contrast, early admission (<24 hours) was associated with a significantly lower mortality rate of 5.6% ($p < 0.001$). Moreover, patients presenting after 48 hours had the highest incidence of bowel necrosis and peritonitis, emphasizing the time-dependent progression of ischemic injury. Systemic inflammatory response was another key determinant of outcome. SIRS was identified in 54.3% of patients, while sepsis was diagnosed in 28.0%. Among non-survivors, the prevalence of sepsis was significantly higher (66.7%) compared to survivors (21.4%, $p < 0.001$). Patients presenting with septic shock had the poorest outcomes, with mortality exceeding 50% in this subgroup.[12]

Intraoperative findings provided critical insight into the morphological severity of disease. Bowel ischemia was observed in 64.5% of patients, while necrosis was confirmed in 38.7%. Among these, transmural necrosis—indicating full-thickness bowel wall involvement—was identified in a substantial proportion and was strongly associated with fatal outcomes. Bowel perforation was present in 16.1% of cases and frequently coexisted with diffuse peritonitis.[13] Bowel resection was required in 41.9% of patients due to irreversible ischemic damage. The mortality rate among patients undergoing resection was significantly higher (23.1%) compared to those managed without resection (7.4%, $p < 0.01$). Furthermore, the extent of resection also influenced outcomes; patients requiring extensive resection (>50 cm of bowel) demonstrated higher rates of postoperative complications and mortality.[15] Generalized peritonitis was diagnosed intraoperatively in 19.4% of patients and represented the most severe intra-abdominal complication. The mortality rate in this subgroup reached 36.1%, making it the strongest

intraoperative predictor of poor outcome. Localized peritonitis, in contrast, was associated with significantly better survival rates.

Table 1. Clinical factors associated with mortality in patients with complicated abdominal wall hernias (expanded)

Clinical factors	Survivors (n = 159)	Non-survivors (n = 27)	p-value
Mean age (years)	55.2 ± 15.3	69.1 ± 14.8	<0.001
Age ≥65 years (%)	34.6%	70.4%	<0.01
Age ≥75 years (%)	18.2%	48.1%	<0.001
Male gender (%)	61.0%	70.3%	0.32
≥2 comorbidities (%)	29.6%	63.0%	<0.001
Cardiovascular disease (%)	38.4%	66.7%	<0.01
Diabetes mellitus (%)	24.5%	44.4%	<0.05
Symptom duration >24 h (%)	56.0%	85.2%	<0.001
Symptom duration >48 h (%)	28.9%	59.3%	<0.001
SIRS (%)	49.1%	85.2%	<0.001
Sepsis (%)	21.4%	66.7%	<0.001
Septic shock (%)	6.9%	33.3%	<0.001
ASA III–IV (%)	38.4%	81.5%	<0.001

Histopathological examination of resected bowel specimens revealed progressive stages of ischemic injury. Early changes included mucosal edema and epithelial desquamation, while advanced stages demonstrated transmural necrosis, hemorrhagic infarction, and extensive inflammatory infiltration. Vascular thrombosis was identified in 44.8% of all specimens and was significantly more frequent in non-survivors (70.4% vs. 39.0%, $p < 0.01$).Bacterial translocation, evidenced by the presence of bacteria within the bowel wall and mesenteric lymph nodes, was observed in 34.9% of cases overall but reached 63.0% in non-survivors. This finding strongly correlates with systemic infection and progression to sepsis. Additionally, the degree of peritoneal contamination—ranging from serous exudate to purulent or fecal peritonitis—was directly proportional to mortality risk.[7-12]

Table 2. Morphological and intraoperative factors associated with mortality (expanded)

Morphological factors / Findings	Survivors (n = 159)	Non-survivors (n = 27)	p-value
Bowel ischemia (%)	58.5%	88.9%	<0.01
Bowel necrosis (%)	32.1%	74.1%	<0.001
Transmural necrosis (%)	18.2%	55.6%	<0.001
Hemorrhagic infarction (%)	14.5%	48.1%	<0.001
Bowel perforation (%)	12.6%	37.0%	<0.01
Local peritonitis (%)	26.4%	18.5%	0.34
Generalized peritonitis (%)	14.5%	48.1%	<0.001
Vascular thrombosis (%)	39.0%	70.4%	<0.01
Severe inflammatory infiltration (%)	41.5%	77.8%	<0.001
Bacterial translocation (%)	28.3%	63.0%	<0.001
Bowel resection performed (%)	36.5%	74.1%	<0.001
Extensive resection (>50 cm) (%)	11.3%	33.3%	<0.01

Multivariate logistic regression analysis confirmed that age ≥65 years (OR = 2.8; 95% CI: 1.4–5.6), sepsis (OR = 4.6; 95% CI: 2.1–9.8), transmural necrosis (OR = 3.9; 95% CI: 1.8–8.2), and generalized peritonitis (OR = 5.2; 95% CI: 2.3–11.5) were independent predictors of mortality. Additionally, delayed admission (>48 hours) and the presence of septic shock significantly increased the risk of fatal outcomes. Overall, the results demonstrate that lethality in complicated abdominal wall hernias is determined by a complex interplay of clinical and morphological factors. Advanced age, delayed presentation, systemic infection, and severe ischemic bowel damage represent the most critical determinants of poor prognosis. [7-12]

Discussion

The findings of the present study confirm that lethality in patients with complicated abdominal wall hernias remains a significant clinical challenge and is determined by a complex interaction of clinical presentation, systemic response, and morphological severity of tissue damage. The observed overall mortality rate of 14.5% is consistent with previously reported data in emergency hernia surgery, where mortality ranges between 5% and 20%, increasing substantially in cases complicated by strangulation, bowel necrosis, and generalized peritonitis.[9,10] One of the most important findings of this study is the strong association between delayed hospital admission and increased mortality. Patients presenting more than 24–48 hours after symptom onset demonstrated significantly higher rates of bowel necrosis, sepsis, and death. This reflects

the well-established pathophysiological progression from reversible ischemia to irreversible transmural necrosis and perforation.[12]

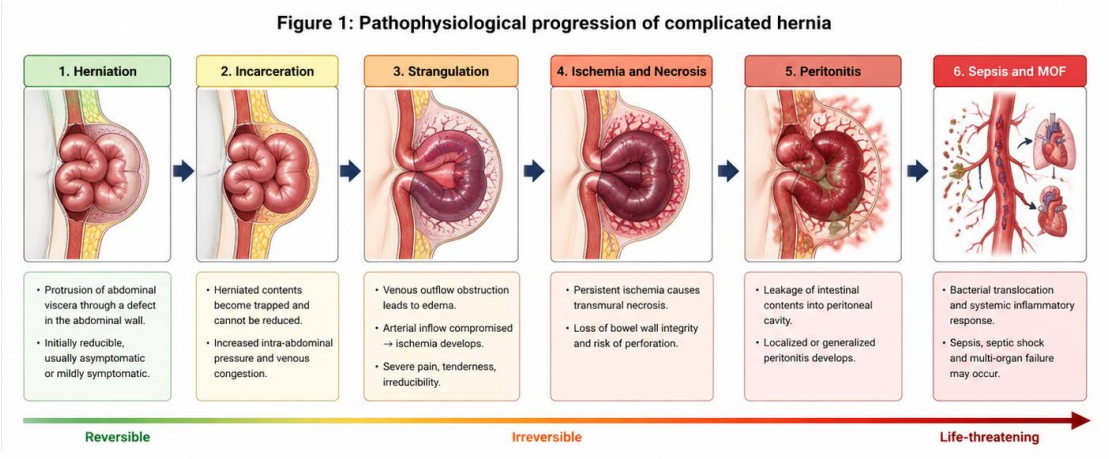

Figure 1. Pathophysiological progression of complicated abdominal wall hernia, demonstrating the transition from herniation to sepsis and multi-organ failure.

Early diagnosis and timely surgical intervention remain the most critical modifiable factors in reducing lethality.Age was identified as an independent predictor of mortality, with patients aged ≥65 years demonstrating significantly worse outcomes. This can be explained by reduced physiological reserve, higher prevalence of comorbidities, and impaired immune response in elderly patients. The high mortality observed in patients with ASA class III–IV further supports the importance of preoperative systemic condition as a determinant of prognosis. Similar findings have been reported in multiple clinical studies, emphasizing that patient-related factors are as important as disease severity in predicting outcomes.[6]

Sepsis and septic shock emerged as the most powerful clinical predictors of mortality in this study. The high prevalence of bacterial translocation and systemic inflammatory response among non-survivors highlights the central role of infection in the progression of complicated hernias. Once systemic infection develops, it significantly worsens hemodynamic stability and increases the risk of multi-organ failure. This underscores the necessity of early antibiotic therapy, aggressive resuscitation, and prompt surgical source control.

From a morphological perspective, the degree of bowel wall damage was strongly correlated with patient outcomes.

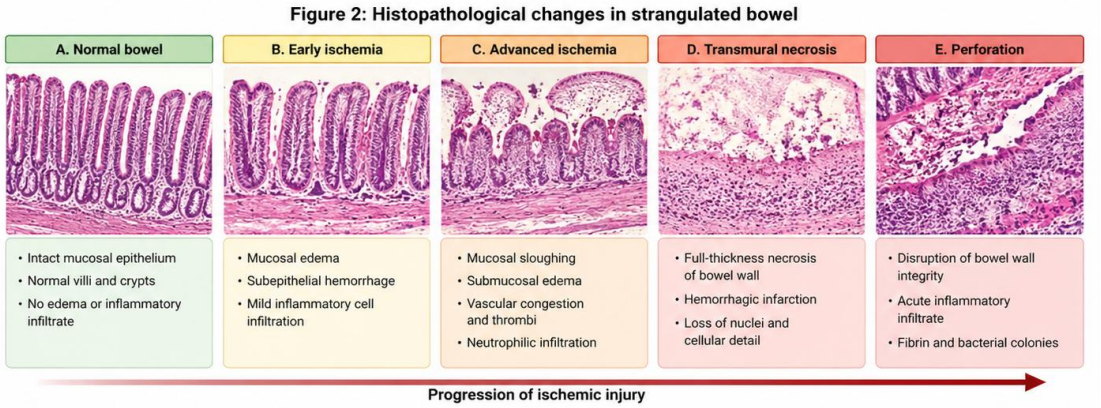

Figure 2. Histopathological changes in strangulated bowel, illustrating progressive ischemic injury from early mucosal damage to transmural necrosis and perforation.

Transmural necrosis, hemorrhagic infarction, and vascular thrombosis were significantly more frequent in non-survivors, indicating advanced and irreversible ischemic injury. These findings are in line with histopathological studies demonstrating that full-thickness necrosis is associated with a high risk of perforation, peritonitis, and septic complications. The presence of generalized peritonitis was identified as the strongest intraoperative predictor of mortality, reflecting the severity of intra-abdominal contamination and systemic inflammatory burden.[9,10] The need for bowel resection, particularly extensive resections, was also associated with increased lethality. This may be explained not only by the severity of underlying pathology but also by the increased risk of postoperative complications such as anastomotic leakage, intra-abdominal abscess, and prolonged septic states. Therefore, intraoperative decision-making plays a crucial role in balancing radicality and patient safety.

Importantly, the results of this study demonstrate that both clinical and morphological factors should be integrated into a unified prognostic approach. Isolated assessment of either clinical presentation or intraoperative findings may not provide sufficient predictive accuracy. Instead, a combined evaluation—including patient age, comorbidities, duration of symptoms, presence of sepsis, and extent of morphological damage—offers a more reliable method for risk stratification. [3,4] These findings have important implications for clinical practice. First, increasing awareness among patients and primary care providers regarding the urgency of complicated hernias may reduce delays in hospital admission. Second, the development of standardized clinical scoring systems incorporating both systemic and morphological parameters could improve early risk assessment. Third, optimizing perioperative management, particularly in high-risk patients, may significantly reduce mortality.[5]

However, this study has certain limitations. The relatively limited sample size and the single-center design may affect the generalizability of the results. Additionally, although both retrospective and prospective data were included, potential selection bias cannot be completely excluded. Future multicenter studies with larger patient populations and standardized protocols are required to validate these findings and further refine prognostic models.

Conclusion

In conclusion, lethality in patients with complicated abdominal wall hernias remains a significant and multifactorial clinical problem, driven by the interplay of patient-related factors, disease progression, and morphological severity of tissue damage. The findings of this study demonstrate that advanced age, delayed hospital admission, presence of comorbidities, and the development of systemic inflammatory conditions such as sepsis and septic shock are key clinical determinants of poor outcomes. Equally important, morphological factors—particularly transmural bowel necrosis, vascular thrombosis, perforation, and generalized peritonitis—play a decisive role in determining prognosis. These structural changes reflect the progression from reversible ischemia to irreversible tissue damage and are strongly associated with increased mortality. The need for bowel resection, especially in extensive and advanced cases, further contributes to the risk of adverse postoperative outcomes. The integration of clinical and morphological parameters provides a more comprehensive and reliable approach to risk stratification in patients with complicated hernias. Early recognition of high-risk patients, prompt surgical intervention, and aggressive perioperative management are essential to reducing lethality. In particular, minimizing delays in hospital admission and improving early diagnostic accuracy should be considered primary targets for intervention. Despite advances in surgical techniques and critical care, mortality rates remain high in severe cases, emphasizing the need for continued research and optimization of treatment strategies. Future multicenter studies with larger cohorts and standardized assessment tools are required to refine prognostic models and improve clinical decision-making. Overall, a multidisciplinary and timely approach, based on both clinical assessment and morphological evaluation, is crucial for improving survival outcomes in patients with complicated abdominal wall hernias.

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