Current Approaches in the Management of Complicated Hernias: Focus on Strangulated, Obstructed, and Recurrent Cases

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Abstract

Complicated hernias strangulated, obstructed, and recurrent are surgical emergencies with high morbidity and mortality. Strangulation involves vascular compromise leading to ischemia, obstruction causes bowel blockade, recurrence follows previous repair failure. Approximately 5-15% of inguinal hernias present with complications, with 5-year recurrence rates exceeding 40-70%. CT imaging is the gold standard, supplemented by ultrasound (>90% sensitivity) and biomarkers including elevated lactate and CPK. Diagnostic laparoscopy serves dual diagnostic-therapeutic roles when imaging is inconclusive. Immediate resuscitation includes aggressive fluid replacement, nasogastric decompression, and broad-spectrum antibiotics, followed by urgent surgical intervention within 24 hours. Open repair is preferred for unstable patients and laparoscopic repair is viable in stable cases. Mesh selection depends on contamination class, with emerging evidence supporting selective synthetic mesh use. Multidisciplinary management timely diagnosis, aggressive resuscitation, judicious surgery, and thoughtful material selection optimizes outcomes in this high-risk population.

Keywords: Complicated hernias, strangulated hernia, obstructed hernia, recurrent hernia, surgical emergency, hernia repair, mesh repair, laparoscopic repair, , hernia recurrence, surgical management**.**

1 Introduction

Complicated hernias encompass a spectrum of acute hernia presentations requiring urgent intervention. An incarcerated hernia is defined as a hernia where contents have become irreducible due to narrow fascial openings or adhesions between contents and hernia sac. A strangulated hernia occurs when vascular compromise develops, typically through venous obstruction followed by arterial compromise, leading to tissue ischemia and potential necrosis. An obstructed hernia presents with intestinal obstruction secondary to pressure at the hernia neck without immediate vascular compromise. Richter hernias represent a variant where only the anti-mesenteric border of bowel wall becomes trapped while the lumen remains patent,

potentially delaying clinical recognition. Recurrent hernias are defined as hernia reappearance at the same or adjacent site following previous repair [1–3].

Complicated hernias constitute a significant surgical emergency. Approximately 5-15% of inguinal hernia patients present with complications requiring emergency surgery. The global burden of hernia disease is substantial, with the middle sociodemographic index regions experiencing 4.00 million incident cases in 2019. Among hernias presenting as emergencies, 50% manifest with features of intestinal obstruction, irreducibility, and strangulation [3,4]. Recurrent hernias present substantial challenges, with 5-year recurrence rates reaching 44.9% for mesh repairs and 73.7% without mesh in ventral hernia repair. Among patients undergoing recurrent emergent hernia repairs, 77% underwent one recurrent repair, while 36.5% experienced mortality during the study period. The lifetime risk of strangulation for inguinal hernias is low (0.27% for 18-year-old males), but once strangulation occurs, the clinical consequences are severe. Incarcerated hernias carry a 3% risk of progression to strangulation with observation, necessitating surgical intervention [1,5].

This review synthesizes current evidence-based approaches to management of strangulated, obstructed, and recurrent complicated hernias. It addresses diagnostic strategies, surgical techniques (open and minimally invasive approaches), mesh utilization, perioperative optimization, and prevention of recurrence. The objective is to provide clinicians with contemporary guidance on managing these high-morbidity surgical emergencies.

2 Pathophysiology of Complicated hernias

2.1 Obstructed hernia

An obstructed hernia occurs when a segment of bowel becomes trapped within the hernial sac, leading to mechanical intestinal blockage. The obstruction causes proximal dilatation of the bowel and accumulation of fluid and gas. This results in electrolyte imbalance, dehydration, and bacterial proliferation. If left untreated, obstruction can progress to strangulation [6].

2.2 Strangulated hernia

Strangulation develops when venous outflow from the herniated bowel is obstructed, followed by arterial compromise. This leads to congestion, ischemia, necrosis, and eventually perforation. The ischemic tissue releases toxins and bacteria into circulation, leading to sepsis and multi-organ dysfunction if untreated. Mortality rises significantly once bowel gangrene sets in [7].

2.3 Recurrent hernia

Recurrent hernias develop after previous repair and result from technical errors, mesh infection, poor wound healing, or patient-related factors such as obesity, smoking, or chronic cough. Scar tissue and fibrosis around the operative site weaken the abdominal wall, creating a structurally fragile area prone to re-herniation. These cases are more complex surgically and carry a higher risk of obstruction and strangulation. The causes are multifactorial, Technical errors during the initial surgery (e.g., inadequate mesh fixation, improper overlap, tensioned tissue repair). Biological factors such as poor wound healing, infection, or seroma formation. Patient-related factors including obesity, smoking, diabetes, chronic cough, or heavy lifting [8].

3 Clinical presentation of Complicated hernia

The clinical presentation of complicated hernias varies depending on whether the patient presents with obstruction, strangulation, or recurrence. Although hernias often remain asymptomatic in the early stages, progression to complications results in acute and

recognizable signs that demand urgent surgical attention. Most patients with complicated hernias present with painful swelling at a known hernia site. The swelling is often irreducible, firm, and tender, contrasting with the soft, reducible bulge of an uncomplicated hernia. Local skin changes such as erythema, edema, or warmth may suggest strangulation or impending ischemia. Accompanying systemic features, such as fever, tachycardia, hypotension, or features of sepsis, indicate progression to advanced disease [7].

3.1 Obstructed hernia

An obstructed hernia manifests primarily with symptoms of intestinal obstruction. The sequence typically begins with colicky abdominal pain, reflecting hyperperistalsis proximal to the obstruction. This is followed by abdominal distension, nausea, vomiting, and absolute constipation. On examination, the abdomen is distended with visible peristalsis in early stages, later progressing to hypoactive or absent bowel sounds as ileus sets in. The hernia itself is tense, tender, and irreducible [6].

3.2 Strangulated hernia

Strangulated hernia represents an acute surgical emergency. Patients often present with sudden, severe, localized pain at the hernia site, which may radiate to the abdomen. Unlike obstruction, the pain is constant and progressively worsens due to ischemia. Clinical signs include irreducible, tense, tender swelling at the hernia site Figure: 2. Skin changes erythema, edema, or dusky discoloration overlying the hernia. Systemic features tachycardia, fever, leukocytosis, and eventually shock. If bowel necrosis or perforation occurs, peritonitis develops with guarding, rigidity, and rebound tenderness [9].

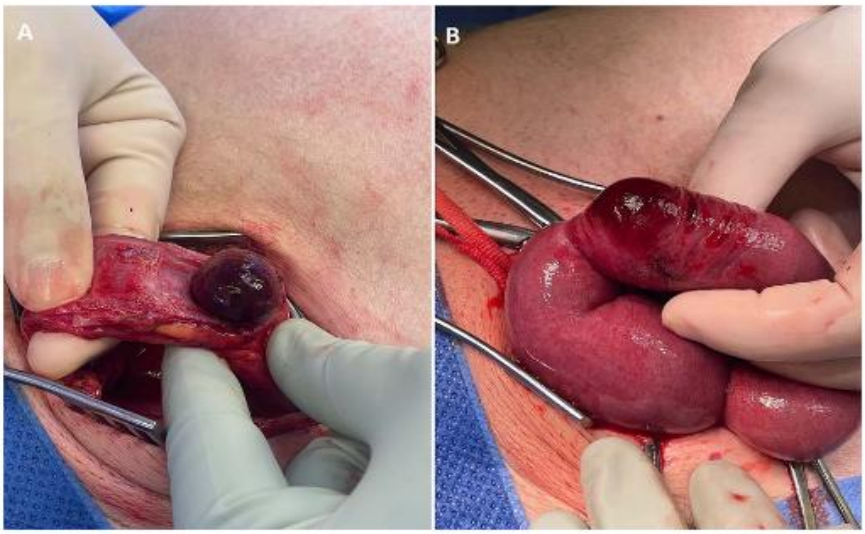

Figure: 1 Intra-operative images show: (A) a strangulated small bowel visible upon opening the indirect inguinal hernia sac, and (B) the exteriorized bowel segment, revealing that only the anti-mesenteric border was trapped features characteristic of a Richter's hernia.

3.3 Recurrent Hernia

The clinical presentation of recurrent hernias is often more insidious compared to obstruction or strangulation. Patients frequently report a return of swelling or bulge at or near the site of a previous hernia repair. The swelling may initially be reducible but tends to increase in size over time. Symptoms include discomfort or pain at the operative site, especially during exertion, coughing, or lifting heavy objects. Cosmetic concerns due to visible bulge. In complicated recurrent cases, patients may present with obstruction or strangulation similar to primary hernias [8].

3.4 Special Clinical Considerations

Elderly patients may present with vague abdominal pain or confusion rather than classic symptoms, delaying diagnosis. In Obese patients hernia site may be difficult to identify due to overlying adipose tissue, masking strangulation. In Women femoral hernias are more common and have a higher risk of strangulation, often presenting late [7].

4 Diagnosis of Complicated hernias

4.1 Clinical assessment

Complicated hernias present with acute symptoms requiring prompt diagnosis. Strangulated hernias typically present with sudden, severe localized pain, irreducible swelling, nausea, vomiting, and signs of acute abdomen with abdominal wall rigidity. Obstructed hernias manifest with intestinal obstruction symptoms including abdominal distension, inability to pass gas or stool, and vomiting. Patients with complicated hernias often exhibit systemic inflammatory response syndrome (SIRS) features including fever, tachycardia, and leukocytosis [3,10].

4.2 Computed Tomography

Computed Tomography (CT) is the gold standard for diagnosing complicated hernias in acute settings. CT with contrast provides detailed visualization of fascial defects, herniated contents, and signs of strangulation including bowel wall thickening, free fluid in the sac, and fat stranding **Table *1***[11]. CT is superior for identifying acute complications such as bowel obstruction and is considered the optimal first-line imaging modality for emergency presentations [11,12].

Table 1 CT key points of internal hernias

Bowel configuration	A saclike mass or cluster of dilated small bowel loops within an abnormal anatomic location in the setting of small bowel obstruction
Mesenteric abnormalities	Convergence of vessels and mesenteric fat at the hernia orifice Displacement of key mesenteric vessels Engorgement, crowding, twisting, or stretching of the mesenteric vessels may be observed when strangulation is present.
Position of surrounding viscera	Displacement of surrounding structures around the hernia sac

4.3 Ultrasound

Ultrasound (Ultrasonography) provides real-time, non-invasive assessment with high sensitivity (>90%) and specificity (82-86%). Sonographic signs of incarceration include free fluid in the hernial sac, bowel wall thickening, fluid-filled bowel loops within the hernia, and dilated loops in the abdomen. When two or more of these signs are present, sensitivity and specificity for incarceration reach 100% [13].

4.4 Magnetic Resonance Imaging

Magnetic Resonance Imaging (MRI) excels in soft-tissue assessment and visualization of mesh-related complications in recurrent hernia cases, particularly for chronic complications [12].

4.5 Laboratory Findings

Serum creatinine phosphokinase (CPK) appears to be a reliable indicator of early intestinal strangulation. Elevated serum lactate (≥2.0 mmol/L) is the most useful laboratory parameter predicting nonviable bowel in strangulation. D-dimer elevation correlates with intestinal ischemia, though with low specificity. Leukocytosis and elevated C-reactive protein reflect systemic inflammation [10,14].

4.6 Diagnostic Laparoscopy

In doubtful cases, diagnostic laparoscopy serves as both a diagnostic and therapeutic tool, particularly when imaging results are inconclusive. It allows direct visualization of bowel viability and facilitates immediate repair [15].

5 Initial Resuscitation and Pre-operative Care in Complicated Hernias

Complicated hernias, such as strangulated, obstructed, or recurrent cases, are considered true surgical emergencies. However, immediate surgery without stabilization can worsen outcomes. Therefore, the cornerstone of management begins with resuscitation and pre-operative optimization to improve survival and reduce perioperative morbidity.

5.1 Hemodynamic Stabilization and Airway Management

The initial management of patients with complicated hernias focuses on rapid hemodynamic stabilization before surgical intervention. At least two large-bore intravenous lines should be secured to allow rapid fluid infusion and administration of medications. Oxygen supplementation is provided to maintain adequate oxygenation, and continuous monitoring of vital signs including heart rate, blood pressure, and oxygen saturation is essential. In patients with altered mental status or hemodynamic instability, airway assessment and management become critical priorities [10,16].

5.2 Fluid Resuscitation and Electrolyte Correction

Aggressive fluid resuscitation is necessary to correct hypovolemia and metabolic derangements commonly seen in strangulated hernias. Isotonic crystalloid solutions (0.9% normal saline or lactated Ringer's) are administered initially as boluses of 1-2 liters, with continued infusion titrated to clinical endpoints including restoration of blood pressure, improved urinary output, and normalization of mental status. The goal is to achieve euvolemia while avoiding excessive fluid administration that may precipitate complications such as pulmonary edema [17].

5.3 Nasogastric Decompression

A large-bore nasogastric tube should be inserted for gastric decompression, particularly in patients with intestinal obstruction. This measure reduces abdominal distension, alleviates nausea and vomiting, and decreases the risk of aspiration [10,16].

5.4 Antibiotic administration

Intravenous broad-spectrum antibiotics should be initiated early to cover gram-negative organisms, gram-positive bacteria, and anaerobes. Standard prophylaxis includes cephalosporins such as cefazoline (1 g IV), which has been shown to effectively reduce surgical site infections in emergency hernia repair. In patients requiring surgical intervention due to

suspected bowel perforation or peritonitis, therapeutic rather than prophylactic antibiotics are indicated [10].

5.5 Urgent Surgical Intervention

Patients with suspected intestinal strangulation should undergo emergency hernia repair immediately when strangulation is suspected, as delayed diagnosis and intervention beyond 24 hours significantly increases mortality and morbidity rates. The decision to proceed to surgery should not be delayed by prolonged attempts at resuscitation if clinical signs of strangulation are evident [10,16].

6 Surgical Management of Complicated Hernias

6.1 Operative timing

Complicated hernias are time-critical conditions. Immediate surgery is indicated when strangulation is suspected clinically or on imaging (localized severe pain, irreducibility with systemic toxicity; CT signs of ischemia/closed-loop obstruction). Early operation reduces bowel necrosis and the need for resection, and lowers postoperative morbidity. International emergency-surgery guidance emphasizes prompt exploration once resuscitation is underway and a high index of suspicion exists. Emerging data also support the “time-to-knife” concept: prolonged symptoms (e.g., ≥24 h from onset) correlate with non-viable bowel and worse outcomes, reinforcing early operative decisions [10,18].

6.2 Open Repair

Open repair remains the gold standard approach for managing complicated hernias especially in patients who are hemodynamically unstable, present with diffuse peritonitis, or are at high risk of requiring bowel resection. This approach provides immediate, wide exposure of the surgical field, allowing surgeons to safely assess bowel viability, perform urgent resections, manage contamination, and create stomas if needed *Figure: 2* [19]. It is particularly valuable in resource-limited settings where laparoscopic infrastructure may be unavailable. International consensus, including the World Society of Emergency Surgery (WSES) guidelines, strongly supports open repair under these conditions, reinforcing its role as the default approach in emergencies with high contamination or physiologic compromise [10].

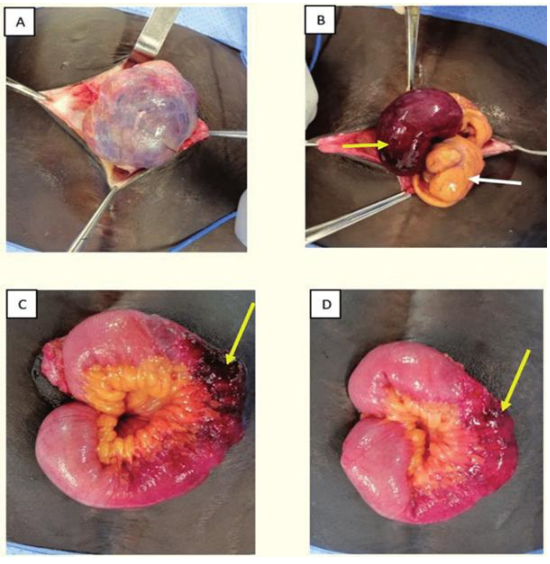

Figure: 2 Intra-operative image showing the open approach to a strangulated umbilical hernia

6.3 Laparoscopic Repair

Laparoscopic repair is increasingly being adopted for complicated hernias but only in carefully selected cases. In stable patients without overt bowel ischemia or contamination, this minimally invasive approach brings tangible benefits: less postoperative pain, shorter hospital stays, quicker return to normal activities, and the capability to survey the entire peritoneal cavity, which may reveal occult hernias or previously undetected pathology. A 2025 prospective cohort study demonstrated that laparoscopic repair of incarcerated incisional hernia resulted in significantly reduced pain, shorter hospital stays, and less perioperative bleeding compared to open repair *Table 2* [20]. Moreover, multiple retrospective series have confirmed its feasibility and safety in emergency settings, with no increase in recurrence rates. Nevertheless, laparoscopy is contraindicated in unstable or septic patients, or where extensive bowel compromise is suspected, as it may prolong operative time and elevate technical challenges. Consensus guidelines advocate a tailored approach, preferring laparoscopy in stable cases managed by experienced surgeons in well-equipped centers [21].

Table 2 Various methods for laparoscopic hernia repair in complicated cases.

Operation	Concept	Applied to
IPOM	Intraabdominal peritoneal onlay mesh repair	1. Incision hernia 2. Recurrent hernia
TAPP	Transabdominal laparoscopic preperitoneal hernia repair	1. Large hernial sac 2. Incarcerated hernia 3. Female patients
TEP	Totally Extraperitoneal hernia repair	1. Straight hernias 2.Bilateral hernias 3. Elderly patients
Robotic inguinal hernia repair	Robotic inguinal hernia repair	Robotic inguinal hernia repair is currently performed at only a few hospitals, where it is available

6.4 Intraoperative priorities: reduction and viability

During surgery, the main priorities are safe reduction of hernia contents and assessment of bowel viability. If the bowel is viable, definitive hernia repair is performed. When viability is uncertain, the bowel may be observed with warming and oxygenation, with reassessment or a planned relook if required. Non-viable bowel mandates resection, with primary anastomosis undertaken if conditions are favourable, or a stoma created to reduce risk in high-contamination settings. These decisions are guided by WSES recommendations, which standardize management based on wound class and contamination severity [22].

6.5 Mesh strategy by contamination class

Mesh selection in hernia repair should be guided by contamination level and the balance between infection risk and recurrence. In clean or clean-contaminated fields, such as obstruction without spillage or controlled resection with minimal contamination, synthetic

mesh is recommended as it lowers recurrence rates. In contaminated or dirty settings, including ischemic perforation or gross spillage, traditional teaching favors suture repair; however, emerging evidence indicates that carefully selected synthetic meshes can be safe when combined with meticulous technique and appropriate antibiotic use. Systematic reviews have shown no significant rise in surgical-site infection with mesh across contamination classes, and randomized trials report lower recurrence with synthetic compared to biologic mesh in single-stage repairs of clean-contaminated or contaminated ventral hernias. For complex abdominal wall hernias in high-risk patients, biosynthetic or bioabsorbable meshes are a promising option with favorable short-term outcomes *Table 3* [23], though long-term data remain limited [22,24].

Table 3 Summary of Biosynthetic Meshes used in Contaminated hernias

Mesh (Manufacturer)	Material Composition	Pore Size	Mesh Density	Resorption Timeline
TIGR® Matrix (Novus Scientific)	• Rapid-degrading fibers (40%): glycolide lactide TMC copolymer • Slow-degrading fibers (60%): lactide TMC copolymer	1–1.5 mm	135 g/m²	Partial resorption by ~4 months; complete resorption by ~36 months
GORE® BIO-A® (W.L. Gore)	PGA:TMC composite	Not specified	Not specified	Typically resorbed within ~6–7 months
Phasix™ (BD)	P4HB (poly-4-hydroxybutyrate)	0.26 mm	182 g/m²	Approximately 12–18 months
Transorb™ (Medtronic)	PLLA:TMC copolymer	1.4 mm	170 g/m²	Gradual resorption over ~18–60 months

Abbreviations: TMC = Trimethylene carbonate; PGA = Polyglycolide; P4HB = Poly-4-hydroxybutyric acid; PLLA = Poly-L-lactide.

6.6 Technique selection for groin vs ventral defects

The HerniaSurge and European Hernia Society guidelines advise that in recurrent inguinal hernias, the surgical approach should mirror the prior repair method choose a laparo-endoscopic (TEP/TAPP) method following a failed open repair Figure: 3 [20], and opt for an open repair after a failed laparo-endoscopic attempt [20]. In Ventral/incisional hernias (emergency) emergency management should emphasize safe content reduction, rigorous contamination control, and a repair strategy aligned with wound class and patient condition.

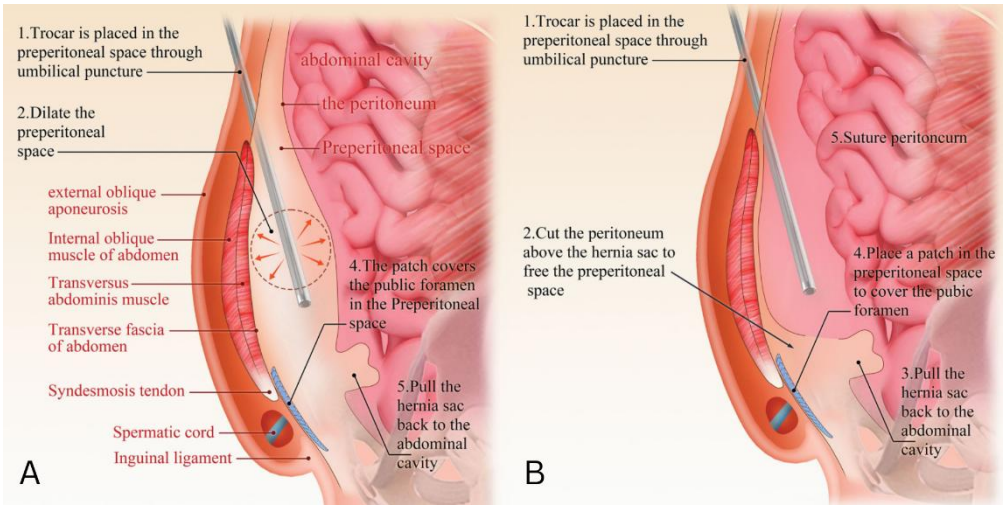

Figure: 3 Diagrammatic representation of laparoscopic hernia repair techniques: (A) TEP procedure and (B) TAPP procedure

Minimally invasive surgery may be considered in stable patients when performed by experienced surgical teams [18,22].

7 Postoperative care

Postoperative care in complicated hernia surgery centers on hemodynamic monitoring, pain control, infection prevention, and early mobilization. Multimodal analgesia and enhanced recovery protocols reduce ileus and shorten hospital stay. Antibiotic therapy should be tailored to wound class, ranging from single-dose prophylaxis in clean cases to extended courses in contaminated or strangulated hernias with bowel resection. Nutritional support with early enteral feeding, alongside correction of electrolytes, enhances recovery and prevents prolonged ileus. Continuous surveillance for complications such as wound infection, seroma, or anastomotic leak is essential, as wound-related morbidity remains frequent. Finally, long-term prevention relies on optimization of comorbidities, smoking cessation, weight control, and adherence to structured hernia-specific ERAS pathways to reduce recurrence risk [22,25].

8 Discussion and Future directions

Despite significant advances in imaging, surgical techniques, and perioperative care, the management of complicated hernias particularly strangulated, obstructed, and recurrent cases remains fraught with challenges. Emerging evidence supports selective use of permanent synthetic mesh in contaminated fields, challenging the traditional paradigm favoring biological meshes for such cases. Biosynthetic meshes such as Phasix™ provide reliable long-term durability and offer cost-effective alternatives to biologic meshes while maintaining low infection risk profiles. Additionally, novel mesh suture materials (such as Duramesh™) show promise in improving fascial closure and tissue integration in contaminated settings [26].

Regarding surgical approach, both open and minimally invasive techniques are now considered viable options for emergency hernia repair. While laparoscopic and robotic-assisted approaches traditionally have been reserved for elective cases, recent data demonstrate their safety and efficacy in emergency settings, including strangulated hernias. The implementation of robotic hernia programs has shown remarkable adoption rates, with centers reporting increases in minimally invasive major ventral hernia surgeries from 25% to 75% following program establishment [27]. These minimally invasive approaches offer the dual benefits of reduced postoperative pain, shorter recovery times, and lower complication rates compared to traditional open surgery.

9 Conclusion

Complicated hernias presenting with strangulation, obstruction, or recurrence are surgical emergencies requiring prompt recognition and management. Advanced imaging, particularly CT scanning, has improved early diagnosis. When imaging is inconclusive, diagnostic laparoscopy serves as both diagnostic and therapeutic tool, enabling assessment of bowel viability and immediate repair. Preoperative resuscitation with fluids, electrolyte correction, nasogastric decompression, and early antibiotics are essential, but surgical intervention must not be delayed beyond 24 hours in suspected strangulation. Contemporary surgical approaches incorporate both open and minimally invasive techniques with selective mesh use, including biosynthetic options in contaminated fields. While significant advances have been made, research gaps remain regarding optimal mesh selection, bowel viability assessment protocols, and recurrence prevention strategies. Future directions should prioritize biocompatible materials, tissue engineering, and standardized management protocols across centers. Ultimately, multidisciplinary management combining timely diagnosis, aggressive resuscitation, judicious surgery, and thoughtful material selection optimizes outcomes in this high-risk population.

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