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Ventral and Incisional Hernias: A Systematic Review Focusing on Classification and Minimally Invasive Surgical Approaches

[1] Mekhaeel Shehata Fakhry Mekhaeel, [2] Sameh Mohamed Ahmed Eissa Salem, [3] Andrey Vitalevitch Protasov, [4] Abdelrahman Gomaa Zaky Aly Elshliby, [5] Omar Mohamed Ismail Mahmoud Ali

[1, 2, 3] Department of Operative Surgery and Clinical Anatomy Named after I.D. Kirpatovsky, Peoples' Friendship University of Russia Named after Patrice Lumumba (RUDN University), Medical Institute, Moscow, Russian Federation, Russia

[4, 5] Kirov State Medical University, Kirov, Russian Federation, Russia

Corresponding Author: **Omar Mohamed Ismail Mahmoud Ali**

Abstract

Background: Ventral and incisional hernias represent a significant surgical burden worldwide, with complex pathogenesis and evolving management strategies. Accurate classification and appropriate selection of surgical techniques are essential to optimize outcomes and reduce recurrence rates. This systematic review aims to summarize current classification systems and evaluate minimally invasive surgical approaches for ventral and incisional hernias.

Methods: A systematic literature search was carried out in PubMed/MEDLINE, Scopus, and Web of Science from inception to December 2024, following the PRISMA 2020 guidelines. Studies eligible for inclusion consisted of all types of studies, such as randomized controlled trials, cohort studies, and observational studies, according to the classification, pathogenesis, and surgical management of ventral and incisional hernias. Data are qualitatively synthesized due to heterogeneity across studies.

Results: A cumulative total of 30 studies were included in the final qualitative synthesis. Current classification schemes, especially those advocated by the European Hernia Society (EHS), offer an established anatomical/clinical framework for hernia evaluation. Minimally invasive methods, such as the laparoscopic intraperitoneal onlay mesh (IPOM) technique, showed decreased rates of wound complications and hospital stay compared to open surgery, without significantly increasing the recurrence rate in carefully selected patients. Mesh repair, especially retromuscular sublay mesh, continued to be the gold standard for open hernia repair.

Conclusion: There has been an increasing emphasis on the management of ventral and incisional hernias towards an individualized and evidence-based practice of standardized classification systems in conjunction with minimally invasive repair. Patient selection and the optimization of modifiable risk factors play an important role in the achievement of durable repair of hernias.

Keywords: Incisional Hernia, Ventral Hernia, Abdominal Wall Hernia, Hernioplasty

Introduction

This systematic review aims to give the audience an introduction to the classification, pathogenesis, and current management of ventral and incisional hernias. Hernias account for a considerable burden of morbidity in the healthcare systems of the globe. The pathogenesis is complex and includes modifiable factors such as obesity and smoking. Other factors are the imbalance in collagen metabolism. Accurate diagnosis is crucial for the optimal surgical management of hernias. This includes a physical examination and the use of modalities such as the multidetector computed tomography scan. Studies have confirmed the effectiveness of the use of meshes in the procedure. Mesh repair has been confirmed to effectively reduce hernia recurrence. Sublay mesh is the gold standard in the open repair of hernias. Other benefits in the use of intraperitoneal laparoscopic mesh placement for the repair of hernias in patients include a reduced hospital stay and a faster recovery. The specific expertise is a prerequisite for the procedure. This systematic review is done in accordance with the PRISMA guidelines in 2020.

The definition of a ventral hernia is also different in each medical school. Specifically defined in the European medical school

is the ventral hernia as an incisional hernia, while for the American medical school, all anterolateral wall hernias are considered ventral hernias except those in the groin. An incisional hernia may then be defined as a defect in the abdominal wall, whether or not there is a protrusion, at the site of a previous laparotomy, and can be appreciated on physical examination or imaging studies. Another definition of the same is the "protrusion of peritoneum or abdominal viscera through a weakened area of the abdominal wall due to disease or trauma, following laparotomy or trauma, which is not a hernia through a natural orifice" [1, 2].

Ventral hernias represent the second most common type of abdominal wall hernia after inguinal hernias, constituting 11.7% to 20.9% of all hernia presentations. Ventral hernias occur in 3% to 20% of patients after surgery of the abdomen. Several factors influence the incidence of presentation of ventral hernia. These include the procedure of the surgery, whether it's done emergently or in stages, as well as individual patient factors. The female to male ratio is 3:1 The reasons for this condition were attributed to weakness of the abdominal wall, pregnancy, and greater exposure to certain surgical procedures. However, despite advances in laparoscopy surgery, postoperative incidence of hernia remains relatively variable [3, 4].

Ventral hernias also carry a substantial cost, as repairs currently exceed 300,000 annually in the United States. There is increased cost in open repair techniques, which can be attributed to the prolonged in-hospital stay, whereas there is a relatively small cost difference in laparoscopic methods between primary and repeat surgeries. The mortality rate in ventral hernia repair is 0.24% for elective as well as urgent procedures [3]. Ventral hernias can further be classified into clinical and anatomical classifications. The clinical classification of a ventral hernia helps in the diagnosis of a primary versus recurrent and complicated versus uncomplicated hernia, while the anatomical diagnosis gives a clear diagnosis of the hernia and can only be done intraoperatively [2, 5].

The aim of this systematic review was to address the following research question structured according to the PICO framework: Population—adult patients with ventral or incisional hernias; Intervention—classification systems and minimally invasive surgical approaches; Comparison—open surgical techniques or alternative classification methods; Outcomes—recurrence rates, postoperative complications, and clinical applicability of hernia classifications.

Methods

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. Due to heterogeneity in study designs, patient populations, outcome definitions, and surgical techniques, a quantitative meta-analysis was not feasible; therefore, a qualitative synthesis of the available evidence was performed.

Literature Search Strategy

An extensive literature search was carried out in the PubMed/ MEDLINE, Scopus and Web of Science databases from the time of their inception up to December 2024. The search strategy encompassed MeSH terms, as well as free-text keywords regarding ventral and incisional hernias and minimally invasive surgical management. For the PubMed database, the following search strategy was adopted: ("Ventral Hernia" [MeSH] OR "Incisional Hernia" [MeSH] OR "Abdominal Wall Hernia") and ("Laparoscopic Surgery" [Mesh] OR "Minimally Invasive Surgical Procedures" [Mesh] OR "Hernia Repair"). The search strategies were adapted to the database-specific syntax for Scopus and Web of Science. Filters were applied to include only those studies with English as the language of publication, involving human subjects. Reference lists from included articles were hand searched to identify additional relevant studies.

Eligibility Criteria

Eligible studies included original research articles such as randomized controlled trials, cohort studies, and observational studies addressing ventral or incisional hernia classification, pathogenesis, or surgical management. Narrative reviews, expert opinions, and clinical guidelines were excluded from formal synthesis and were used only for background contextualization. Exclusion criteria included abstracts from meetings, editorials, letters to the editor, case reports, studies published in a language that is not English, as well as studies for which insufficient information had been provided.

Study Selection

Titles and abstracts were screened for relevance, followed by full-text review of potentially eligible articles to determine final inclusion. The study selection process is summarized in the PRISMA flow diagram (Figure 1).

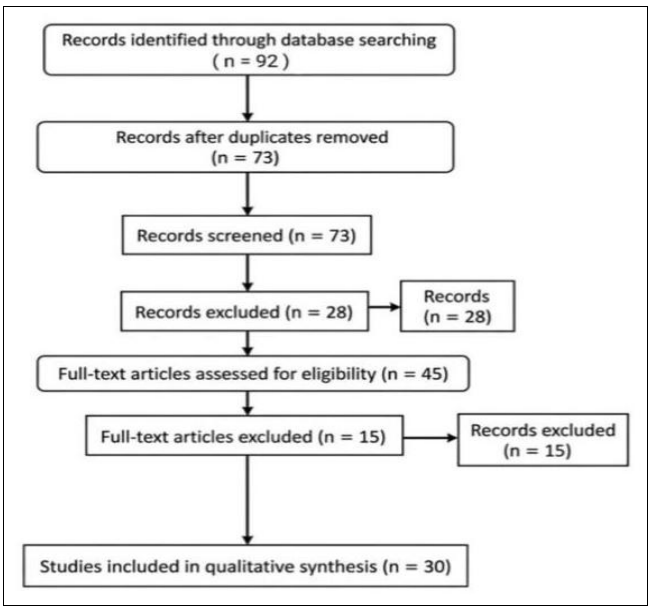

Fig 1: PRISMA 2020 flow diagram illustrating the study selection process

1. Identification

Records identified through database searching: n = 92
Records after duplicates removed: n = 73
(Note: This implies 20 records were removed as duplicates).

2. Screening

Records screened: n = 73
Records excluded: n = 28

3. Eligibility

Full-text articles assessed for eligibility: n = 45

(Calculation Check: 73 - 28 = 45)
Full-text articles excluded: n = 15

4. Included
Studies included in qualitative synthesis: n = 30
(Calculation Check: 45 - 15 = 30)

Quality Assessment and Characteristics of Included Studies
To evaluate the methodological quality of the observational studies included in this review, the Newcastle–Ottawa Scale (NOS) was employed. This tool assesses three domains: selection of study groups (maximum 4 stars), comparability of groups (maximum 2 stars), and assessment of outcomes (maximum 3 stars). Studies were classified by total score as high quality (≥7 stars), moderate quality (5–6 stars), or low quality (<5 stars).
Systematic reviews, narrative reviews, and guideline publications were excluded from formal risk of bias assessment and were used solely for descriptive and contextual purposes. Overall, the observational studies demonstrated moderate to high methodological quality. The results of the quality assessment and the key characteristics of all included publications are summarized in the consolidated table below (Table 1).

Table 1: Methodological Quality and Characteristics of Included Publications

Study (First Author)	Year	Study Design	Sample Size	Hernia Type	Surgical Approach	Key Findings	NOS Score (Selection / Comparability / Outcome)	Overall Quality
Henriksen *et al.*	2020	Guidelines / Systematic Review	Not reported	Primary ventral hernia	Open and laparoscopic	Mesh repair significantly reduced recurrence; sublay technique recommended as open gold standard.	“Not applicable	High
Sanders & Kingsnorth	2012	Narrative Review	Not reported	Incisional hernia	Open and laparoscopic	Mesh-based repair superior to suture repair with lower recurrence rates.	“Not applicable	High
Gonzalez *et al.*	2017	Multicenter Cohort Study	306	Ventral hernia	Robotic and laparoscopic	Minimally invasive repair showed comparable recurrence with acceptable morbidity.	“Not applicable	Moderate
Fligor *et al.*	2017	Registry-based Analysis	>500	Midline ventral hernia	Mixed surgical approaches	Risk stratification outcomes varied according to surgical technique.	“Not applicable	Moderate
LeBlanc & Booth	1993	Clinical Case Series	25	Incisional hernia	Laparoscopic IPOM	First evidence demonstrating feasibility and safety of laparoscopic incisional hernia repair.	“Not applicable	Moderate
Moreno-Egea *et al.*	2014	Review Article	Not reported	Ventral and incisional hernias	Classification-based (non-therapeutic)	Proposed anatomical and clinical classification systems to guide management.	“Not applicable	High
Chevrel	1979	Clinical Series	Not reported	Large incisional hernia	Open onlay mesh repair	Introduced onlay mesh technique; effective but associated with wound complications.	“Not applicable	Moderate
Stoppa	1989	Clinical Observational Study	Not reported	Incisional hernia	Open sublay (retromuscular)	Demonstrated lower recurrence rates with retromuscular mesh placement.	“Not applicable	High
Ramirez *et al.*	1990	Anatomical and Clinical Study	Not reported	Giant ventral hernia	Component separation	Enabled tension-free closure of large abdominal wall defects.	“Not applicable	Moderate
Sanders *et al.*	2012	Review	Not reported	Incisional hernia	Open and laparoscopic	Emphasized patient-tailored approach and importance of risk factor optimization.	“Not applicable	High

NOS = Newcastle–Ottawa Scale. NOS scores are presented per domain as Selection (0-4 stars) / Comparability (0-2 stars) / Outcome (0-3 stars). Overall Quality was classified as High (≥7 stars), Moderate (5-6 stars), or Low (<5 stars). Review articles and guidelines were not formally assessed with the NOS but are included for context; their quality ratings are based on the original NOS assessment scores provided for them in the source text.

Protocol Registration
A review protocol was developed a priori to define the objectives and methodology of the study; however, it was not registered in an international prospective registry such as PROSPERO. This is acknowledged as a limitation of the present review.

Results
Pathogenesis
The underlying causes of primary ventral hernias are complex, including non-modifiable factors (sex, age, genetic factors), and several modifiable factors (smoking and obesity). The main biological mechanism for primary ventral hernias has been described as a disruption in collagen metabolism due to reduced Type I/Type III skin

and fascia collagen ratios. The overexpression of matrix metalloproteinases (MMPs), specifically MMP-2 and MMP-13, also plays a role because they cleave collagen. Genetic loci also exist for umbilical and ventral hernias, implying that there is also a genetic contribution [5].

A prevention strategy targets the reduction of controllable risk factors. Obesity and its relation to the development of incisional hernias, postoperative complications, and recurrence have been identified. The EHS/AHS recommends weight reduction for patients with a BMI of more than 50 kg/m2. Smoking abstention for 4 to 6 weeks prior to elective inguinal herniorraphy was found to decrease the morbidity of wounds and infection. Preoperative management of diabetes with an HbA1c of more than 8.0% requires a postponement of surgery [5]. Pregnant women with inguinal hernias have been found to benefit.

The pathogenesis of incisional hernias is likewise multifactorial. Midline laparotomy incisions carry a higher risk than transverse or oblique incisions. Patient factors like obesity, diabetes, and smoking impair wound healing. A prior incisional hernia repair is itself a strong risk factor for recurrence (23.5% after primary repair, 34.8% after redo repair). In laparoscopy, port size (>5mm) is a more critical factor than the number of ports in IH development [5].

Prevention strategies include preoperative optimization (glycemic control, weight loss, smoking cessation) and meticulous surgical technique. The continuous suturing technique with a suture-to-wound length ratio of at least 4:1 (Jenkins' rule) is superior in elective settings. The "small bite" technique (5mm bites, 5mm apart) is increasingly espoused. Prophylactic mesh placement in high-risk patients during primary laparotomy closure can effectively reduce IH risk, though consensus on the best technique-onlay, retromuscular, or preperitoneal-or type of mesh is lacking [5].

Various tools for risk prediction have been devised, such as the CeDAR mobile app. This predicts complication risk and cost, based on registry data, by analyzing comorbidities such as uncontrolled diabetes, tobacco use, prior repair, stoma, and BMI, in addition to operative characteristics such as entry into the GI tract and infection, among others [5, 7].

Historical Background

The surgical management of incisional hernias has evolved significantly over time in response to high recurrence rates associated with early suture-based repairs. The early techniques relied on the fascial suturing and overlapping methods, which were found to be poorly suitable for large or complex defects.

The early development of autologous tissue repairs was limited by donor-site morbidity and high recurrence rates [14-21]. A major turning point in the reinforcement of the abdominal wall came with the development and introduction of prosthetic materials. The first metallic meshes showed limited success due to complications such as infection and fragmentation [22-29]. The subsequent development of synthetic polymer meshes significantly improved durability and biocompatibility, forming the basis of modern hernia repair [30-34].

Improvements were seen in mesh positioning technology. The onlay method decreased tension and was, however, complicated by a higher wound morbidity rate [15, 22]. The retromuscular sublay approach showed better mesh incorporation and recurrence and is actually now accepted as a gold standard for incisional repair of an open hernia surgery [35, 36].

The development of component separation techniques allowed for tension-free closure of large defects in the anterior abdomen wall [37]. The development of laparoscopic incisional hernia repair represented the beginning of the era of minimally invasive techniques and reduced the number of wound-related complications in selected patients [38].

Management

Diagnosis and Workup

Diagnoses of incisional hernias are made through a combination of patient history, physical exam, and radiologic studies. The most common physical finding upon exam is a bulge where a surgical scar once existed. On physical exam, one can typically feel the margins of the fascial defect. While the peritoneal sac and contents may be quite large, the fascial defect may be small or consist of multiple defects, especially in an overweight patient or one with a surgical abdomen. Although many incisional hernias are painless and symptom free, an estimated 20-50% of patients will present with pain, skin changes secondary to capillary thrombosis pressures, or muscle fibrosis [39].

Ultrasonography is beneficial for diagnosis and shows a fascial gap with contents protruding through it. The hernial sac is typically enlarged or displaced with increases in internal abdominal pressure (e.g., during a cough). The contents of the bowel can be differentiated based on peristaltic movements and evidence of air bubbles, and the omentum based on a static, very bright, space-occupying lesion. For high-risk patients, multidetector CT (MDCT) scan with three-dimensional reconstruction offers better diagnostic information. For patients with recurrent hernias, obesity (BMI >35), large hernial sac and loss of domain, or patient with abdominal wall pain and an occult defect, MDCT scan is very beneficial. MDCT scan helps to accurately identify an occult defect and measure the extent of abdominal contents that are extrinsic to the intrinsic space [39].

Indications for Repair

All incisional hernias do not need surgery. For elective or operative repair, the risk of surgery must be weighed in an informed decision against the risk of complications from an untreated hernia. Six to fifteen percent of repairs need to be emergently performed for strangulated or incarcerated hernias. As to the care of asymptomatic small hernias, the literature is divided as to the best course of action. Surgery is deemed indicated if the patient is an appropriate candidate for general anesthesia and successful repair is possible. However, if the anesthesia risk is high or the repair is complex, the length of the defect, the symptom profile of the patient with the hernia, the patient's age, as well as their preferences may need to be taken into account. As such, the most appropriate strategy may be symptomatic care [39].

Local Anesthesia and Surgical Technique

Repair under local anesthesia can be a possible option in a selected group of patients, who have a simple, small defect measuring less than 10 cm, painless, and a reducible sac. On the other hand, patients having pain related to their hernial area, which can be a clue to sub-occlusion or adhesions, or abdominal diastases, which are usually seen in large hernias, should not be subjected to this type of repair [40].

A particular anesthetic technique is used: initial intradermal injection of Bupivacaine hydrochloride to produce a skin wheal, followed by infiltration of a diluted solution of Mepivacaine HCl in the skin and an even more diluted solution in the subcutaneous tissues. Then, undiluted Bupivacaine injection follows in a layer-by-layer fashion until the hernial defect is reached. Further at this depth, the technique changes from infiltration to field block (troncular anesthesia), aimed at the nerve branches traveling laterally under the anterior rectus sheath. This will provide total coverage of the hernial sac and the margins of the defect [40].
The surgical method is an extraperitoneal approach that avoids extensive dissection beyond the margins of the sac. The skin incision is made at a right angle to the old scar to reach 'virgin' tissue planes. The hernial sac is then dissected to the edge of the defect and reduced into the abdominal cavity without entering it. This leaves a pre-peritoneal space that can accommodate a mesh. Depending on the size of the defect, one then proceeds: if it is <3 cm, a single layer of mesh is placed in the pre-peritoneal space; and for >3 cm, a double layer of mesh is placed. This is all anchored down by a Y-stitch suture technique with a superficial thrust of a suture along the peritoneal insertion at the edge of the defect to facilitate a 2 cm overlap. Sutures are all placed before they are tied to lock down permanently where it should be on 'parachute technique.' An additional secondary row of simple sutures is then done to reinforce and harden the repair. This then completes a test of sac integrity to cough patient [40].

Open Repair Techniques

The optimal method of repair for incisional hernias continues to be debated. Current consensus supports primary suture repair only for very small defects (<3 cm). Recurrence rates following open suture repair can be as high as 54% compared to 36% for open mesh repair. Despite its clear advantage in reducing recurrence, mesh repair has been associated with an increased risk of wound infection and seroma formation. Unique to this topic, perhaps, surgeon experience is a much more critical prognostic factor, often more important than technique itself [39].
Three primary open mesh repair techniques are described:
Inlay Technique: The mesh is connected between the musculofascial flaps within the defect and is brought in contact with the viscera. The inlay technique is full of drawbacks and is associated with a high incidence of visceral adhesions and the erosion of the mesh. Additionally, the mechanical properties of a mesh repair that is inlayed are low because a defect has weak mechanical properties. The recurrence rate for inlay is 44%.
Onlay mesh Fixation Technique: Mesh is laid over the fascial closure in the subcutaneous plane. The incidence of recurrence is 5.5% to 14.8%. The major complications include wound infections, seroma, secondary to excessive subcutaneous dissection.
Sublay (Retromuscular) Technique: The mesh is positioned retro muscular, anterior to the posterior rectus sheath and peritoneum. When there is a defect in the posterior sheath and it cannot be closed, the defect can be bridged with the help of the mesh. The recurrence rates in these cases range from 1% to 23%. Because of its increased success rates, the European Hernia Society has accepted the sublay technique as the gold standard for open repair of hernias despite the increased time taken for performance compared with the onlay technique [39].
Laparoscopic Repair: Typically, the laparoscopic method involves the use of a composite or coated mesh in the Intraperitoneal Onlay Mesh (IPOM) position, usually without fascial defect closure. The benefits include the capacity to inspect the whole previous scar for small defect clearance, decreased chances of wound infections, shorter hospitalization, and lower overall complications than in the open method. The drawbacks include its dependence on mesh and fixation for support, as well as possible cosmetic concerns given the absence of removal of the hernia sac or defect closure. The laparoscopic method is generally unsuitable for large hernias or in areas close to the costal margin or pelvis, where mesh overlap is challenging. The incidence of recurrence is similar to mesh repairs in the open method [39].
Postoperative Pain: The prevalence of chronic pain after open mesh repair is 10-20%. Etiologies are varied and include inflammation from the mesh, nerve injury or entrapment by devices, visceral adhesions, and tension. Patients with chronic pain should be referred to their surgeon. CT scan can assist in differentiating recurrence or port site hernia. When recurrence or port site hernia can be excluded, the plan usually involves a policy of watchful waiting and referral for chronic pain management. Some success has been reported with resecting the tackers or replacing the mesh, but literature evidence for management algorithms is not readily available [39].
Complex Hernias: Giant Defects and Loss of Domain. Giant incisional hernias (with defect size >10 cm) or obesity (with BMI > 35) often entail poorly developed abdominal wall musculature and the presence of multiple comorbidities. The most dangerous complication is the loss of domain, wherein a considerable part of the abdominal content permanently escapes the native domain. Reduction of the content can lead to abdominal compartment syndrome, which requires considerable physiological adjustment (mainly respiratory) if the hernia content size > 20% of the domain. While the use of preoperative pneumoperitoneum to stretch the abdominal domain partially inhabits the defect, component separation methods are the mainstay of the surgery wherein the myofascial flaps (rectus muscle, internal oblique, transversus muscle) can be brought medially to defectively close the massive defects (size > 20 cm) in the midline. The process can then combine with mesh to fix the defect and represents the prime alternative in the treatment of giant midline hernias [39].
Special Consideration: Pregnancy: It has been noted that large incisional hernias in younger pregnant women often necessitate careful counseling on future pregnancy. Although successful pregnancies have been documented, even when the uterus is inside the hernia sac, individual options ought to be considered. Minimal, painless hernias can probably be merely observed until childbearing has been accomplished. Intuitively, large, painful hernias needing repair may be better treated without mesh, perhaps by a suture method such as the shoelace method, because of concerns regarding unknown mesh complications in a pregnant uterus along with a high incidence of recurrence associated with pregnancy [39].
The management of ventral hernias is complex and deserves a refined process of integrating patient presentation and/or

findings, knowledge of the type of hernia, and surgical knowledge or expertise. To effectively combine the different decision-making processes offered in this review, we developed a decision-making algorithm (see Figure 2 below), which should help guide the clinician step by step from diagnosis and evaluation through to determining which surgical method works best in each case. The algorithm should help simplify the decision-making process for the clinician and allow for decisions based on simple factors, namely whether the patient presents with symptoms and/or complications.

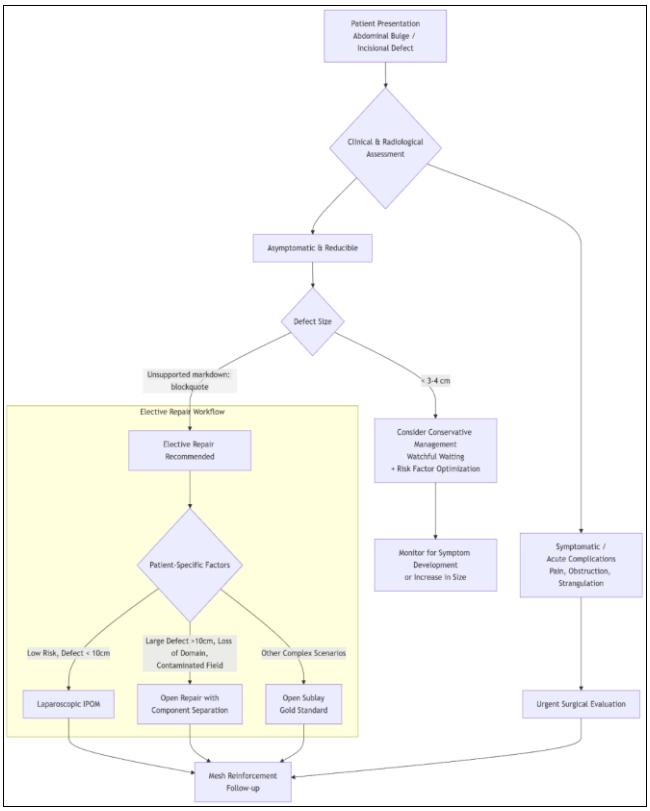

Fig 2: Algorithm for the management of ventral hernia

Decision-Making Algorithm for Ventral Hernia Management

The management algorithm for ventral hernia is guided by a structured evaluation of three key pillars: the patient's clinical presentation, the anatomical defect characteristics, and individual patient factors. The decision pathway begins with a comprehensive assessment, typically initiated by a patient presenting with a bulge or defect at a prior surgical site. Diagnosis is confirmed through clinical examination, with imaging modalities like Ultrasound or Computed Tomography (CT) used to precisely characterize the hernia's size, location, and contents.

The first critical branch point hinges on whether the hernia is symptomatic or asymptomatic. For patients with symptomatic or acute presentations—such as pain, signs of obstruction, or strangulation—urgent surgical evaluation is mandated. In contrast, management of asymptomatic and reducible hernias is primarily dictated by defect size. For smaller defects (< 3–4 cm), a conservative strategy of watchful waiting coupled with aggressive optimization of modifiable risk factors (e.g., weight loss, smoking cessation, glycemic control) is often a valid and recommended approach. For larger asymptomatic hernias (> 4 cm), elective repair is generally advised due to a higher lifetime risk of complications.

When elective repair is indicated, the selection of surgical technique is determined by a matrix of factors beyond size alone. For smaller to moderate defects in patients without significant loss of domain or a history of complex prior surgeries, a laparoscopic intraperitoneal onlay mesh (IPOM) approach is often suitable. The open sublay (Rives-Stoppa) technique is considered the gold standard for open repair and is applicable to a wide range of defects, particularly midline hernias. For the most complex cases—such as giant hernias (>10 cm), those with significant loss of domain, or operations in contaminated fields—an open component separation is typically required to achieve tension-free closure, almost always combined with mesh reinforcement.

The algorithm culminates in the universal principle of modern hernioplasty: mesh reinforcement of the posterior abdominal wall to ensure a durable repair. This is followed by appropriate postoperative surveillance and follow-up to monitor for recurrence and complications.

Limitations

This review has several limitations. First, heterogeneity in study design, patient populations, and outcome reporting precluded quantitative meta-analysis. Second, the inclusion of older observational studies may introduce historical bias. Third, the review protocol was not registered in an international prospective registry such as PROSPERO, which may limit transparency. Despite these limitations, this review provides a comprehensive qualitative synthesis of current evidence.

Conclusion

Management of ventral and incisional hernias has evolved toward individualized, evidence-based strategies. Open sublay repair remains the gold standard for complex defects, while minimally invasive techniques such as laparoscopic IPOM provide effective alternatives in selected patients. Optimization of modifiable risk factors and appropriate surgical planning are essential for achieving optimal clinical outcomes.

Prevention and personalization are the-keys to success in the future. Modifiable factors in patients should now be made optimal prior to surgery, as this is now a basic requirement rather than a nicety in patient outcomes. Where patients have complex anatomy, such as in giant rupture with loss of domain, techniques such as component separation are now necessary. The future is expected to bring advances in the use of materials science, robotic, and recovery-based advances. The endpoint is still simply to provide a sound, functional repair without increasing morbidity or improving patient outcomes in a complex patient body. To consider MST in specialized patients as the initial procedure.

Ethics Statement

This systematic review did not involve human participants or animals and therefore did not require ethical approval.

Author Contributions

Conceptualization and design: All authors.
Literature review and data acquisition: All authors.
Writing – original draft preparation: All authors.
Writing – review and editing: All authors.

All authors approved the final manuscript and agree to be accountable for all aspects of the work.

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