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Ventral Hernia: Causes and Management

Abdul Mannan Khan Rao

Abstract

Ventral hernia is the most common type of hernia after inguinal hernias. The term “ventral hernia” creates some confusion, because in most countries of the world, especially in Europe, it is considered as incisional hernia, while in the USA, it is usually considered as hernias of anterior abdominal wall except groin hernias. Daily in the world millions of abdominal surgeries are being performed by both open or conventional and laparoscopic techniques, with 3–20% incidence of incisional. That’s why mainly incisional hernia and its causes, risk factors, and predisposing conditions and management will be discussed in this chapter, though other ventral hernias will be described briefly. The important causes, risk factors [congenital and acquired (patients and postoperative)], and predisposing conditions for ventral hernias will be discussed in detail. The signs and symptoms produced by ventral hernia (incision) will be described initially and later, and how to investigate to confirm the diagnosis and necessary investigations before surgery for different types of patients is described. In managing the ventral hernia, different treatment options are discussed and described, like conservative management, open method, laparoscopic technique, and more advanced robotic technique. After surgery postoperative care of patient and wound is also discussed.

Keywords: hernia, ventral, incisional, anterior abdominal wall defect, open technique, laparoscopic technique

1. Introduction

In general term, the ventral hernia is the protrusion of intra-abdominal contents, through the anterior abdominal wall fascia defect [1], except groin hernia. In this way ventral hernia may be umbilical, paraumbilical, epigastric, incisional, Spigelian, parastomal, and lumbar. Sometimes this term creates confusion, because in Europe the term “ventral hernia” is used for incisional hernia, while in USA, this term is used for abdominal wall hernia, other than groin hernias [2]. In this chapter we will focus more on incisional hernias because worldwide this is a more common surgical problem.

Primary abdominal hernia can occur spontaneously at any area of natural weakness of abdominal fascia and muscles. Unlike abdominal wall hernias, which occur through a weak anatomical point, incisional hernias occur through a weakness at the site of abdominal wall closure after surgery. Ventral (incision) hernia is a common complication after open abdominal surgeries with an incidence of approximately 10% [3]. The true incidence is difficult to determine; the reasons for this are the lack of standardized definition, the inconsistency of data sources, and

short length of follow-up. The reported incidence of incisional hernia after midline laparotomy is 3–20% and becomes doubled if the wound gets an infection [4]. Usually 50% of incisional hernias are detected within 1 year of surgery, but they can occur several years after surgery, with a subsequent risk of 2% per year [5].

Every year in the world, millions of abdominal surgeries are performed for different indications, and incisional hernia is one of the major complications of these surgeries, resulting in an increased morbidity and putting burden of cost on patients. It is estimated that each year approximately 10,000 repairs are performed in the UK, and 100,000 are performed in the USA [6].

Ventral hernias occur through anteriolateral abdominal wall; the structure of this wall consists of many layers including the skin, fat, fascia, muscles, and peritoneum. The order of abdominal wall layers change at different location. Above the arcuate line (imaginary line between the umbilicus and pubic symphysis), the fascia of internal oblique aponeurosis envelopes the rectus sheath. The external oblique aponeurosis always lays anterior to the internal oblique aponeurosis and the transversus abdominis aponeurosis always posterior to it. Below the arcuate line, all three layers of aponeurosis become anterior to the rectus muscle, and it is no longer enveloped. The only fascial layer below the rectus is the transversalis fascia which is separated from the transversus abdominis aponeurosis [7, 8]. These layers work together to give strength to the abdominal wall and prevent the intestine, omentum, and other tissues from bulging out.

2. Causes and risk factors

Causes of ventral hernia may be congenital (Ehlers-Danlos syndrome, Marfan's syndrome, etc.) or acquired (surgery, trauma). If patient developed abdominal hernia having no previous surgery at the hernia site, these are often due to weakness in the abdominal wall present at birth. As the patient becomes older or injured, these weaknesses can worsen, leading to hernia. Other risk factors are:

- Pregnancy
- Obesity
- History of previous hernia
- History of abdominal surgeries
- Injuries to abdominal wall
- Family history of hernia
- Frequently lifting or pushing heavy objects
- Chronic cough
- Straining during defecation or micturition
- Some medicines, such as steroid

Incision hernia (ventral) can occur after any abdominal surgery, but they are more common in some patients, such as:

- Old patient
- Obese patient
- Diabetics
- Patients using steroid
- Lung disease
- Smoking
- Surgical site infection
- Postoperative repeated vomiting
- Postoperative abdominal distention (intestinal obstruction)

All these have been related to increased incisional hernia rate. This occurs most often after a long incision in the middle of the abdomen, but they can occur through incisions anywhere on the abdomen [9]. Sometimes these hernias developed only in part of the incision.

After abdominal surgery, if persistent or repeated, intra-abdominal pressure increased from any cause (ileus, ascites, etc.) can lead to microscopic tears of scar. Over time this can decrease the strength of tissue, predisposing patient to develop hernia. Tissue strength following surgery can only achieve an 80% tensile strength of previous healthy tissue; this is an additional effect in the formation of incisional hernia. In this way after second midline laparotomy, the maximum tissue strength would be 80% of 80%, which will be 64%, and this 80% predicted tensile strength in under perfect conditions, assuming no evidence of malnutrition or wound infection. If these conditions are present, the chance of incisional hernia formation further increases.

Until now it is thought that incisional hernia results mainly from a technical failure in the surgical closure of the abdominal wall. However it is known that, there are complex patients, surgical and post operative, variables influence incisional hernia development.

3. Patient factors

Patients with some connective tissue diseases (Marfan's syndrome, osteogenesis imperfecta, and Ehlers-Danlos syndrome) have increased the incidence of incisional hernia [10, 11]. It is concluded from research that collagen metabolism in patients with a hernia is changed at three levels.

- The ratio between type I collagen (strong) and type III collagen (weak) is decreased.
- The quality of collagen is poor.
- Collagen breakdown is increased via increased matrix metalloproteinase (MMP) activity [12].

Risk factors	Effect on wound healing
Old age (>65 year)	Decreased collagen formation and reduced tissue perfusion
Atherosclerosis	Wound blood perfusion reduced
Diabetes	Alteration in microcirculation and reduced inflammatory response
Obesity	Increased risk of wound infection, presence of obesity related comorbid diseases (diabetes, atherosclerosis, etc.)
Malignancy or debilitating diseases	Increase chance of malnutrition, wound infection, wound dehiscence, poor wound healing
Renal failure	Abnormal metabolic conditions prevent normal granulation tissue
Protein deficiency	Reduced collagen formation
Immunosuppression	Increased chance of wound infection, alteration in normal tissue regeneration
Smoking	Vasoconstriction and repeated increased intra-abdominal pressure from coughing
Drugs (steroid, etc.)	Immunosuppression, reduced vascular perfusion
Vitamin C deficiency	Reduced collagen formation

Table 1.
Patient-related risk factors for incisional hernia development.

However it has not been clear and established whether these changes are localized to the hernia site or whether it affects all body tissues. Other patient-related risk factors are shown in **Table 1**.

4. Operative factors

Though incisional hernias can occur after any type of laparotomy incision, they are most common after midline (especially upper midline) and transverse incisions [5]. The incidence of incisional hernia after midline abdominal incision is approximately 10.5, and 7.5% after transverse incisions [9]. Research shows that a continuous closure technique with simple running sutures is the best option for closure of laparotomy incisions [13, 14]. The use of slowly absorbable monofilament suture material versus

Risk factors	Effect on wound
Midline incisions	Result in increased incidence of incision hernia
Suture material	The use of slowly absorbable monofilament has a better result
Suture technique	Sutures having small bite reduce the incidence of incision hernia and wound infection
Homeostasis	Good bleeding control reduces the chance of wound infection
Ratio of suture length to wound length	If it is >5.1, it may result in an increased incidence of wound infection
Overuse of diathermy	Result in more necrotic tissue in wound; this increases the incidence of wound infection
Prophylactic use of mesh	Reduces the incidence of incision hernia
Prophylactic antibiotic	Reduces the chance of wound infection

Table 2.
Showing surgical factors that affect incidence of incision hernia.

nonabsorbable or braided material decreases the rate of incisional hernia and reduces the postoperative wound infection [13, 14]. Suture length used with ratio to wound length between 4:1 to 5:1 minimizes the risk of incisional hernia [15, 16]. Traditionally surgeons close laparotomy wound with continuous suture placed 10 mm apart and 10 mm away from edge. Recent studies shows that large tissue bites have been shown to be associated with an increase in the amount of necrotic tissue and slackening of the stitches, resulting in increased risk of wound infection and the development of an incisional hernia [17, 18]. Small stitches placed 4–6 mm from the wound edge and 4 mm apart (in the aponeurotic layer only) minimized the risk of incisional hernia from 18 to 5.6% and reduced wound infection rates by 50% [19]. According to recent studies, the surgeon should adopt a small bite technique instead of large bite technique; it may result in better outcome. Surgical factors are summarized in **Table 2**.

5. Postoperative factors

The most important and common factor that results in incision hernia formation is wound infection, and it is thought to double the risk^{1/4}. Other factors are increase in intra-abdominal pressure in the immediate postoperative period, such as postoperative ileus, coughing, vomiting, and mechanical ventilation, and also increase in the risk of incisional hernia [20].

After laparotomy, the risk of incisional hernia cannot be eliminated except by avoiding a laparotomy incision. However the risk can be minimized by reducing systemic risk factors, especially smoking, obesity, and nutritional deficiencies, and by optimizing diabetic management. The risk can be further minimized by meticulous surgical technique; when closing the abdominal wall, homeostasis should be secured properly; diathermy use should be avoided to lessen the necrotic tissue in wound; if surgeon suspects that the wound may ooze, drain can be used, but it should be removed as early as possible, to reduce the incidence of wound infection. Prophylactic use of antibiotic at the time of anesthesia induction reduces the incidence of wound infection.

6. Signs and symptoms

Ventral hernia usually presents as painless bulge or lump in abdomen under the skin, which increases in size over time. Sometimes it presents as only discomfort in abdomen and sometimes discomfort or pain with bulge. Sometimes ventral hernia may cause pain when a patient:

- Cough
- Strains during defecation
- Stands or sit for long time
- Lifts or pushes heavy objects

Usually in initial stage, the hernia disappears when the patient lies down and then reappears or enlarges when a patient stands or lifts or pushes something heavy; this is reducible hernia. When the tissues or content inside the hernia becomes adherent to the sac or with each other, then the hernia becomes irreducible. When hernia content becomes stuck or trapped in abdominal muscle, it can cause pain, nausea, vomiting, constipation, etc. If the hernia content especially intestine gets tightly trapped in the

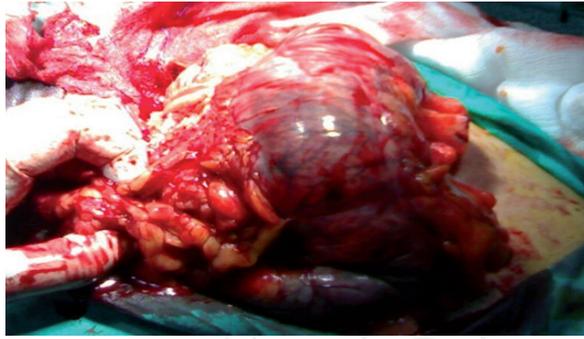


Figure 1.
Gangrenous bowel of patient in Figure 2 having strangulated hernia.



Figure 2.
Strangulated ventral hernia and content are shown in Figure 1.

tear in the muscles, layer or intestine loop is constricted at the narrow neck of hernia sac or apex of loop of intestine adherent to hernial sac especially at fundus and becomes twisted; the blood supply to the intestine can become cut off or reduced, resulting in bowel necrosis or rupture; this may lead to a potentially life-threatening condition known as “strangulation.” This condition requires emergency surgery. Other symptoms of strangulated hernia include severe abdominal pain, abdominal distention, severe nausea and vomiting, profuse sweating, increased pulse rate, and fever. Initially pain is colicky in nature; if strangulation is not relieved, it will change in character and become continuous or disappear; this is an ominous sign that the intestine becomes necrosed or dead. **Figure 1** shows necrosed/gangrenous bowel in strangulated ventral hernia.

7. Diagnosis and evaluation

Usually ventral hernia can be diagnosed by history and clinical examination only. If there is confusion in diagnosis or hernia is complex and complicated, one can advise ultrasound, CT scan or MRI scan, to make the diagnosis confirm and elaborate the anatomy of hernia (**Figure 3**).

Patients usually present ventral hernia as reducible swelling in abdomen or at the site or near the incision scar of previous surgery; it disappears when the patient lies down and enlarges when the patient stands, coughs, or defecates. On clinical examination, expansile cough impulse will be present. In some cases when a hernia is incarcerated or strangulated, the swelling may be erythematous. Obesity can limit the examination; it is important that the patient should be examined in a different position, as hernia can change with exertion or standing. If incision in there

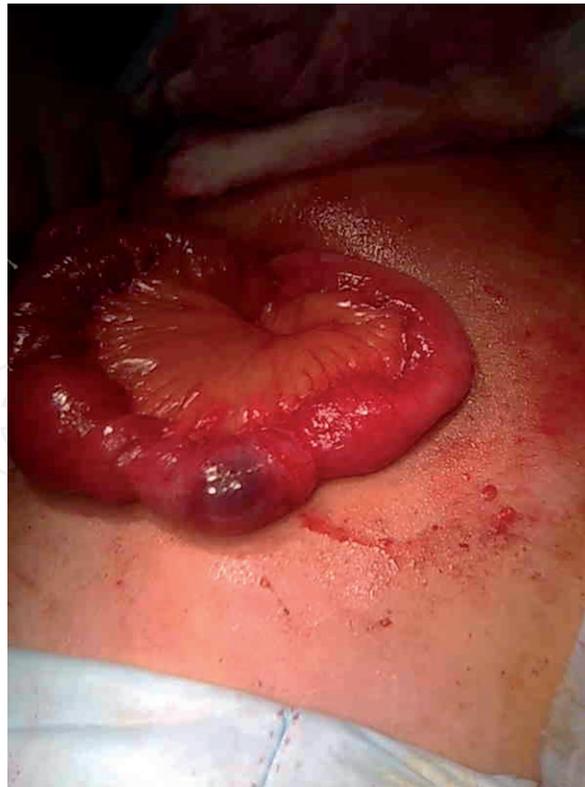


Figure 3.
Showing portion of small bowel that is stuck at narrow neck of hernia.

it should be palpated in whole length, because sometimes incisional hernia form at multiple site in a incision, and try to palpate the neck of hernia(whole in fascia at the site of incision), whether it is narrow or broad, narrow neck more prone to strangulate. Sometimes size of fascial defect may be difficult to discern clinically. The size of the peritoneal sac and associated contents is often large, although the fascial defect may be small, particularly in obese patients and after multiple abdominal operations, where there may be many small fascial defects. Usually incisional hernias are asymptomatic, but 20–50% present with pain. Skin changes may present in large and longstanding hernias.

Ultrasonography is commonly used to confirm the clinical diagnosis. The ultrasonography in hernia can reveal the fascial gap with protruding hernia contents. The hernia should increase in size or change location when the patient coughs. Bowels are characterized by peristaltic movement and inside air, whereas the omentum appears as a stationary, space-occupying structure.

In some patients of ventral hernia, detailed diagnostic imaging (ultrasonography, CT scan, and MRI) is indicated; these are:

- Obese patients (BMI > 35)
- Patients with recurrent incisional hernia
- Patient having huge hernia (second abdomen)
- Patients having pain within the abdominal wall but with no physical and detectable hernia.

In these patients CT scan with 3D reconstruction is useful. Occult hernia is accurately delineated; the content of sac is defined.

8. Management

Whenever the patient develops hernia, it will not get better on its own and can get worsen (enlarge) over time. The most common treatment of ventral hernia is surgery. Some hernias are repaired on an elective basis like asymptomatic hernia, but hernia which presents with strangulation requires immediate surgery. Irreducible or incarcerated hernia without strangulation is not a surgical emergency. The risks and benefits of surgery should be discussed with the patient. The patients with reasonable operative risks should have their hernia repaired within a sensible time frame. Nonsurgical management of ventral hernias with the use of binders, trusses, or corsets is considered to be ineffective. This may be the only option in a patient who is not a reasonable candidate for surgery [21–23].

In the past, before appropriate meshes and techniques for implanting them were available, sutures alone were used to close the weakness in the abdominal wall. These often were unsuccessful in the long term, as in most patients hernia would recur. For some very small ventral hernias, suturing alone remains acceptable.

Commonly ventral hernias are repaired by making an incision over the fascial defect in the abdominal wall. The intestine, fat, or other organs in the hernia are placed back in the abdomen. The defect in muscle or fascia is then closed with sutures alone or is reinforced with mesh. The abdominal wall is then closed with suture over the mesh. Sometime drainage tubes are placed through the skin to prevent serum or blood collection.

At present many types of surgical techniques have been developed to repair hernias. The most important tension-free repair is using mesh. If mesh is used, it should be placed 3 to 5 cm overlapping the edges of the fascial defect. Mesh should be handled meticulously to prevent surgical site infection. The most basic approach is primary open repair without mesh; this is typically reserved for defect in the fascia of less than 2 cm. Open mesh repair has several options, including what type of mesh and where to place the mesh. Main methods of ventral hernia repair are:

- Open hernia repair
- Minimally invasive hernia repair (laparoscopic)
- Robotic ventral hernia repair

Laparoscopic ventral hernia repair, when we compare it with open hernia repair, showed decreased overall complication rate, decreased hospital length of stay, and a quicker return to work. The disadvantage of laparoscopy includes a higher potential for visceral injury, and it is technically more difficult.

Robotic ventral hernia repair has also become popular secondary to increased freedom of motion during surgery. Closing the fascial defect robotically is far easier from a technical standpoint than attempting it with classical laparoscopic instruments. Robotic surgery is more expensive and has longer operative times than laparoscopy.

Not all patients of incisional hernia are suitable for surgical repair, and the risk of surgery must be balanced against the risk of complication if the hernia is left untreated. Small incisional hernia invariably enlarges with times as a result of the continuous intra-abdominal pressure, diaphragmatic contractions, and increased pressure from coughing or straining. Despite recent advances in the management of incisional hernias, the recurrence rate is still high. The method of choice for repair of incisional hernia is still debatable.

It is found that incisional hernia repair without prosthetic mesh is associated with high recurrence rate, whereas hernia repair with mesh results in low recurrence rate. It is accepted that only the small (less than 3 cm) incisional hernia can be repaired by primary tissue approximation with sutures.

9. Laparoscopic repair

Worldwide surgeons use laparoscope to repair the incisional/ventral hernias with promising results. A composite or coated mesh (to reduce the bowel and visceral adhesions) is placed in the intra-peritoneal position, and the hernia is usually not closed. This is said to be an intra-peritoneal onlay mesh. The advantages of the laparoscopic approach are that it allows the whole of the previous incision to be visualized and small fascial defect can be identified, but at the same time it has the disadvantage of relying fully on the strength of the mesh and its fixation. Another disadvantage of laparoscopic repair is that it is criticized for producing cosmetically worse results than the open repair because the hernia sac is not excised and the defect is not closed. Furthermore, laparoscopic repair is not always possible for large incisional hernias or when the hernia extends towards the costal margin or pelvis because adequate mesh overlap cannot easily be achieved.

10. Open mesh repair

In practice there are three types of open repair for incisional hernia with mesh—the inlay, onlay, and sublay techniques.

In the inlay method, the mesh is placed between the muscles in a bridging position. Polypropylene mesh anchors to all adjacent tissues and can therefore induce extensive adhesions to the viscera if placed in position where it becomes adjacent to the bowel. The mesh can erode into the intestine and may result in entero-cutaneous fistulas. Recurrence rate for inlay technique is also high: These are the main drawbacks of this method. Therefore this technique is not recommended. Furthermore, the force needed to dislocate a bridged mesh is much lower than for a closed defect.

In the onlay method, the mesh is placed in the subcutaneous prefascial space, over the abdominal wall closure. The main criticism of this method is the high incidence of wound infection and seroma formation.

In the sublay technique, the mesh is placed over the closed posterior rectus sheath and peritoneum. In case if hernia is large and the posterior sheath cannot be closed, the mesh is sometimes used to bridge the defect (gap). The European Hernia Society has adopted a sublay mesh repair as a gold standard open repair.

Common surgical complications after ventral hernias repair are wound infection, mesh infection, seroma, hematoma, recurrence, ileus, intestinal adhesions, injury to abdominal organs, and chronic pain. If pain presents for more than 3 months postoperatively after incisional hernia repair, it is termed as chronic pain. The cause of the pain is poorly understood but probably includes a combination of mesh associated inflammation and nerve damage from mesh fixation.

11. Giant incisional hernia

If incisional hernia has a fascial defect more than 10 cm in transverse diameter, it can be considered as giant incisional hernia. If the patient is obese (BMI > 35),

then there are more surgical and anesthetic challenges. These patients often have poor quality abdomen wall musculature; in addition there may be multiple comorbid medical problems. In giant incisional hernia, a further problem that has to be overcome is the risk of serious “loss of domain” once the hernia is repaired, which can result in an abdominal compartment syndrome. Loss of domain implies that a proportion of the abdominal contents entered in the hernia sac permanently outside the natural abdominal cavity. With time abdominal cavity become small, and after long time, if these abdominal contents again reduced to abdominal cavity in hernia repair, it will result in increase intra-abdominal pressure, which result in respiratory compromised and reduced venous drainage, and reduced abdominal organs perfusion.

In such cases to prevent this catastrophe complication, it is necessary to increase the intra-abdominal cavity space, before hernia repair, so that abdominal cavity could be able to accommodate hernia contents easily without increasing intra-abdominal pressure. Preoperative pneumoperitoneum has been used to overcome the problem of loss of domain by increasing the size of the abdominal cavity before hernia repair. Although this technique may be effective, it has not been widely adopted.

The compartment separation technique allows a flap of the rectus muscles, anterior rectus sheath, internal oblique, and transversus abdominis muscle to slide medially, enabling giant hernia defect to be closed. It can be reinforced with mesh.

12. Ventral hernia and pregnancy

In premenopausal women, the repair of large incisional hernia imposed especial problems, because elasticity and expansion of the abdominal wall will be needed if the patient subsequent becomes pregnant. Prosthetic mesh reduced the elasticity of abdominal wall enough to cause complication during pregnancy. Small incisional hernia can be left safely until the completion of family. If hernia is large and symptomatic, then it should be fixed, and in these cases it may be better to avoid the use of mesh and to use a sutured repair such as the shoelace technique. It is necessary to warn the patient about the high risk of recurrence with subsequent pregnancy.

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