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Overview of Ventral Hernia Repair : Causes, Diagnosis and Surgical Management

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ABSTRACT

Hernias are among the oldest surgical challenges which have confronted the surgical community. A hernia is an out pouching of a visceral organ or a part of organ through an opening that it does not normally transverse. When hernias are associated with the abdomen, they may occur through the inguinal canal, lumbar trigon of Petit, femoral canal, or umbilicus. Nerve damage and weakening of the muscles, as a postsurgical complication, may lead to herniation. Abdominal wall hernias are usually asymptomatic, discovered incidentally on routine physical examination. However, complications of abdominal hernia may be life threatening and require urgent medical attention. Many surgical techniques have been developed to repair hernias, the most important being tension-free closure. The open repair with mesh has several options, including what type of mesh and where to place the mesh.The aim of the present study was to review the causes, diagnosis and surgical management of ventral hernia repair.

Keywords: Surgical Management ; Diagnosis ; Ventral Hernia Repair

INTRODUCTION

Ventral hernias of the abdomen are defined as a non-inguinal, non-hiatal defect in the fascia of the abdominal wall. The repair of these abdominal wall defects is a common surgery performed by general surgeons. Surgery is typically recommended for individuals with acceptable operative risk, symptomatic hernias, or those at elevated risk of developing complications from a hernia. They can affect an individual's quality of life and can lead to hospitalizations and even death in some cases **(1).**

The most recent and widely accepted classification for primary abdominal wall hernias is made by European Hernia Society (EHS) which is based on 2 variables: Localization and size of hernia. (1) Localization of the hernia: Two midline (epigastric and umbilical) and two lateral hernias (Spighelian and lumbar) are identifiable entities with distinct localizations. (2) Size of the hernia: Primary abdominal wall hernias are usually more or less round or oval shaped. Therefore, the size can be described with one measurement. Width and length will be comparable most of the time. We agreed to use the "diameter" of the primary abdominal wall hernia as the second variable. Cutoff values of 2 and 4 cm were chosen to describe three subgroups according to size: small, medium, and large **(2).**

Aetio-pathogenesis:

The main causes of ventral hernia can be classified in to:

a. **Congenital Causes**: Congenital sac, apertures in the linea alba and aponeurosis or in linea semilunaris. The umbilicus is sometimes imperfectly developed at birth permitting the viscera to protrude through the umbilical cord. Congenital muscle defects **(3)**.

b. **Acquired Causes**: The hernia may result from any condition which tends to weaken the abdominal wall or tends to increase the intra-abdominal pressure. Post-operative incisional hernias may result from imperfect closure of peritoneum and anterior abdominal wall following laparotomy **(1)**.

Chronic strain (e.g. whooping cough in children, chronic Bronchitis constipation, urinary out flow obstruction in adults). Stretching and relaxation of abdominal musculature because of increase in size of contents e.g pregnancy, direct trauma; blunt and penetrating injuries and obesity; Fat acts like a pile driver as it separates muscle bundles and layers, weakening aponeurosis and favors the outcome of hernia **(3).**

1- Epigastric Hernia:

Epigastric hernia refers to a protrusion of the peritoneal fat, usually without peritoneal sac, through the linea alba of the epigastrium. The hernial sac may be in the form of a reducible midline nodule that becomes evident in the standing position. It usually contains extraperitoneal fat or it may contain part of the greater omentum or small intestine. Epigastric hernia may produce severe pain, due to ischemia that mimics chronic peptic ulcer **(4).**

2- Umbilical and paraumbilical hernia:

An umbilical hernia presents as a bulge at the site of the umbilicus; it is a common finding during routine well-baby visits for the first few months of life, usually occurs through the umbilical fibromuscular ring, which is usually obliterated by age 2 years. It is congenital in origin and repaired if persist in children older than 2-4 years **(5).**

Although umbilical hernias in children arise from failed closure of the umbilical ring, only one in 10 adults with umbilical hernias had this defect as a child. Adult umbilical hernias occur through a canal bordered anteriorly by the linea alba, posteriorly by the umbilical fascia, and laterally by the rectus sheath **(6).**

Surgery becomes essential when the defect is relatively large and persists beyond the age of 4 or becomes incarcerated. In the adult, umbilical hernia may develop more commonly in women, usually postpartum, and a pose serious danger due to the rigid walls of the linea-alba, which predisposes the hernial sac to strangulation and incarceration, also any increase in the intra-abdominal pressure, due to chronic cough, constipation, straining while passing urine and Ascites will predispose it **(7).**

3- Spigelian hernia:

The Spigelian hernia is a defect in the aponeurosis of the transverse abdominis muscle between the semilunar line and the lateral border of the rectus abdominis (Spigelian aponeurosis). The semilunar (Spigelian) line represents the transition of the transverse abdominis from muscle to aponeurosis. The hernial sac and the opening cannot usually be palpated because of the intramural location of the hernial sac posterior to the aponeurosis of the external oblique aponeurosis. It can present synchronously with inguinal hernias in neonates, and regardless of age of presentation is almost always congenital in origin. There are two subtypes of spigelian hernia, interstitial and subcutaneous. Distinguishing between

these subtypes helps optimize the surgical approach (when indicated) and is best done by means of computed tomography (CT) **(8).**

4- Inguinal hernia:

Inguinal hernia sac which represents approximately 95% of abdominal wall hernias in the male and 50% in the female, has the highest incidence of onset in the 1st year of life followed by a second peak between the ages of 16 and 20 years. The bony attachments of the inguinal region counteract abdominal thrust and the presence of natural gaps that exist in this region may allow peritoneal diverticula to externalize and appear as hernias **(9).**

Inguinal hernias are commonly classified as either direct or indirect. A direct inguinal hernia usually occurs as a consequence of a defect or weakness in the transversalis fascia area of the Hesselbach triangle. The triangle is defined inferiorly by the inguinal ligament, laterally by the inferior epigastric arteries, and medially by the conjoined tendon. An indirect inguinal hernia follows the tract through the inguinal canal. It results from a persistent processus vaginalis **(10).**

5- Femoral hernia:

Femoral hernia is more common in female than male at the ratio of 3:1. It affects approximately 35% of the female population particularly in women over 50 years of age. This gender-based difference is attributed to the unique shape of the pelvis, the size of the ring, and the dramatic changes exerted during pregnancy. Its incidence is far lower than that of inguinal hernia and can be easily missed during physical examination **(11).**

The femoral ring, which is the upper margin of the femoral canal, is the medial portion of the lacuna vasorum. It is bounded anteriorly by the extension of the transversalis fascia, and posteriorly by the continuation of the pectineal fascia. The neck of the hernial sac is always distal and lateral to the pubic tubercle, a bony landmark between the site of inguinal and femoral hernia. The fundus of the hernial sac (lower part) usually occupies themedial part of the femoral triangle. The hernial sac traverses the femoral canal and descends vertically posterior to the inguinal ligament, displacing the femoral vein, to exit through the saphenous opening **(12).**

6- Incisional hernia:

Incisional hernia occurs up to 5 years following surgical procedures at a site of previous laparatomy where healing was not complete. Post laparascopy incisional hernia is generally a minor complication and rarely strangulates. It can be visualized by having the patient perform the Valsalva maneuver or raise his or her head while in the supine position. It is the most common type of hernia among all ventral abdominal hernias, and is associated with old age, obesity, improper suturing techniques, post-operational strain, cirrhosis, steroid therapy, infection, hematoma, and ileus. Due to the relatively large size of the neck of the hernial sac, strangulation is rare **(13).**

7- Lumbar hernia:

Lumbar herniation may occur through the superior or inferior lumbar spaces. It is classified as congenital and acquired; the acquired lumbar hernia is subdivided into primary and secondary types. The hernial sac usually consists of the peritoneum, or extra-peritoneal tissue, and may contain part of the intestine, kidney, omentum, or mesentery **(14).**

The hernia produces mild symptoms and can easily be surgically reduced and very rarely becomes strangulated. The superior lumbar hernia occurs through Gynfelt's triangle,

which is bounded superiorly by the 12th rib and the serratus posterior inferior muscle, laterally by the internal oblique, and medially by the erector spinae muscle **(15).**

8- Obturator hernia

Obturator hernia (OH) is a relatively rare but quite important form of abdominal wall hernia. OH occurs through the obturator foramen, which is formed by the rami of the ischium and the pubis, subsequently passing into the obturator canal which is 2–3 cm long and 1 cm wide bordered by the free edge of the obturator membrane and the pubic bone and contains the obturator nerve and vessels. Obturator hernia tends to occur more frequently in elderly, slender, multiparous women, with the vast majority of OH patients presenting with mechanical bowel obstruction. The associated clinical symptoms are mostly vague and non-specific with the pathognomonic sign for its diagnosis being the Howship–Romberg sign, which consists of ipsilateral inner thigh pain on internal rotation of the hip **(16).**

- **Ventral Hernia**

Ventral hernia may be umbilical, paraumbilical, epigastric, incisional, Spigelian, parastomal, and lumbar. Primary abdominal hernia can occur spontaneously at any area of natural weakness of abdominal fascia and muscles **(1).**

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 and some drugs as steroid **(17)**.

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 has cough, strains during defecation, stands or sit for long time, lifts or pushes heavy objects **(18).**

When hernia content becomes stuck or trapped in abdominal muscle, it can cause pain, nausea, vomiting, constipation. If the hernia content especially intestine gets tightly trapped in the defect of the muscles, it is constricted at the narrow neck of hernia sac; the blood supply to the intestine can become cut off or reduced, resulting in bowel ischemia, necrosis, and perforation; 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 **(19).**

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 **(20).** In these patients CT scan with 3D reconstruction is useful. Occult hernia is accurately delineated; the content of sac is defined **(21).**

Management:

A- Preoperative Management (22):

Weight reduction is very important before operating for ventral hernia. It is required to bring the BMI < 30–40 Kg/m^2.

Diabetes reduction: While glycemic control throughout all phases of patient management is important, preoperative reduction in baseline glycosylated hemoglobin (Hgb A1c) is essential for optimal outcomes.

Nutrition and Metabolic Control: The nutritional status of the patient should be evaluated and optimized prior to major surgical procedures.

Control of COPD, definitive treatment of benign prostatic hyperplasia, stricture of the urethra and all other conditions who may increase the intra-abdominal pressure in postoperative period in view to avoid the recurrence. Also, cessation of smoking is very helpful for good outcome.

Optimizing the patient preoperatively including smoking cessation, glucose control, and nutritional support can all be achieved over a relatively short time (1–5 weeks). Obesity, however, is a major threat to this high-risk group that takes months for patients to lose significant weight, be it with diet and exercise or even following a bariatric operation. If the surgeon has the luxury of waiting (minimally or asymptomatic hernia), patient should wait until the patient has lost considerable weight to maximize outcomes. Unfortunately, for those hernias which are highly symptomatic or with threatened bowel, the surgeon may not have the advantage of waiting **(22).**

B- Indications of surgery for ventral hernia repair (Toffolo et al., 2021).

To get the relief from symptoms. Prevention of complication like pain, incarceration, bowel obstruction and strangulation. To improve the quality of life. There are various operations for the treatment of ventral hernia depending upon the size of the defect, location of the hernia, patient choice as per their economic conditions as laparoscopic repair may be costly and surgeon expertise **(23).**

C- Overview of operative approaches for ventral hernia repair:

Whenever the patient develops hernia, it will not get better on its own and can get worsen 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 ineffective. This may be the only option in a patient who is not a reasonable candidate for surgery **(24).**

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 **(25).**

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 **(26).**

I. Laparoscopic repair

First time in 1993, LeBlanc and Booth introduced the laparoscopic method for ventral and incisional hernia repair, it has evolved worldwide in recent years and carries many advantages such as reduced postoperative pain, length of hospital stay, and recurrences in comparison with conventional open approach **(27).**

Contraindications include inability to create a working space, acute or emergency procedure as bowel obstruction, infection of skin or surrounding structures overlying the repair (all infection must be treated and cured before the procedure), ascites with Child class 'C' cirrhosis, those with loss of domain (because the contents of the hernia sac cannot be reduced). Occasionally due to unusual dense adhesions, patients who have had a previous incisional hernia repair with mesh placement are contraindicated. Though obese patients should be consulted regarding the increased risk for hernia recurrence, obesity is not a contraindication. For them, a bariatric evaluation is recommended with encouraging them to lose weight preoperatively if possible **(28).**

Assisted by an Endo-suture passer, the 4 to 8 transfascial sutures are used to fix the mesh to the anterior abdominal wall, avoiding postoperative migration of mesh and holding the mesh close to the abdominal wall for excellent tissue incorporation. The mesh is further secured with 5-mm titanium tacs. After tying the knot, pull the transfascial sutures from the skin outwards to release any tension. Disadvantages of transfascial fixation suture are poorer cosmetic result and pain during the early postoperative period **(29).**

II. Open mesh repair

Although minimal invasive surgery is widely acceptable and treatment of choice in present era, but open surgery still plays a very important role in hernia repair especially in conditions contraindicated for laparoscopic surgery like very large, non-reducible hernia and strangulated hernia. Besides these contraindicated cases, for small umbilical hernias, open repair is preferred choice **(30).**

a. Non- prosthetic primary fascial repairs:

Non-prosthetic primary fascial repair techniques have an unacceptably high incidence of recurrence (up to 50%) and these operations have largely been abandoned in most centres. Interrupted or continuous closure may be used, but the sutures should be non-absorbable and tied neither too tight nor under tension. A simple non-prosthetic technique should be reserved for only the very smallest incisional hernias < 2 cm in diameter in patients without risk factors for further recurrence **(31).**

b. Prosthetic repairs:

Tension-free repair by a synthetic mesh is accompanied by a much lower recurrence rate (2–10%) and is the repair that is in general use. There are different designs of prosthesis for use in the repair of ventral hernia, and it is often difficult to choose the most appropriate. The biological behavior of the material must be a key part in the selection, although this behavior will vary depending on what materials are available. A proper understanding of the relationship of the material with the abdominal wall dynamics is another important factor in this selection. Finally, we need a stable repair without long term side effects **(32).**

1) The inlay technique:

It involves excision of the hernia sac and identification of healthy fascial margin. For bridging the fascial defect, polypropylene mesh anchors to all adjacent tissues and has the propensity for inducing extensive adhesions to viscera if placed in a position where they become adjacent to bowel in this technique. As these meshes do not restore the anatomy and physiology of the anterior abdominal wall, activities that increase intra-abdominal pressure impact significant tension on the mesh-fascial interface, which is the weakest point of the repair. The re-herniation rate of this technique tends to be higher than those of the underlay and onlay technique **(33).**

2) The onlay technique:

In the onlay method, the mesh is placed in the subcutaneous pre-fascial space, over the abdominal wall after closure of the hernia defect with non-absorbable sutures in tension-free manner. The main criticism of this method is the high incidence of wound infection and seroma formation **(9).**

3) The sublay technique:

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 **(33).**

The number and type of biologic grafts has expanded greatly over the last decade. The huge downside to biologic meshes is they are typically very expensive. They are usually reserved for infected or contaminated fields and the strength of the repair is considered inferior to synthetic mesh placement. They typically consist of an acellular collagen matrix derived from human dermis or porcine small intestine submucosa. These biologic meshes still generate a foreign body reaction as well so they can cause adhesions but are unlikely to become infected **(34).**

D- Postoperative course

A broad-spectrum antibiotic was administered to all patients for 5–7 days postoperatively. In the meantime, another dose of antibiotic was administered to the patients following the removal of any infected material. The patients were deprived of any oral administration till they pass flatus indicating return of bowl function. Along with this other routine postoperative care, methods like pulmonary toileting and venous thromboembolism prophylaxis were provided **(35)**.

Complications:

Recurrence of a ventral hernia after the repair has varying rates over time, but with the introduction of mesh, the recurrence rates have dropped significantly. Recurrence rates differ among the type of repairs: in laparoscopic repairs with mesh are around 10% to 12%, open-mesh repair 13% to 15%, and open-tissue repairing 18% to 20% **(36).**

Mesh infection is a catastrophic complication of ventral hernia repairs because it is typically followed by a second operation that is more complex and associated with a high chance for recurrence of a hernia. There are many risk factors including a high BMI, COPD, prior surgical site infection, mesh type, longer operative time, lack of tissue coverage of the

mesh and enterotomy. With a mesh infection, it is much more common to require removal of the mesh, but salvage is a possibility with antibiotics **(37).**

Other common surgical complications after ventral hernias repair are seroma, hematoma, ileus, intestinal adhesions, injury to abdominal organs, and chronic pain. If pain presents for more than 3 months postoperatively after 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 **(33).**

CONCLUSION:

Ventral hernia is the protrusion of intra-abdominal contents, through the anterior abdominal wall fascia defect. Causes of ventral hernia may be congenital or acquired.

Ventral hernia can be diagnosed by history and clinical examination only. In complicated hernia ultrasound, CT scan or MRI scan are advised to confirm the diagnosis.

Laparoscopic ventral hernia repair has become a popular method, when compared to open techniques , it has fewer complications, less hospital stays and early recovery.

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