

Ventral abdominal hernias in adults

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Abstract

Ventral abdominal hernias (VAHs) are distinguishable from incisional hernias (IHs) and warrant a separate research and studies from IHs for better practice and interpretation of the outcomes. There are significant differences between IH and primary ventral hernia (PVH), in regard to etiology, mode of treatment, and different techniques employed for repairing, as well as complications and postoperative adverse results. Ventral hernias could be primary and these include umbilical hernia, epigastric hernia, spigelian hernia, and lumbar hernia, and secondary ventral hernias include IH. The aim of the present article is to review the risk factors, incidence, pathogenesis, prevention, complication, and management of the PVHs and to draw attention to the less common primary VAH, for those who need to acquire the knowledge about the topic, namely, under- and post-graduate medical students, surgical trainees, and junior surgeons in practice. A database search was performed using a combination of the search terms: primary ventral hernia, umbilical hernia, epigastric hernia, spigelian hernia and lumbar hernia risk factors, incidence, pathogenesis, prevention, and complications. Some of the relevant reference lists were searched manually to obtain more relevant literature.

Key words: Epigastric hernia, lumbar hernia, primary ventral hernias, spigelian hernia, umbilical hernia

INTRODUCTION

Ventral abdominal hernia (VAH) is a term used to describe all abdominal wall hernias excluding groin and pelvic hernias. The European Hernia Society (EHS) in 2012 developed a platform for registration and outcome measurement of VAHs. In this registry, the EHS defined VAH as a hernia of the abdominal wall excluding inguinal area, pelvic area, and diaphragm.^[1] Although it excludes groin, diaphragmatic, and the rare pelvic hernias, it does not exclude incisional hernias (IHs). The study of IH together with the primary ventral hernia (PVH) results in confusing conclusions. PVHs are distinguishable from

IHs and warrant a separate research and studies from IHs for better practice and interpretation of outcomes. There are significant differences between IH and PVH, in regard to etiology, mode of treatment, and different techniques employed for repairing IH and PVH, as well as complications and postoperative adverse results.^[2] VAH could thus be primary and include umbilical hernia (UH), epigastric hernia (EPH), spigelian hernia (SPH), and lumbar hernia (LH), and secondary ventral hernias include IH. EHS defined the different types of ventral hernias as follows: PVH is a VAH that was present at birth or that developed spontaneously without trauma to the abdominal wall as the cause of hernia. Secondary ventral hernia is a ventral hernia that developed after a traumatic breach of the integrity of the abdominal wall. A separate classification of the PVHs was necessary because PVHs have different etiology and pathology compared with IHs. The EHS classification of PVH is based on the site

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and size of the hernia defect. The site of the PVH is either midline (UH and EPH) or lateral (SPH and LH). The size of PVH is described as a diameter, because almost all the defects could be either rounded or oval, and then the width and length of the defect are the most appropriate measures to describe the size. The size of the PVH in the EHS classification could be either small, medium, or large.^[1]

PVH represents 75% of the repaired ventral hernias in the USA, and 5% of the general population of the USA has an UH or EPH. Ventral hernia complications are one of the most common causes of emergency surgery and the second most common cause of intestinal obstruction (10%–15%).^[3-5] UH accounts for 10% of all abdominal wall hernias. EPH accounts for 1.6%–3.6% of all abdominal wall hernias. SPH accounts for 1%–2% of the total abdominal wall hernias, and LH represents <2% of the all abdominal wall hernias.^[5-8]

Diagnosis of PVH is straightforward by history and physical examination; however, clinical diagnosis may be difficult, in obese patients, in the presence of tender abdomen and scarred abdomen. Abdominal images such as ultrasound and computed tomography (CT) scan can play a role in establishing and confirming the diagnosis of VAH in difficult cases.^[9]

PVHs should be repaired electively due to the increased morbidity and mortality associated with emergency repair. VAHs repaired in emergency setting were attained by up to 22% morbidity rate and 1.8% mortality rate whereas the repair of VAH in elective setting was attained by 18% morbidity and 0.55% mortality rates.^[10] VAH in the presence of suspected strangulation and intestinal obstruction should be repaired immediately.^[5] VAH can be repaired by simple open suture technique or using prosthetic mesh or using minimally invasive technique. Open suture repair of VAH was attained by high complication rates and a recurrence rate up to 28%. However, open suture repair can be reserved for small defects of <2 cm in nonobese patients.^[7] Open mesh technique can be used for repairing all types of VAHs; it is followed by less complications and recurrence rates compared with open suture repair. Laparoscopic ventral hernia repair (LVHR) compared with open mesh repair decreases the rates of postoperative complications, including the rate of surgical site infection (SSI) in all types of ventral hernias.^[11-13] LVHR has witnessed a 4-fold increase during the first decade of the 21st century from 6.5% to 28% in 1 year whereas the open repair of the VAH decreased from 93.5% to 72% during the same period. The outcomes of the LVHR versus open ventral hernia repair revealed that LVHR had a significant short hospital stay (3 days vs. 4 days $P < 0.001$)

and less postoperative, intraoperative, and pulmonary complications.^[14] Complications of laparoscopic repair of VAH are not common, but when they occur, they are potentially more severe; 23% of the complications of the LVHR required surgical intervention and 5% of them were life-threatening. Bowel injuries which can result from the release of adhesions are the main causes of the serious complications of LVHR. Bowel injuries can also occur during open repair of ventral hernias; however, its recognition and the immediate repair can prevent further complication.^[15]

Umbilical hernia

It is a ventral hernia with its center at the umbilicus.^[1] UHs are the most common type of linea alba defect in adults, and it is followed by EPH and both represent 10%–15% of PVH. UHs are 5 times more common in women than in men and usually develop after the age of 35 years. They are usually small with narrow neck, a fact that increases the risk of incarceration and strangulation. UH could be direct (true) which protrudes through the umbilical ring, and this occurs commonly in neonates and infants. Indirect UH (paraumbilical hernia) protrudes through a defect at the upper or the lower border of the umbilicus; it is the most common type that develops in adults.^[16-18] The pathogenesis of UH is still a matter of debate. Adults' UH is not a residue of UH of childhood; it arises *de novo* in adult life. The umbilical canal through which the adult UH protrudes is bordered posteriorly by the umbilical fascia, anteriorly by the linea alba, and medially by the two rectus muscle sheaths; hence, UHs in adults do not resolve spontaneously like the direct UH in children.^[16]

During embryological development of the fetus, there are four structures that pass in or exit out of the peritoneal cavity through the umbilicus, namely, umbilical vein in its upper border, two umbilical arteries, and urachus at the lower border. Through these potentially weak areas in the umbilicus, the hernia content can protrude. The most common site is that at the upper border of the umbilicus. The presence of predisposing factors such as multiple pregnancies, obesity, smoking, ascites, cirrhosis and chronic pulmonary diseases, and conditions which increase the intra-abdominal pressure, together with anatomical disposition of the umbilicus contribute to the development of UH in adults.^[16-18]

The most common symptom of UH is abdominal pain which occurs in 44% of patients. Umbilical swelling and symptoms of incarceration or strangulation may develop; in fact, UH is liable for complications (irreducibility, obstruction, incarceration, strangulation, skin ulceration, and even rupture of the hernia) more common than

any other abdominal hernia. Diagnosis of UH can be established by detailed history and physical examination when a patient presents with umbilical pain and swelling. Rarely, radiological imaging is required for confirming UH diagnosis. All UH in adults should be repaired electively to prevent the high risk of complications.^[19-21] A relative contraindication for the elective repair of UHs is the presence of uncontrollable ascites, in liver cirrhosis with child's B and C class and low albumin levels of <30 g/L. Obese patients should be counseled on weight reduction before surgery. UH hernia repair in the presence of ascites and/or esophageal varices is associated with significant postoperative complication rates. Moreover, the emergency repair is associated with higher morbidity and mortality. Overall mortality in patients with liver cirrhosis is 5.1%–6.5%.^[22]

Many techniques were described for repairing UH. The aims of repairing UM are to prevent complications of the hernia, reduce the complications of its repair, and reach a high level of patients' satisfaction. Open suture repair of UH was attained by a high infection rate; Mayo's repair had a recurrence rate of 28%. Open mesh hernioplasty of UH reduces the rate to 8.9%.^[23,24] The high rate of SSI after open repair of UH can be reduced by prophylactic antibiotics because the umbilicus is not a clean anatomical structure and it is difficult to disinfect it from all bacteria. UH repair by primary suture can be performed safely under local anesthesia and sedation in patients with small UH. General anesthesia is reserved for laparoscopic repair of UH and in patients with the American Society of Anesthesiologists I and II.^[7,25] Minimally invasive mesh techniques proved to reduce postoperative complications in obese patients and the proceed ventral patch can be safely and effectively used for repairing small and medium size UHs in obese patients.^[26] Many minimally invasive techniques were employed for repairing UM: Intraumbilical approach and minimal incision scar-less technique.^[27,28] The presence of UH with other abdominal wall surgical disorders may encourage or force the surgeon to combine UH repair with other surgical procedures. Simultaneous cesarean section and UH repair can be performed safely with the advantage of avoiding second surgery and acceptable results by the surgeon and the patients.^[29,30] Concomitant UH repair and abdominoplasty and/or correction of diastases of the recti were also performed successfully with good results.^[31,32] The complications of UH repair include hematoma formation in 46% of patients, seroma in 19%, postoperative pain in 77%, and recurrence.^[19-21] The recurrence rate is high in obese patients, defects larger than 3 cm, smoking, diabetes, rapid weight gain after repair, rapid and excessive accumulation of ascites in cirrhotic patients, and following wound infection. Laparoscopic repair of UH proved to

results in less postoperative morbidity, shorter hospital stay, and decreased recurrence rate.^[12-15,25]

Epigastric hernia

It is a primary VAH close to the midline with its center above the umbilicus.^[1] EPH is a common condition with a prevalence of 10%, but a major proportion of EPHs are asymptomatic. The fact that a minority of EPHs are symptomatic can explain the scanty of the studies published about EPH. Studies on cadaver showed a rate of 0.5%–10%. EPH accounts for 8% of midline ventral hernias, and 1.6%–3.6% of all abdominal hernias and 0.5%–5% of all operated abdominal hernias are EPH.^[16] EPHs are usually small in size and rare voluminous ones can occur. About 20% of the EPH are multiple; a fact that warrants a thorough examination of the whole linea alba above the umbilicus. EPH occurs 2–3 times more common in men than in women and in patients in their 20–50 years of age.^[16-21]

The development of EPH is related to the extensive strains exerted on the aponeurosis of the anterior abdominal wall. The fibers of the anterior abdominal wall aponeurosis, above the umbilicus, cross the midline and decussate with the fibers on the opposite side. EPH protrudes through these fibers. It is the extraperitoneal fat that herniates between the decussated fibers of the aponeurosis or through the perforations in the linea alba made by the perforating vessels lacunae. Vigorous strains, caused by strenuous exercise, coughing, vomiting, on the aponeurotic fibers of the linea alba, will stretch the crossing fibers and allow the development of fatty hernia of linea alba.^[16] The theory of the extratension exerted by the diaphragm through its anterior attachment on the epigastric region is the most accepted explanation for the development of EPH.^[8]

The most common presenting symptom of EPH is epigastric pain which is not related to meals, but it is exacerbated by physical exercise (heavy lifting) and by the increase of the intra-abdominal pressure. A palpable epigastric lump, anywhere between the xiphisternum process and 3 cm above the umbilicus, is the second most common presenting symptom of EPH. The lump is always tender and it is frequently irreducible.^[33] The lump in the linea alba may be difficult to detect on palpation in obese patients. Diagnosis of EPH can be established by detailed history in the presence localized epigastric pain not related to meals and a tender small midline lump. In difficult cases, ultrasound has 100% sensitivity in detecting small asymptomatic EPHs.^[34,35]

EPH, when symptomatic, should be repaired electively to prevent complications, and the high rates of morbidity

and mortality associated with the emergency repair.^[10] EPH can be repaired using different techniques. The open suture repair was the first employed technique, but it was attained by high rates of complications and recurrence. Open suture repair is still practiced in many countries, for small ≤ 2 cm hernias and for its cost-effectiveness.^[34,36] Open mesh hernioplasty reduced the rate of recurrence to 2.2% compared with 8.2% for open suture repair. However, mesh repair is attained with higher rate of postoperative seroma formation and SSI.^[3,37] The use of laparoscopy for repairing EPH is increasing, even for small size hernias, because laparoscopic technique for EPH reduced the postoperative complications, hospital stay, and resulted in high patients' satisfaction.^[14,38]

Spigelian hernia

It is a PVH in the fascia spigelian aponeurosis.^[1] SPH is a ventral hernia that occurs through a slit-like defect in the anterior abdominal wall adjacent to the semilunaris line. It is a rare hernia; der Spiegel was the first to describe the linea semilunaris in 1645. However, in 1764, Klinkosch described a spontaneous lateral ventral hernia located in the linea semilunaris.^[39] SPHs are unique because they are situated mostly intraparietal; a fact that makes the diagnosis of SPH difficult on clinical finding.^[40] Linea semilunaris represents the site of union of the rectus sheaths with the fascia of the lateral abdominal muscles. Above the semicircular line of Douglas, the aponeurosis of internal oblique muscle splits to enclose the rectus muscle (forming the anterior and posterior rectus sheaths). Since the precise location of the semi lunar line varies, so does the site of the hernial defect of the SPH. Below the semicircular line of Douglas, the posterior rectus sheath is absent; this could be an explanation of the development of SPH just below the semi lunar line. SPHs are those ventral hernias that occur above the inferior epigastric vessels; those which occur below the inferior epigastric artery are classified as direct inguinal hernias.^[41-43] SPH develops as the results of an acquired weakness of the transversalis and internal oblique muscles.^[44] The exact cause of SPH is not known due to its rarity. However, its development is related to multiple factors such as collagen disorders, aging, obesity, rapid loss of weight, repeated pregnancies, trauma, and history of abdominal surgery, COPD, and congenital disorders. The defect through which SPH herniates is narrow, hence the high rate of incarceration and strangulation (21%–33%). SPHs constitute about 1%–2% of all abdominal hernias are more common on the right side of the abdomen. They are more common in women than men in their fourth–fifth decade of life; female:male ratio is 4:3 and are rarely bilateral. Increased intra-abdominal pressure and abdominal trauma were incriminated as etiological factor in adults.^[39]

The most common symptoms of SPH are a localized abdominal pain, at the lateral border of the rectus muscle in 60% of patients, and a palpable abdominal mass in 35% of patients. In more than 50% of patients, the physical examination alone failed to establish the diagnosis of SPH.^[45] Ultrasound can establish the diagnosis of SPH and in experienced hands all the structure of the anterior abdominal wall can be visualized by ultrasound, especially when examination is performed in the standing position and under Valsalva maneuver.^[46] Ultrasound has a sensitivity of 90% and positive predictive value (PPV) of 100%; CT scan has a sensitivity of 100% and PPV of 100%; while the clinical assessment has a sensitivity of 100% and PPV of 36%. When there are no obvious signs of SPH, the diagnosis can be confirmed by ultrasound and CT scan. In cases of uncertainty, a diagnostic laparoscopy can be performed. Clinical assessment alone is not accurate for making a decision to operate.^[47]

The approach to the management of SPH should be prompt surgical repair to prevent the high risk of incarceration and strangulation. The classical surgical techniques are open suture repair and open mesh repair. Laparoscopic repair of SPH is introduced recently with result that reduced the postoperative pain, shortened the hospital stay, and allowed early return to normal activities and work.^[48,49]

Lumbar hernia

It is a primary VAH in the lumbar region.^[1] The anatomical existence of LH is dating back for four centuries; when Barbate in 1672 suggested its existence and in 1731 Garangoet reported the first case of LH. Since that time and up to the second decade of the 21st century, only 300 cases of primary LH were described in the surgical literature.^[50] The primary LHs are very rare and commonly occur through the inferior lumbar triangle of Petit. The secondary LH commonly occurs through the superior lumbar triangle of Grynfelt, mainly after trauma (surgical or nonsurgical), 20% are congenital, which occurs during infancy and childhood, and commonly associated with other congenital malformations. The remaining 80% are acquired which may be primary (spontaneous) or secondary to surgery or trauma. LH affects men in their sixth decade of life more than women; it accounts for <2% of all VAHs. LH has a 25% risk of incarceration and >8% risk of strangulation. Risk factors for LH include advance age, chronic debilitating diseases, COPD, obesity, strenuous physical exercise, and muscular atrophy.^[51-54]

Anatomical considerations

The lumbar region of the abdomen is bounded superiorly by the 12th rib, medially by the erector spinae muscle, inferiorly by the crest of the iliac bone, and laterally by

the external oblique muscle. The layers of the abdominal wall in the lumbar region are composed, from superficial to deep layer, of skin and superficial fascia. Superficial muscular layer contains latissimus dorsi, external oblique, and thoracolumbar fascia. Middle muscular layer contains sacrospinal muscle, internal oblique, and serratus posterior inferior muscle. Deep muscular layer contains the quadratus lumborum and psoas muscles transversalis fascia and preperitoneal fat and most deep peritoneum. There are two well-defined and constant areas of weakness in the lumbar region: The superior lumbar triangle (Grynfelt's triangle) is an inverted triangle with its base formed by the 12th rib and the lower edge of the serratus posterior inferior muscle; posteriorly, it is bounded by the sacrospinal muscle, and anteriorly, by the internal oblique. The roof of the superior lumbar triangle is formed by the external oblique and transversalis fascia. There are three areas of weakness within the superior lumbar triangle: (1) Immediately below the 12th rib, where the transversalis fascia is not covered by the external oblique muscle, (2) at the site of the penetration of the 12th dorsal intercostal neurovascular pedicle, and (3) between the inferior edge of the rib and ligament of Henle. Tall thin persons with angulated 12th rib will have a smaller superior lumbar triangle than short obese persons with horizontal 12th ribs.^[55,56]

The inferior lumbar triangle (Petit's triangle) is bordered by the iliac crest at its base, external oblique muscle laterally, and latissimus dorsi muscle medially; the floor is formed by the internal oblique muscle.^[57]

The predisposing factors that increase the risk of hernia development within the inferior lumbar triangle could be related to the alteration of the origin of the external oblique muscle and the more medially situated latissimus dorsi muscle; this situation gives rise to a wide base of inferior lumbar triangle (common in women with wide pelvis) The development of LH within the inferior lumbar triangle is associated with trauma, which results in extensive fibrous tissue formation, which increases the risk of herniation in the presence of the predisposing factors.^[55] The most common clinical presentation of LH is with a palpable lumbar swelling, which increases with strenuous exercise coughing and straining and it disappears in the decubitus and spine position; back pain is another presentation of LH, and in the presence of strangulation, presentation could be that of intestinal obstruction.

Preoperative diagnosis of LH is feasible due to the presence of the physical signs on examination. However, when physical examination is obscure, ultrasound, CT scan, and magnetic resonance imaging can reliably establish an early diagnosis of LH. In cases where the clinical presentation

suggesting strangulation, a diagnostic laparoscopy can be performed.^[54-60] Surgery is the only treatment of LH and it should be performed early to prevent complications. The selection of the operative technique for LH should be based on the size of the hernia defect, location, contents, etiology, possibility of recurrence and availability of facilities, and expertise in the hospital. LH can be repaired by primary suture, using fascial and muscle flaps taken from the nearby musculofascial structures (gluteus major and medius, latissimus dorsi, and fascia lata). This type of repairing LH is followed by high rate of recurrence due to the poor fascial strength and the high tension of the repair. LH can also be repaired by hernioplasty technique using mesh, which can be fixed to the external oblique, latissimus dorsi and the periosteum of the iliac crest. The open mesh technique can be reinforced by reapproximating the superficial layer of the lumbar region muscles. Since the nineties of the 20th century, laparoscopy was introduced for repairing LHs.^[57-61] Comparison between open versus laparoscopic repair of LH revealed that there is statistically significant lower morbidity rates, shorter length of hospital stay, reduced postoperative pain, and less required analgesia and earlier return to normal activity and work in favor of laparoscopic repair. However, using synthetic mesh directly with contact with the peritoneal content leads to fistula formation and intestinal obstruction, this can be avoided either by preperitoneal insertion of mesh or using biosynthetic mesh. Open procedures for repairing LH should be reserved for very small hernial defects and for patient with very large defect and for those who failed laparoscopic approach.^[57-61]

The aim of this review was to draw attention to the less common primary VAHs, for those who need to acquire the knowledge about the topic, namely, under- and post-graduate medical students, surgical trainees, and junior surgeons in practice. The secondary ventral hernia (IH) was reviewed in two previous articles published in this journal.

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Conflicts of interest

There are no conflicts of interest.

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