Overview of Abdominal Wall Hernias and Laparoscopic Transabdominal Retro Muscular (TARM) Repair

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ABSTRACT

The anterolateral muscles of abdomen act as a strong barrier enclosing the abdominal viscera, maintaining the intra-abdominal pressure, and assisting in respiration.A protrusion of a viscus or portion of a viscus through a hole in the abdominal wall is known as an external hernia. The two main categories are aetiology and location. Primary ventral hernias can occur (umbilical, epigastric, Spigelian, obturator, or lumbar hernias). Ventral wall hernias are often treated surgically, either through an open repair through a skin incision or through a laparoscopic procedure (herniotomy, herniorrhaphy, or hernioplasty). Due to the risks associated with intraperitonealonlay mesh repair for ventral hernias, open Rives-Stoppa surgery is preferred over sublay mesh implantation (ORS). Using a polypropylene mesh (PPM) with sublay, midline closure, and the addition of posterior component separation (PCS) by transversusabdominis release, a low-cost laparoscopic trans-abdominal repair was required (TAR). Therefore, the aim of the present study to review abdominal wall hernias managed using laparoscopic transabdominal retro muscular (TARM) repair.

Keywords: Ventral wall hernias**;** hernialrepair ; laparoscopic transabdominal retro muscular

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INTRODUCTION

The Rectus abdominis muscle flex the lumbar spine, Lateral flexion and rotation of the trunk are done by the coordinated contraction of the oblique muscles of both sides of the midline. Allabdominal muscles act together to increase the intraabdominal pressure and if the respiratory passage is open, the diaphragm is pushed upwards as in forced expiration as with sneezing and coughing. However, if the air way is closed the abdominal pressure is increased to help when lifting heavy objects, during defecation, childbirth, and vomiting **(1).**

An external hernia is defined as protrusion of viscus or part of viscus within a peritoneal sac through a defect in the abdominal wall. They are typically classified by etiology and location. Ventral hernias can develop primary (umbilical, epigastric, Spigelian, obturator, or lumbar hernias). Or Secondary as a result of prior surgery (incisional hernia) **(2)**.

1-Umbilical hernia:

A congenital umbilical hernia is a congenital defect in the linea alba, which develops when the umbilical scar fails to heal at birth, The incidence of umbilical hernia ranges from 10 to 30 percent and is more common in African American children than in Caucasians. Many umbilical hernias close in the first 12 to 18 months of life; repair is rarely recommended until a child is approximately two years old **(3).**

2-Paraumbilical hernia:

Paraumbilical hernias in adults are acquired, rather than congenital, and occur more commonly in females than in males with a 3 to 1 ratio. Paraumbilical hernias are associated with increased

intraabdominal pressure due to obesity, abdominal distension, ascites, and pregnancy **(4).**

The diagnosis of paraumbilical hernia is made when the patient presents with a soft swelling at the umbilicus that may be asymmetric, located slightly above, slightly below, or to one side or another. Paraumbilical hernias most often present incarcerated in men; females, particularly those close to their ideal body weight, are more likely to have easily reducible hernias. Typically, it is omentum or preperitoneal fat that incarcerates into the hernia**.** Certain hernias may be so small and asymptomatic that the patients may not be aware that a hernia is present. These hernias do not require repair and can be observed without the need for immediate intervention **(5).**

Ascites and umbilical hernias:

When umbilical hernias exist in cirrhotic patient with ascites, great care must be taken in the repair. Asymptomatic umbilical hernias can often be treated conservatively unless there is associated skin ulceration. If repair is to be done care should be taken to prevent the subsequent enormous fluid and electrolyte alterations that may follow **(6).**

3-Epigastric hernia:

Epigastric hernias are defined as a defect in the abdominal wall in the midline between the umbilicus and the xiphoid process **(7).** Epigastric hernias may develop due to congenitally weak lineaalba, increase intraabdominal pressure, or muscle weakness. The frequency of epigastric hernia is estimated to range from 3 to 5 percent. It is most commonly diagnosed in middle age; that is more common in males by a ratio of 3 to 1 **(8).**

4-Divercation of recti:

Divarication of recti is an anatomical description of an acquired condition in which the two rectus muscles are separated by a variable distance, hence a separation of the rectus muscles >2 mm, would be considered a divarication of recti, Divarication of recti is not considered as a true form of hernia as there is no fascial defect nor a clear sac therefore there is no risk of complications (obstruction or strangulation) **(9).**Divarication of recti can also be seen in infants, but as the infant grows and their rectus abdominis strengthens and hypertrophies, the divarication of recti disappears **(10).**

5-Spigelian hernia:

Spigelian hernia occurs through a defect in the abdominal wall along the semilunar line, mostly at the lower abdomen below level of lineasemilunaris where the posterior rectus sheath is deficient. The hernial sac is usually found intra parietal that passed through transversusabdominis and internal oblique muscle and get entrapped under the external oblique aponeurosis, it is very rare form of hernial and is difficult to diagnose **(11).**

Incisional Hernia

Is the type of hernia that result from incomplete healing of surgical wounds that may happen due to development of seroma, hematoma, wound contamination, or infection, raised intra-abdominal pressure, obesity, or poor surgical technique. The most commonly seen incisional hernia is following midline exploration laparotomy **(12).**

Hernial Repair:

As a general role the treatment of ventral wall hernia is surgical, either as an open repair through a skin incision, or laparoscopic, done using one of these techniques (herniotomy, herniorrhaphy,

or hernioplasty)**(13)**. Open repair for small hernia (smaller than 2 cm in diameter), a vertical or curvilinear incision is made over the hernia sac, and the dissection is carried down to the fascia then the sac itself is identified. The sac is then dissected to its fascial attachments. Once the fascia has been cleared, the hernia sac is either inverted and the fascia closed with a sturdy nonabsorbable suture, or the hernia sac is excised, and the fascia closed. If the defect is particularly large, and if the fascial edges will not come together without tension, mesh should be used **(14).**

Mesh repair:

Prosthetic materials are widely used today in the repair of all kind of abdominal hernias. Randomized clinical trial revealed that the recurrence rate was lower after mesh repair than that after suture repair (1% vs. 11%) in a 64month mean postoperative follow-up **(15).** However, many surgeons still make his/her decision on the basis of the size of the umbilical/paraumbilical defect suggested a tailored repair and stated that suture-based methods for defects <2 cm can provide acceptable recurrence rates (6%) in long-term follow-up**.** Meshes can be placed via both the open and laparoscopic approaches**(16).**

Mesh properties:

The best mesh offers strength by adhering to the abdominal wall but not to bowel to prevent adhesions, or fistulation, and would not provoke an inflammatory response, also resist infection **(17).**

1- **Tensile strength:**The maximum intra-abdominal pressures generated in healthy adults occur during coughing and jumping. These are estimated to be about 170 mmHg. Meshes used to repair large hernias, therefore need to withstand at least 180 mmHg before bursting. This is easily achieved as even the lightest meshes will withstand twice this pressure without bursting **(18).**
2- **Pore size:**Porosity is the main determinant of tissue reaction. Pores must be more than 75 µm in order to allow infiltration by macrophages, fibroblasts, blood vessels and collagen. Meshes with larger pores allow increased soft tissue in-growth **(19)**.
3- **Mesh weight:**The weight of the mesh depends on both the weight of the polymer and the amount of material used including: (a) Heavy weight meshes use thick polymers, have small pore sizes and high tensile strength. The strength is derived from a large mass of material, which activates a profound tissue reaction and dense scarring. (b) Light weight meshes are composed of thinner filaments and have larger pores (> 1 mm). They initiate a less pronounced foreign body reaction and are more elastic.A new generation of even lighter meshes include the titanium/propylene composite meshes. These have been shown to be associated with a more rapid recovery **(20).**
4- **Reactivity:**Modern biomaterials are physically and chemically inert. They are generally stable, non-immunogenic and non-toxic. Despite this, they are not biologically inert. A foreign body reaction is triggered by their presence. This involves inflammation, fibrosis, calcification, thrombosis, and formation of granulomas. It is very different from the physiological wound healing of suture repair **(21).**
5- **Composition:**Mesh fibers can be monofilament, multifilament (braided), or patches (for example, ePTFE). Multifilament fibers have a higher risk of infection**(22).**
6- **Shrinkage:**occurs due to contraction of the scar tissue formed around the

mesh. Scar tissue shrinks to about 60% of the former surface area of the wound. The smaller pores of heavy weight mesh leads to more shrinkage due to the formation of a scar plate **(Bhattarai and Staat, 2018).**

Mesh placement:

The mesh can be placed above the fascia (Onlay), below the fascia (Sublay), or bridge the gap of the defect by suturing the mesh to the fascial edges (Inlay) **(Figure 1):**

- **Onlay**: the defect is closed with sutures and a sheet of prosthetic material is placed above the repair. This technique is dependent on healing of the primary suture repair and is better than simple sutured repair.
- **Inlay**: primary bridging of the fascial defect is appealing because it should provide tension-free coverage of the defect. It is dependent on the ability of the mesh to be affixed securely to the fascial edges by means of either running or simple interrupted sutures and because no effort is made to provide a tough closure of the abdomen, the patient may find that the hernia is technically repaired but that the abdomen is lax and does not provide adequate support for muscular activity.
- **Sublay**: The Sublay technique has lower recurrence rates compared to either the onlay or inlay. The technique involves dissection of the hernia sac down to the level of the anterior rectus sheath, excision of the sac, and then dissection between the posterior rectus sheath and rectus muscle This undermining dissection is carried laterally for the full extent of the rectus until the posterior sheath has been completely mobilized. It is then sutured to its opposing self and a large sheet of polypropylene mesh is placed between the posterior sheath and the rectus **(20).**

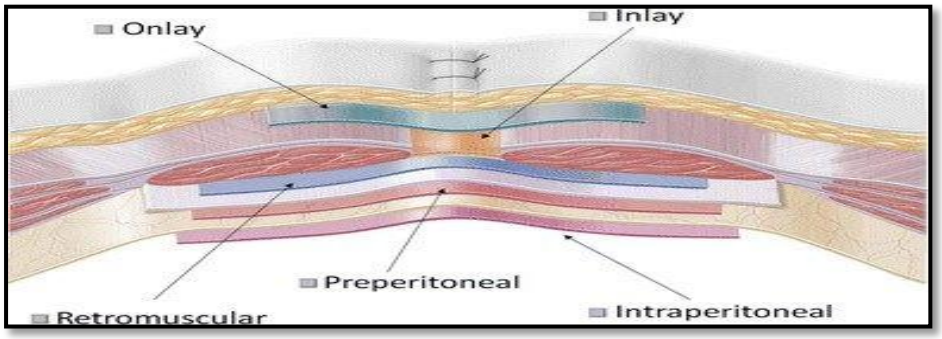

Figure (1): Repair of an abdominal hernia using Onlay, Inlay, and Sublay technique **(24).**

Laparoscopic mesh repairs:

Laparoscopic repair most closely mimics the Sublay technique of open repair. As a large mesh is placed over the defect with a minimum of 5 cm overlap over the hernia that is fixed with sutures or tacks, The basic technique of the laparoscopic ventral hernia repair (LVHR) is establishment of a pneumoperitoneum, placement of intraabdominal cannulas, lysis of adhesions, and reduction of the hernial contents. The hernia sac is then usually removed, though some surgeons leave it in place.The edges of the defect are refreshed with electrocautery to promote adherence of the mesh to this area. The defect is measured, and a piece of mesh sized to cover the defect with a 5 cm overlap is then cut to shape and introduced into the abdomen then sutures or tacks are used to fix the mesh **(25).**

The intraabdominal pressure should be decreased to make the abdominal wall closer to its natural shape and allow a flat placement of the mesh. If the defect is sufficiently large, additional sutures are

then placed every 3 to 4 cm to further secure the margins of the mesh to the anterior abdominal wall. Following suture placement, laparoscopic tacks are placed to affix the mesh to the abdominal wall. For larger pieces of mesh, more transfascial sutures should be placed in order to provide a more secure fixation to the abdominal wall. Drains are not typically used, unless the defect is particularly large **(26).**In laparoscopic ventral hernia repair(LVHR),the mesh will almost always be in contact with viscera, and it is therefore important that a double face composite mesh to be used so as not to provoke a high degree of adhesion **(27).**

Posterior component separation:

Component separation involves the division of portions of the anterior and posterior rectus sheaths to gain adequate fascial coverage of the incision**(Figure 2)**. The procedure involves dividing the external oblique aponeurosis and muscle, elevating the rectus abdominis muscle from its posterior rectus sheath, and then mobilizing the myofascial flap consisting of the rectus abdominis, internal oblique, and transversusabdominis muscles medially **(28).**

This provides additional length to the abdominal wall and allow adequate closure without tension and without prosthetic material. Component separation allows for advancement of the rectus abdominis muscle by as much as 10 cm from each side, thus facilitating closure of the midline, and thereby increasing the intraperitoneal volume. A significant defect can frequently be bridged using this technique. The component separation technique avoids potential complications associated with the use of mesh, but studies have found that it does not have significant advantages over laparoscopic mesh techniques for ventral hernia repair **(29).**

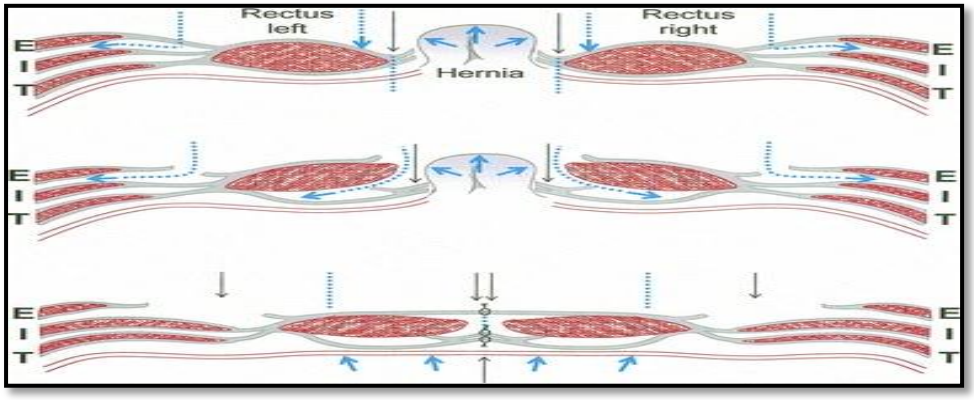

Figure (2):Component separation of anterior abdominal wall(30).

Laparoscopic component separation:

This technique still provides the possibility of bridging abdominal wall gaps of up to 10 cm. Like the open technique, the laparoscopic technique provides excellent abdominal wall function by maintaining musculofascial continuity across the trunk, rather than bridging a defect with mesh alone. The technique involves gaining access to the external oblique muscle laparoscopically and incising the aponeurosis of that muscle. This then provides sufficient length of tissue to reapproximate in the midline **(31).**

- **Laparoscopic Transabdominal retro muscular TARM repair**

Laparoscopic Transabdominal retro muscular TARM repair developed

mainly to avoid two complications first to prevent mesh bowel contact in intraperitonealonlay mesh repair and its complications (adhesions, bowel obstruction, or fistulation) second to avoid the high cost of composite mesh **(32).**

- **Techniques:**The patients are operated under general anesthesia, A high-definition camera system and one or two monitors were used, Peritoneal access done via open Hasson's technique using a 10-mm trocar starting at the left hypochondrium in the mid clavicular line. The operation table was flexed for wider instrument manipulation angles. Based on location, size of hernia and associated rectus abdominis divarication, two techniques were developed as follows **(33).**

I-Technique 1: Three-port TARM :is best for supra-umbilical, infra-umbilical, and lateral hernias. Three trocars were used: one 10 mm for telescope placed 2cm below xiphoid process and two 5-mm trocars as working ports places 2cm subcostal at the mid clavicular line **(Figure 3)** or placed in the lower abdomen (Figure 10) for epigastric hernias **(34).**

After recognition of the hernia (volcano sign) adhesiolysis and reduction of contents of the hernial sac, the defect edge was refreshed using electrocautery then, a 6–8 cm long transverse incision was made on the peritoneum and posterior rectus sheath separating it from the rectus abdominis muscle, dissection goes for about 7 cm all around the defect. The retro muscular space was developed, with careful preservation of epigastric vessels, neurovascular bundles, then the intra-abdominal pressure was then reduced to 8 mm Hg. Midline closure was performed with a running suture of No. 1 polydioxanone (PDS) passing through rectus abdominis muscles and the anterior rectus sheath then a regular polypropylene mesh is placed into the retro muscular space. And fixed using 2-0 Prolene suture or tacks, Then the peritoneum and the posterior rectus sheath is closed using No. 3-0 Vicryl suture, followed by de sufflation and port closure **(32).**

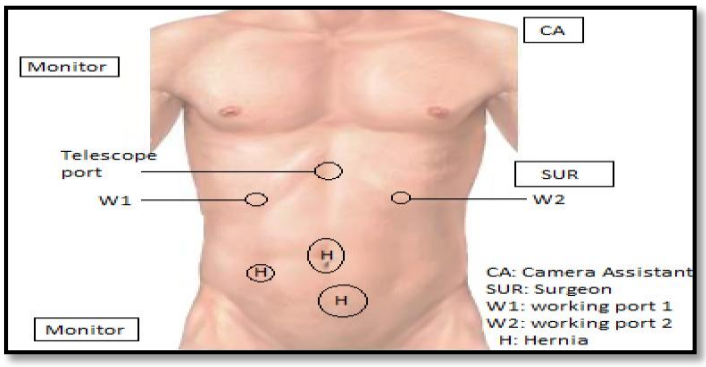

Figure (3): TARM using 3 port technique(35).

II. Technique 2: six-port TARM: is best to repair large hernias, particularly umbilical, para-umbilical, multiple defects, and divarication of recti. Six ports were used to raise two peritoneal-posterior rectus sheath flaps. The first trocar was inserted into the epigastrium with two 5 mm working ports in the mid clavicular line. A transverse incision was made on the peritoneal-posterior rectus sheath, midway between the xiphisternum and symphysis pubis. The retro-rectus space was developed inferiorly till the symphysis pubis and laterally till the lateral border of rectus abdominis muscle. Then three more ports were inserted into the lower

abdomen to lie in the retromuscular space: one 10-mm camera port in the supra-pubic area and two 5-mm working ports. The telescope was then shifted to the supra-pubic port. With the surgeon standing between the patient's legs, an upper flap of peritoneal-posterior rectus sheath was mobilized till the level of the xiphisternum. The initially inserted three trocars were withdrawn into the retromuscular space. The intra-abdominal pressure was reduced to 8 mm Hg, followed by closure of defects and the initial transverse incision on peritoneal-posterior Rectus sheath with running No. 2-0 Vicryl suture. followed by de sufflation and port closure **(33).**

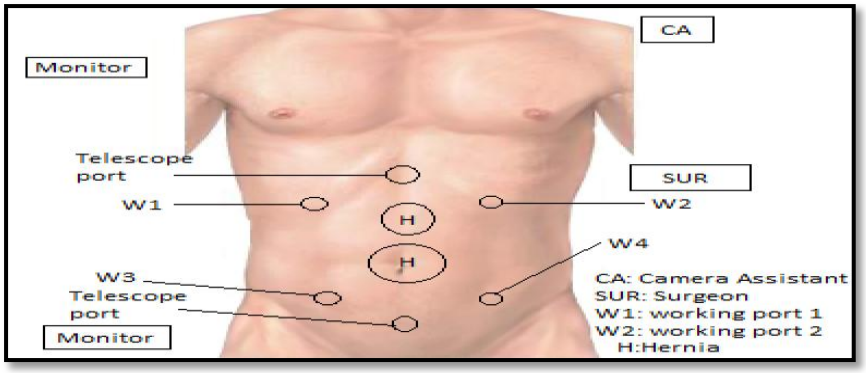

Figure (4): TARM using 6 port technique**(35).**

The techniques used three or six operating ports with triangulation. After adhesiolysis, a transverse incision was made on the peritoneum (P) and posterior rectus sheath (PRS). The retromuscular space was developed by raising a P-PRS flap. Midline closure was performed with No. 1 polydioxanone, and a PPM was placed in sublay, followed by closure of defect and P-PRS incision. For large hernias with divarication; myo-fascialmedialization using PCS-TAR aided low-tension midline closure**(20)**.

CONCLUSION:

Laparoscopic transabdominalretromuscular repair (TARM) was found to be an effective ventral hernia procedure in the short term, as it not only helped to reduce the morbidity but also reduced the cost.

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