Chapter 9
Laparoscopic Ventral Hernia Repair

Juan Guadalajara Jurado and Julio Gómez Menchero

Abstract Ventral hernias are exciting surgical challenges that encompass both treatment and prevention. Between 3 and 13 % of all laparotomy incisions will later develop ventral hernias; this rises to 40 % for those cases that develop surgical wound infections during the postoperative period. This high percentage produces important consequences, economic ones that impact the individuals who experience them as well as the healthy population. In 1991, Leblanc et al. compared the laparoscopic approach in ventral hernia to conventional ventral hernia surgery, in order to compare the results in terms of recurrence and morbidity, as well as the comfort of the patients. Since the beginning of the laparoscopic approach, there have been controversies regarding its indications, surgical techniques, materials, fixation methods, complications, and results. We demonstrate the advantages of this technique, as well as the principal steps that should be taken for a successful ventral laparoscopic hernia repair.

Keywords Hernia • Ventral • Incisional • Surgery • Laparoscopy • Mesh • Midline • Fixation • Complications

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Introduction

Ventral hernias are exciting surgical challenges that encompass both treatment and prevention. Between 3 and 13 % of all laparotomy incisions will later develop ventral hernias; this rises to 40 % for those cases that develop surgical wound infections during the postoperative period [1]. This high percentage produces important consequences, economic ones that impact the individuals who experience them as well as the healthy population.

In 1991, LeBlanc and Booth [2] compared the laparoscopic approach in ventral hernia to conventional ventral hernia surgery, in order to compare the results in terms of recurrence and morbidity, as well as the comfort of the patients. Since the beginning of the laparoscopic approach, there have been controversies regarding its indications, surgical techniques, materials, fixation methods, complications, and results. Some of them are still ongoing [3].

Definition

The origin of the ventral hernia is a fascia defect of the abdominal wall generally occupied with any part of the intra-abdominal content [4], commonly intestine or the omentum.

Classification

The reason why there are no common criteria for the surgical treatment of the ventral hernia is the absence of uniformity by the different authors in naming and classifying this pathology in their studies.

We present the classification of the European Hernia Society (EHS) [5], recognized by many groups because of its simplicity and clarity. According to the EHS, ventral hernias are divided in two groups:

1. *Primary*: there are many factors involved in its origin.
2. *Secondary or Incisional*: it appears subsequent to a previous surgical incision in the abdominal wall.

Both groups have been further subdivided, by location and size.

Primary hernias (Fig. 9.1) are classified by size and location (Fig. 9.2), and incisional hernias are classified by the size (length and width), location, and rate of recurrence (Fig. 9.3). In cases of multiple hernias, the most distal edge is used to measure the diameter (Fig. 9.4).

In this chapter, we will focus only on midline ventral hernias.

EHS Primary Abdominal Wall Hernia Classification		Diameter cm	Small <2cm	Medium ≥2–4cm	Large ≥4 cm
Midline	Epigastric				
	Umbilical				
Lateral	Spigelian				
	Lumbar				

Fig. 9.1 EHS classification for primary abdominal wall hernias (Reproduced with permission from Muysoms et al. [5])

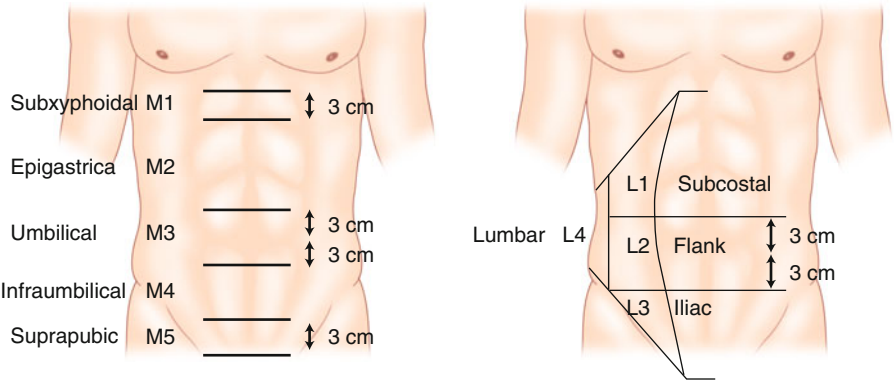

Fig. 9.2 Classification according to the location of incisional ventral hernias (Adapted with permission from Muysoms et al. [5])

Indications

The risk of developing, at any time during the hernia evolution, strangulation of the hernia content [6], damage of the skin that covers the hernia, or loss of home of the herniated intestine always makes it necessary to repair ventral hernia in adults by open or laparoscopic approach [7], avoided only in cases of absolute contraindications to the surgical procedure. There is no hernia measure that indicates or dismisses the laparoscopic approach to ventral hernia.

It is accepted that hernias under 3–4 cm can be repaired using conventional surgery and local anesthesia in an ambulatory setting [8]. Some authors establish 10 cm

EHS Incisional Hernia Classification		M	L	Recurrent incisional hernia?		Length cm	Width cm	Width		
				Yes	No			W1 <4 cm	W2 4–10 cm	W3 >10 cm
Midline	M1 subxiphoidal									
	M2 epigastric									
	M3 umbilical									
	M4 infraumbilical									
	M5 suprapubic									
Lateral	L1 subcostal									
	L2 flank									
	L3 iliac									
	L4 lumbar									

Fig. 9.3 EHS classification for incisional hernia classification (Reproduced with permission from Muysoms et al. [5])

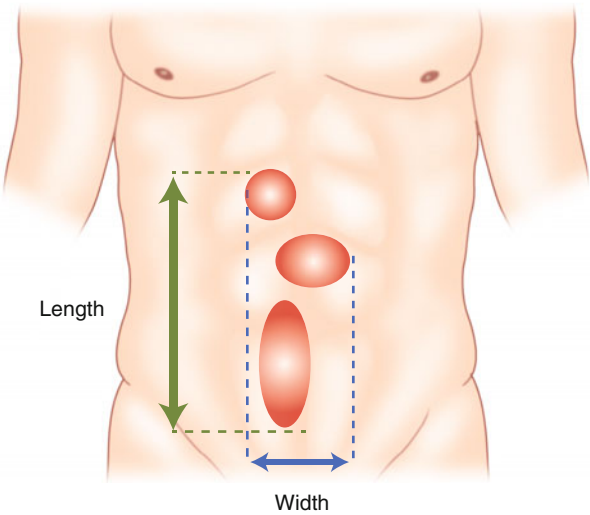

Fig. 9.4 Incisional hernias: multiple diameters (Adapted with permission from Muysoms et al. [5])

as the longest size in transversal diameter for laparoscopic repair, while others set this limit at 15 cm.

It seems to be reasonable that limits depend on the technical difficulties of handling the instruments and the mesh in the abdominal cavity [8, 9].

Some exceptions, like small hernias in an obese patient or giant ventral hernias, can benefit from a laparoscopic approach using component separation in order to reduce the transverse diameter of the hernia hole and then completing the treatment by open [10] or laparoscopic surgery [11].

Surgical Technique

Technical variability between different surgical groups is essentially based on the mesh choice and the fixation method to the abdominal wall.

The common steps in the ventral hernia repair using a laparoscopic approach are as follows: patient positioning, pneumoperitoneum procedure, port placement, adhesiolysis, hernia content replaced inside the abdomen, and fixation of the mesh overlapping the hernia hole.

Patient Positioning

The patient is placed in a supine decubitus position, usually with arms fixed to the body. In obese patients, very often both arms are separated in order to allow better maneuverability of the instruments.

Pneumoperitoneum

Pneumoperitoneum technique will depend on the previous surgery performed on the patient and the surgeon's suspicion of intraperitoneal adhesions to the abdominal wall. A Veress needle in the left hypochondrium is commonly used; previously a nasogastric tube was used in order to avoid a stomach puncture. In case of relevant adhesions, a port of vision is recommended.

Adhesiolysis and Replacing Hernia Content (Fig. 9.5)

Adhesions must be carefully managed with gentle traction maneuvers, using careful dissection whenever possible. Sharp dissection can be performed using an endoscopic scissor; avoid electric scalpels unless you are absolutely sure that there is not a hidden loop of intestine behind the adhesion.

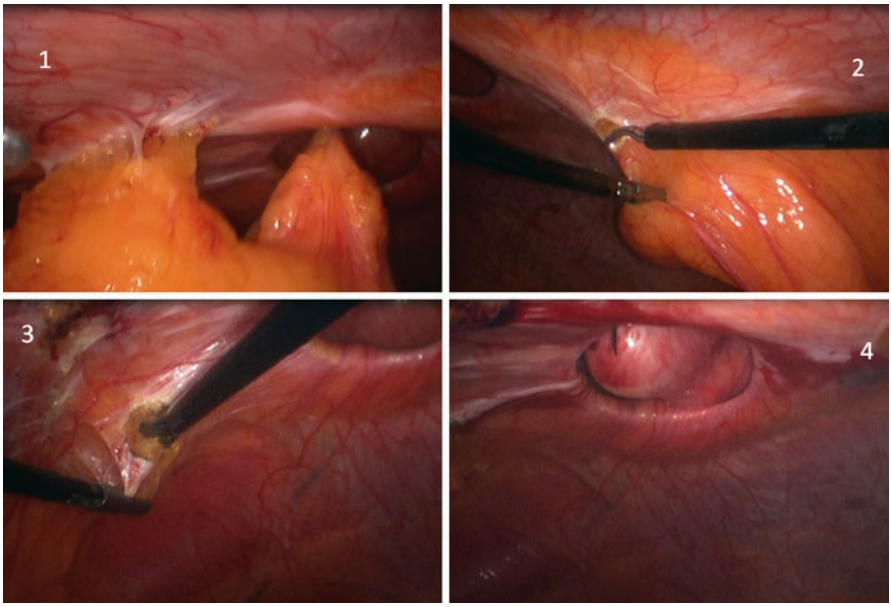

Fig. 9.5 Laparoscopic ventral hernia repair. *1* ventral hernia, *2* section of round ligament, *3* section of umbilical ligament, *4* measure of the diameter of the hernia using a needle

Replacement of the hernia content is managed in a similar way. Exceptionally, external pressure maneuvers are needed to more easily replace the content into the abdominal cavity.

Placement and Fixation of Mesh (*Fig. 9.6*)

A real measure of the hernia edge is needed, using an intramuscular needle inserted into the skin, in the four cardinal points of the hole. Mesh must exceed the size of the hernia hole by at least 3 cm; many authors today recommend a 5 cm mesh overlap.

In the next step, the mesh is rolled on its axis and introduced into the abdominal cavity through a 11 or 12 mm port or wrapped in sterile plastic to avoid contamination.

Double crown technique is generally used to place the mesh in the abdominal wall [12], fixed by absorbable or nonabsorbable tackers, preserving a distance of 1 cm between them, in both fixation lines, internal (edge) and external. Details and controversies will be discussed later in this chapter.

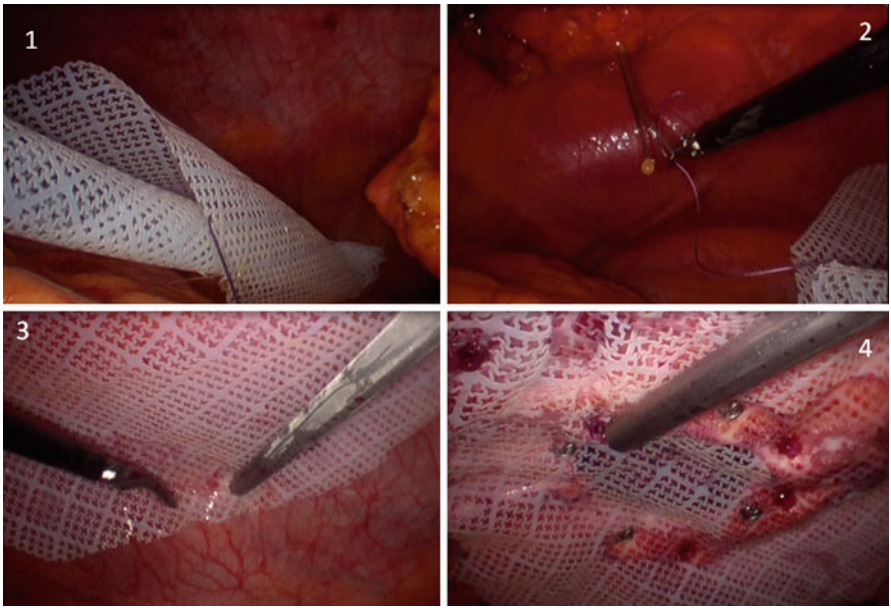

Fig. 9.6 Laparoscopic ventral hernia repair. *1* rolled PTFE-c (Omira) mesh into the abdominal cavity, *2* cardinal points using a Reverdin (proxy) needle, *3* tackers in the outer crown, *4* tackers in the inner crown (absorbable tackers and nonabsorbable tackers, aiming for a lesser rate of pain and adherences)

Complications

Complications can arise during the procedure or once it has been completed. In the sections that follow, we will describe the most common complications related to this procedure.

Intraoperative

These are usually related to the Veress needle puncture and the laparoscopic port placement. Adhesiolysis and hernia content replacement maneuvers may produce bowel perforation, hemorrhage, and visceral injuries [13].

Hemorrhage management includes, in addition to traditional methods, energy sources, sutures, clips, and hemostatic substances involving human thrombin.

Intestine perforation secondary to the treatment of ventral hernia is an added risk, both in open and laparoscopic surgery, with similar consequences [14]. One out of six of these patients will suffer this complication secondary to maneuvering

Table 9.1 Classification of seromas after laparoscopic ventral hernia repair

Type 0	No clinical seroma	No clinical seroma
	0a Neither clinical nor radiological seroma	
	0b No clinical seroma, but it can be detected by radiological exams	
Type I	Clinical seroma lasting less than 1 month	Incident
Type II	Clinical seroma lasting more than 1 month: seromas with excessive duration	
	IIa Between 1 and 3 months	
	IIb Between 3 and 6 months	
Type III	Minor seroma related-complications: symptomatic seromas that may need medical treatment	Complication
	IIIa Clinical seroma lasting more than 6 months	
	IIIb Esthetic complaints of the patient due to seroma	
	IIIc Important discomfort which does not allow normal activity	
	IIId Pain	
	IIIe Superfitial infection with cellulitis	
Type IV	Mayor seroma related-complication: seromas that need to be treated	
	IVa Need to puncture the seroma to decrease symptoms	
	IVb Seroma drained spontaneously (applicable to open approach)	
	IVc Deep infection	
	IVd Recurrence related to seroma	
	IVe Mesh rejection related to seroma	

Used with permission of Morales-Conde [15]

dissection of adhesions, hernia content replacement, or first port placement. It can occasionally occur during the placement of the Veress needle.

An unnoticed intestinal perforation could become a serious threat to the life of the patient.

Postoperative

Postoperative complications related to surgical technique can be divided into minor complications (wound infection, seroma, hematoma, paralytic ileus, pain) and major complications (hemorrhage, prosthesis infection, sepsis, intestinal perforation, recurrence, and mortality).

A recent meta-analysis reported that wound infection in laparoscopic repair is lower compared to open surgery.

Seroma is the most prevalent complication of this surgery, and this still presents in almost 80 % of the cases, although it usually does not cause problems or any inconvenience to the patient. Recently, a classification of five types of seromas was developed (Table 9.1), ranging from the nonobvious clinical seroma to the seroma that needs treatment [15].

Hematoma usually is limited to minimal bleeding or hemorrhagic suffusions located in wounds due to trocar placement or in the area where the mesh has been fixed. Hematomas caused by tacker placement can simulate small recurrences in imaging studies in early stages.

Postoperative abdominal pain should usually be mild and tolerated by the patient during the first 24 h of follow-up. Intense pain after laparoscopic surgery should make us suspect peritoneal inflammation and often involve a laparoscopic review to rule out any serious complication.

Chronic pain is frequently related to transfascial sutures or tacker placement. It is generally caused by nerve entrapment in the fixation area. The use of sealants of fibrin in mesh fixation could reduce the number of tackers and decrease chronic pain.

Treatment of these patients ranges from opiates and nonsteroidal analgesic to local anesthetics infiltration and even removal of tacker or transfascial sutures as the last alternative.

Mesh infection incidence has been reported in 0.7 % of the cases [13–16]. It is usually related to abscesses above or below the prosthesis, disseminated peritonitis, or adhesions between the bowel and the mesh. Patients who previously were subject to open hernia repair and suffered mesh infection reported a higher incidence of mesh infection.

An excessively thin skin above the hernia sac, postoperative seroma punctures, or abdominal wall hematomas are the most frequent causes of mesh contamination.

We must be careful to avoid contamination when we manipulate the mesh before it is introduced inside the abdominal cavity, using new gloves and instruments, wrapping the mesh, and even using skin protector devices such as OPSITE® (Smith & Nephew, London, England).

Mesh infection treatment often requires mesh removal, but exceptionally a percutaneous drainage of the abscess may be useful [16].

Leblanc et al. reported a recurrence incidence of ventral hernia in laparoscopic surgery as ranging between 1 and 16 % [17]. Tobacco and previous hernia recurrence are described as risk factors for recurrence [18]. The most recent meta-analysis [1, 4, 6] concludes that there are no differences between laparoscopic and open surgery in hernia recurrence. However, the latest reviews note that recurrence could be lower in the laparoscopic approach [19]. Multicenter studies based on randomized controlled trials with a longer follow-up are needed to obtain more conclusive and reliable results.

Mortality associated with laparoscopic hernia repair is as low as 0.05 %, but it can increase to 2.8 % in cases of bowel injuries, ranging from 1.7 to 7.7 %, depending on whether bowel injury is noticed or not during the procedure [20].

Controversies

The main controversies arising from ventral hernia repair are related to the approach technique (open or laparoscopic). Other important issues around which there is controversy are patient selection, mesh choice, fixation device, and guidelines to be followed in the case of bowel perforation.

Patient selection has already been addressed earlier in this chapter, but we would like to emphasize here that those hernias greater than 184 cm^2 would be appropriate for an open repair.

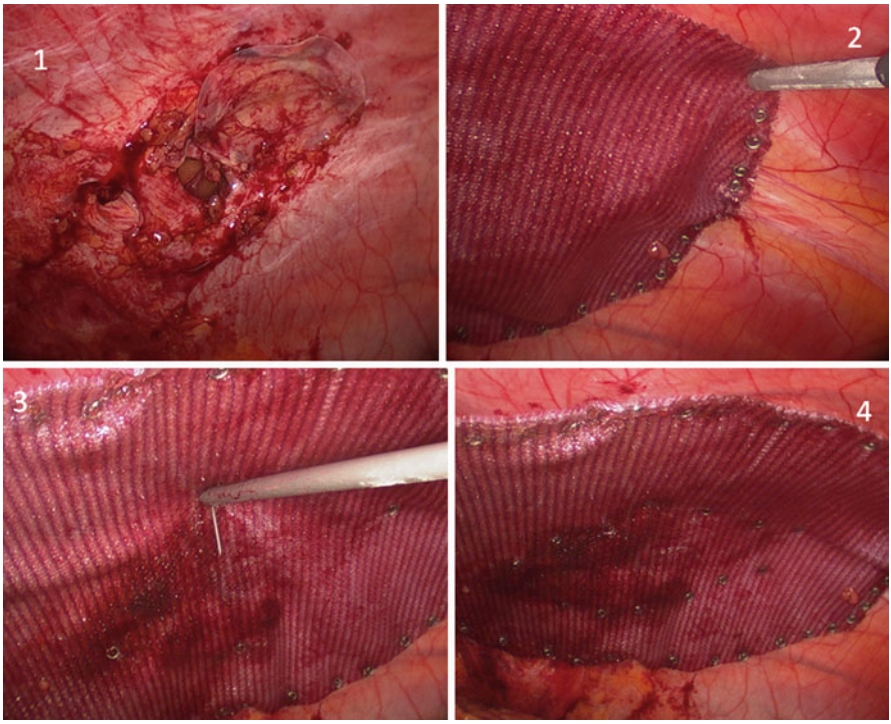

Fig. 9.7 Laparoscopic incisional hernia repair. *1* ventral hernia recurrent, with a previous hernioplasty with plug, *2* outer crown (Sepramesh mesh, tackers at 1 cm), *3* tackers in the inner crown, pointed out by needle, *4* double crown technique

The choice of mesh influences technical maneuvers and surgical results. Several years ago, hernia used to be repaired by meshes thicker than the current ones; these thicker meshes were more difficult to fix using tackers and possibly tended to increased shrinkage. More studies are needed to assert what type of mesh is better. As a general rule, one should use a mesh with a low rate of adhesions, simple or composed, and allow a flap of 5 cm. It is important that a mesh can be easily rolled and handled inside the abdominal cavity, in order to allow for a comfortable setting for today's fixating devices and for a rapid tissue integration. A low rate of infection and the strength of the mesh are very important too. An adequate drainage through the mesh can reduce the seroma incidence [21]. See Fig. 9.7.

There are no significant differences between the use of transfascial stitches and tackers [3], although stitches seem to be more cost-effective. Otherwise [22], placement of stitches is usually more complex, related to higher postoperative pain and worse cosmetic results.

Fibrin glue decreases postoperative pain [23] and contributes to an optimal integration of the mesh to soft tissues, decreasing the number of tackers or sutures needed, but it will increase significantly the cost of the procedure. Currently, absorbable tackers might be an alternative option to prevent adhesions and chronic pain. See Fig. 9.8.

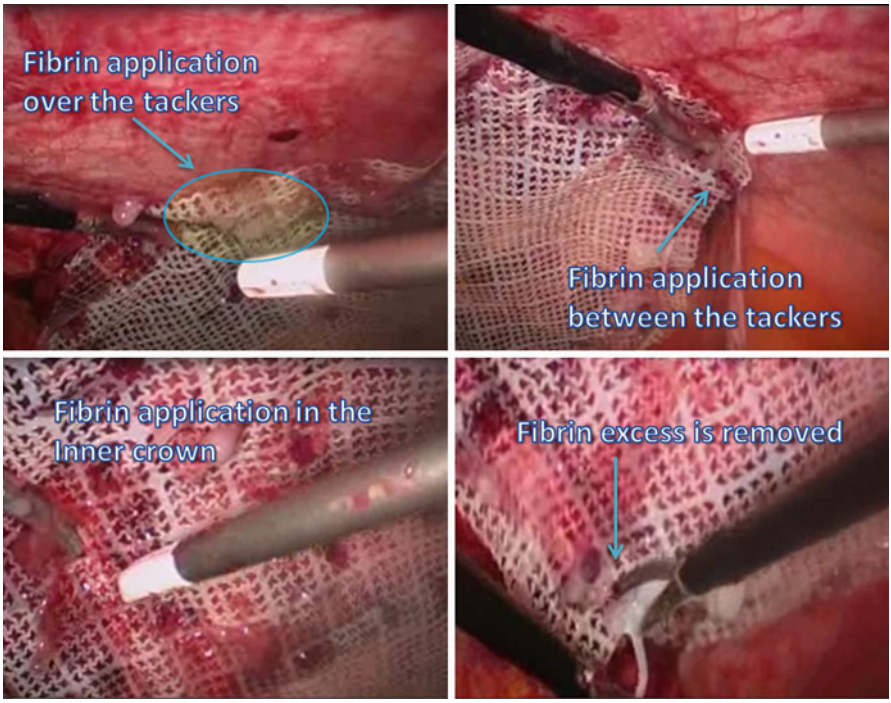

Fig. 9.8 Laparoscopic ventral hernia repair (double crown modified with fibrin glue). *1* fibrin over the tackers to avoid adherences, *2* fibrin between the tackers to minimize the number of tackers, *3* fibrin in the inner crown to reduce the seroma in the hernia sac and minimize the number of tackers, *4* the excess of fibrin must be removed

Bowel injury occurs in 1.78 % of the cases, and it is not related to the surgeon's experience; 92 % of the cases are related to the small bowel. The procedure's success will depend on the size of the intestinal injuries and the surgeon's skill [20].

Bowel repair can be performed using a laparoscopic approach or a conventional approach, depending on the surgeon's experience. A minilaparotomy may be needed.

There is no consensus as to whether a surgeon must complete the procedure once the bowel injury has been repaired. In case of significant contamination secondary to gut contents, the abdominal cavity should be washed using saline solution, intravenous antibiotics should be prescribed, and the procedure should be completed within a period of 3–7 days [20]. In those cases with small output of gut contents, it is acceptable to complete the ventral hernia repair as it was planned before the incident.

Colonic lesion is a more serious issue. Although laparoscopic ventral hernia repair using mesh has been reported in the literature at the same time of a colonic suture, most of authors prefer to perform a primary herniorrhaphy without prosthesis, and, especially in those cases, they changed to open surgery [8, 20, 24].

New Trends

We have already discussed some trends with regard to the use of new mesh and fixation using absorbable tackers or fibrin sealant. We will see the results of the studies that now are taking place in the future.

Minimal access surgery (single port) also has been reported in ventral hernia repair, but it is actually reserved for experienced surgeons in laparoscopic surgery. Benefits of this access are a lower number of surgical incisions and better cosmetic results. A lower percentage of wall hernias associated to ports' incisions has been described when single incision is done using a surgical wound size similar to the conventional port wound [25]. Some critics argue that there are an increase of hernias in access sites, more surgical difficulties, and longer surgery times.

Recently, it has been reported that the hernia default closure before the mesh placement could reduce the seroma incidence and the size of the mesh needed and contribute to a lower recurrence rate. Surgical duration, stitch tension, and postoperative pain, especially in case of a similar rate of recurrences, should be examined.

Laparoscopic separation of components is a technique used to provide myofascial flaps and a tension-free closure of the hernia hole. The aim of this technique seems to be a reduction of complications secondary to large myocutaneous flap dissection in the conventional procedure [10]. The first step in this technique is to perform an incision as lateral as possible, one centimeter below the eleventh rib, and identify the external oblique muscle fibers, then perform a rome dissection to expose the internal oblique muscle. A space is created between these two muscles, initially using a digital dissection and later setting a balloon port. A 30° or 45° angle optic is needed, and 12 mmHg insufflation pressure is required. This maneuver allows you to create enough virtual space under endoscopic supervision from the eleventh rib to the inguinal ligament. Two 5 mm ports are needed, one placed in the posterior axillary line at the level of the umbilicus and another just above the inguinal ligament beside the rectus abdominis muscle. Electrocoagulation with scissors or hook is useful to separate the external oblique muscle fibers, 2 cm to the semilunar line, from the rib to the inguinal ligament. Leaving drainage in this space is optional. The same technique is performed on the opposite side [10, 26]. It is up to the surgeon to decide whether or not to use an open or a laparoscopic ventral hernia repair.

EuraHS (http://www.eurahs.eu) was created to record the measurements of outcomes in reparation of abdominal wall hernias. Analysis of this data may lead in the future to the creation of clinical guides based on the evidence and classified according to patients, types of hernias, types of materials, and available techniques [27].

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