Laparoscopic Ventral Hernia Repair

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Salvador Morales-Conde, María Socas, and Isaias Alarcón

6.1 Introduction

Laparoscopic surgery continues to advance in achieving further benefits over the conventional approach for certain pathologies. In 1992 LeBlanc, et al. carried out the first laparoscopic repairs of ventral hernias (LVHR) [1]. Although not originally considered to be a pathology that could benefit from this approach, laparoscopic repair of ventral hernias has attained wide acceptance in recent years because of the significant advantages afforded by improvements in prosthetic materials and in fixation devices, as well as in the surgical technique used. Even that the latest meta-analysis show similar recurrence rate between the two approaches, this technique offers as a great advantage compared to the open repair since a significant reduction of local morbidity has been observed, making it a procedure that solves a long-standing challenge for the surgeon.

Nevertheless, there are still certain points of controversy that should be clarified, starting with the simple fact of establishing more precise indications and contraindications for the use of this approach. In addition, a multitude of more specific technical details should be discussed, including if the defect should be closed or not, how to manage the seroma, how to choose the type of mesh and its size and how to fix the mesh. One of the most interesting points currently being debated is whether or not it is necessary to use sutures or tacks alone, following the "*Double Crown*" technique, or other additional methods of fixation, such us, glues or the new method of fixations available, such us absorbable tackers.

S. Morales-Conde • M. Socas • I. Alarcón (✉)
Unit of Innovation in Minimally Invasive Surgery, University Hospital "Virgen del Rocío", Sevilla, Spain
e-mail: smoralesc@gmail.com

6.2 Indications and Contraindications

Basically all ventral hernias can be repaired by laparoscopy as the standard procedure. Emergency operations performed in cases of strangulated hernias must be analyzed on an individual basis to assess whether or not laparoscopy should be used. However, various factors place limits on the indications for laparoscopic repair such as the size of the defect, the presence of skin problems, the physical characteristics and the clinical history of the patients and the site where the hernia is localized. Subxyphoid, suprapubic, lumbar and parastomal hernias are good indication for laparoscopy, although these techniques require special technical considerations to be analyzed.

At the lower limit of the size of the defect, hernias that can be repaired with local anesthesia, those under 3–4 cm, are usually excluded. However, in patients requiring laparoscopic surgery for other concomitant conditions, obese patients and multi-recurrent hernias, laparoscopic repair would be indicated despite the small size of the hernia. Regarding the upper limit of the hernia size, different authors has performed many successful repairs of massive abdominal wall defects, although those hernias that need to associate a dermolipectomy or those with loss of domain should be excluded of being repair by this approach. We, therefore, conclude that until the limits are clearly established, the degree of difficulty in managing the instruments within the abdominal cavity and the size of the meshes available are the only actual limit to the technique, as far as large hernias are concerned.

On the other hand, this technique is often criticized by surgeons who perform open ventral hernia repair because the posterior rectus sheath cannot be reapproximated laparoscopically. There is no data to determine whether patients with an important rectus diastasis associated to a ventral hernia or an incisional hernia with an important distance between the rectus sheath, should be repaired by laparoscopy or an anatomical repair by re- approximation of the anterior

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rectus sheath should be performed, to improve the physiopathological function of the abdominal wall. New techniques are being described proposing an approximation of the rectus muscle with a running sutures performed by laparoscopy or a combined approach using an endoscopic component separation dissection before to place the mesh.

Contraindications to laparoscopic ventral hernia repair would include pregnant patients, children and patients with intra-abdominal sepsis, while patients with portal hypertension, previous abdominal radiotherapy or previous abdominal tuberculosis should be considered relative contraindications for this approach. These last two cases should be considered as difficult situations together with incarcerated hernias or those patients with multi-recurrent hernias previously repair with polypropylene, since more adhesions are usually found.

On the other hand, the characteristics of the sac of the hernia are important to determine the contraindications of this technique, since the evolution and complication of the seroma and the cosmetic results would be different depending on the type of sac. Definitive contraindications for this approach include patients with skin problems and fistulas.

6.3 Laparoscopic Surgical Procedure

6.3.1 Preoperative Work-Up

It is controversial whether pre-operative imaging techniques are needed for any ventral repair to select patients for LVHR. There have been suggestions that imaging studies might be helpful in patients with recurrent hernias in unusual anatomic locations and to evaluate the sac content. Having these data preoperatively can aid with decision making, such as the best way to access the reoperative abdomen, or to determine the localization of the bladder, iliac crest, or other important structures relative to a hernia defect.

6.3.2 Instrumentation

- ***Optic***: a 30° angle view scope is essential to perform the laparoscopic approach of ventral hernias since offers an excellent view of the entire anterior abdominal wall, and of the defect that need to be covered.
- ***Trocars***: a 10–12 mm trocar is used for the 30° scope and to introduce the mesh, and two 5-mm trocars are used for introducing the the mechanical fixation devices and the standard laparoscopic instruments.
- ***Graspers***, ***scissors***, ***and other laparoscopic instrumentation***: atraumatic bowel graspers are needed to manage the bowel and to perform traction gently to reduce the content of the hernia sac. Sharp scissors are required for proper dissection and prevention of bowel injury. A needle holder should be also available in case of an enterotomy to suture the bowel and continue the procedure by laparoscopy.
- ***Energy source***: monopolar cautery is acceptable as long as it is used far away from the viscera. Adhesiolysis must be performed with extremely care since missed bowel perforation could be life-threatening for the patient. For that reason, electrocautery should be used in a bleeding area after the adhesions are freed since if the proper plane is maintained blood loss is not expected.
- ***Fixation devices***: meshes could be fixed with tacks alone, which guarantee a proper fixation of the mesh to the anterior abdominal wall if the Double Crown technique is followed, or with transfascial sutures alone or with a combination of both. The new absorbable tackers should be evaluated in the future in order to determine if they could substitute the conventional metal tacks.

6.3.3 Operating Room Set-Up

The description of the technique is based on a primary or incisional ventral hernia at the midline and about 5 cm far from the bone margins, the patient is placed in supine decubitus, with the surgeon and the assistant to the patient's left and the monitor in front of them to the patient's right. A Foley catheter is only used in patients with suprapubic hernias or hernias located at the middle third below the midline and if operation is likely to be prolonged.

6.3.4 Surgical Technique

Creation of Pneumoperitoneum and Placement of Trocars Due to the presence of adhesions in the abdominal cavity, surgeons recognize that there is a risk of intra-abdominal lesion when creating the pneumoperitoneum or introducing the initial "blind' trocar. This has led some authors to recommend open laparoscopy using a Hasson trocar in patients with previous surgeries who will undergo laparoscopy. Many authors, however, are not of this opinion, using systematically Veres needle. In these cases, pneumoperitoneum is created by placing the Veres needle in the left hypochondrium, since this is the area of the abdomen where we are likely to find fewer adhesions because of the lower frequency of inflammatory processes at this level introducing the first trocar in the left side of the patient. Once the pneumoperitoneum has been created, the initial trocar is placed in the patient's side (normally, the left abdomen) away from the proximal border of the hernia in this area, being recommended to use a bladeless or a optic trocar, since bowel injuries are often associated with blind insertion of the initial trocar rather than with the Veres needle itself.

In addition, a high percentage of patients presenting ventral hernias are obese, this factor being associated with the presence of incisional hernias and with their recurrence. In these patients, performing an incision on the side of the abdomen (where trocars for laparoscopic repair of this type of hernia are normally inserted) in order to place a Hasson trocar often involves performing a minilaparotomy, since the fat tissue is generally thicker at the sides than at the midline. This large incision can result in pneumoperitoneum leaks and other complications such as infections, incisional hernias, etc. On the other hand, placing the first trocar with the abdomen insufflated let to place this first trocar far from the hernia defect, allowing secure the mesh in an easier and safer way at this proximal side, avoiding an insufficient fixation and, therefore, recurrences.

Once the pneumoperitoneum is created, the cavity is generally approached from the patient's left side, placing three trocars drawing a line, introducing the 10–12 mm trocar first and then placing the other 5 mm trocars under direct vision (Fig. 6.1). An important thing to remember when placing the trocars is to stay as far as possible away from the defect margin closest to the surgeon. This will provide proper visualization of the margin, making it easier to achieve wide overlap with the mesh and perform any maneuvers needed to secure the prosthesis. When it is not possible maintain a suitable distance from this margin, it is recommended to introduce an additional 5 and 10-mm trocar in the patient's opposite flank in order to adequately fix the mesh on the margin closest to the initial trocar.

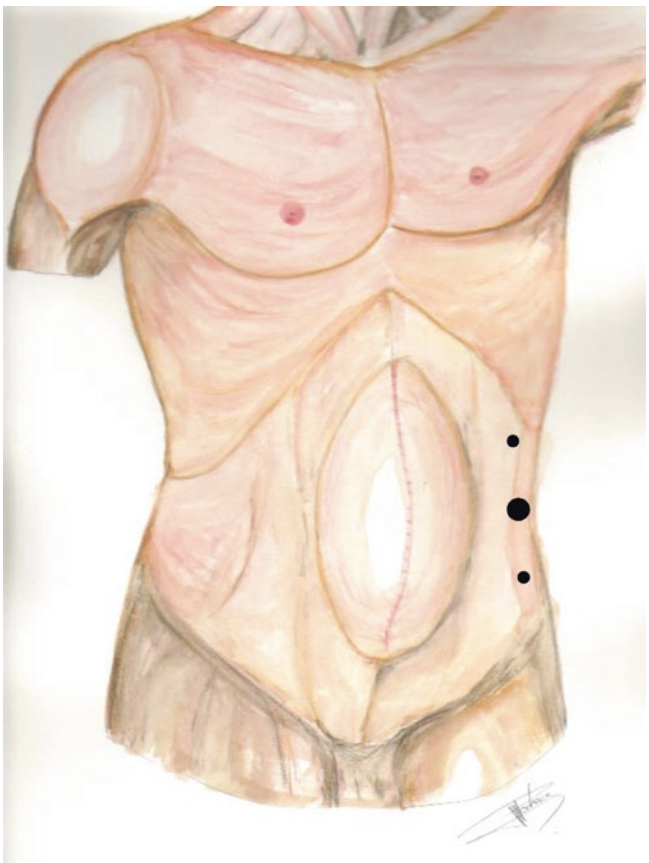

Fig. 6.1 Placement of trocars for ventral hernia repair

Adhesiolysis once the trocars are introduced, the adhesions are evaluated. Adhesiolysis is considered to be a key point of this procedure, since incorrect performance of the adhesiolysis process can have extremely serious consequences for the patient. Nevertheless, if we have any doubts regarding the possibility of bowel perforation the procedure should be converted to open, or at least one of the trocar must be enlarged to check the bowel. Missed perforation of the abdominal wall is associated with high morbidity and mortality. Hemostasis of the area of adhesiolysis should be checked in order to avoid complications.

Identification of the Defect and Selection of the Mesh Once the adhesiolysis process is completed, the actual defect of the hernia must be delimited by drawing them on the skin. A needle could be inserted through the skin, visualizing its tip inside the cavity under laparoscopic vision to detect and trace the hernia defect on the patient's skin. Then the abdomen is deflated and the exact measurements of the defect are determined, in order to select a mesh designed to be placed intra-abdominally, which should overlap at least 5 cm beyond the hernia orifice in all directions. Once the proper mesh is selected, several marks are traced on the patient's abdomen and on the mesh surface that will be placed in contact with the viscera, in order to facilitate orientation of the prosthesis within the cavity. Sutures could be placed at this point at the cardinal points to facilitate also orientation, being removed or let in place later. Afterwards, the mesh is rolled along its long axis, leaving the mesh side that will be in contact with the bowel rolled toward the inside, what will facilitate the maneuvers needed to extend the mesh. Meshes should be introduced through one of the trocars to prevent potential contamination that can occur when it is inserted through the skin. If a large prosthesis is needed, it is recommended to remove the trocar and insert the mesh wrapped in sterile plastic through the trocar hole, and then remove the plastic from inside the cavity.

Fixation of the Mesh Once the mesh is inside the cavity, the area where the cranial tack should be placed is localized either by the previous drawn on the mesh or by a suture at that place. A needle or the suture passer will set the place where the first tack should be placed. When this tack or suture is placed, we stretch the mesh in the caudal direction and perform the same maneuver, placing the second tack or suture at the lower cardinal point. Subsequently, the lateral tacks are placed following the same system, avoiding the

tendency of the mesh to move in the opposite direction from the point where the scope is introduced. Once the mesh is fixed at the four cardinal points, we proceed to extend it adequately, adding an outer crown of tacks that are placed right on the margin of the mesh. These tacks are separated from each other by a distance of one-two centimeter, an adequate distance to ensure that the bowel do not slip between the tacks and cause acute incarceration. Once the outer crown is finished, the inner crown of tacks is added at the margin of the hernia sac, in order to ensure better attachment of the mesh, to perform the Double Crown technique (Fig. 6.2), adding extra-suture in case this technique is not followed. In case the technique proposed combined tackers and glue, the distance among the tackers could be increased to 3–4 cm [2].

While the crown of tacks is being placed, the surgeon must exert strong pressure against the tacker from the outside to ensure that the mesh is fixed to the fascia. Once all the tacks are placed, it is recommended to proceed to identify any of them that are left hanging from the wall or that are improperly placed, and insert them through the entire thickness of the mesh. Poorly positioned tacks will lead to adhesions, as it has been shown in differente experimental studies, and could cause major complications in the future, such as fistulas or occlusions.

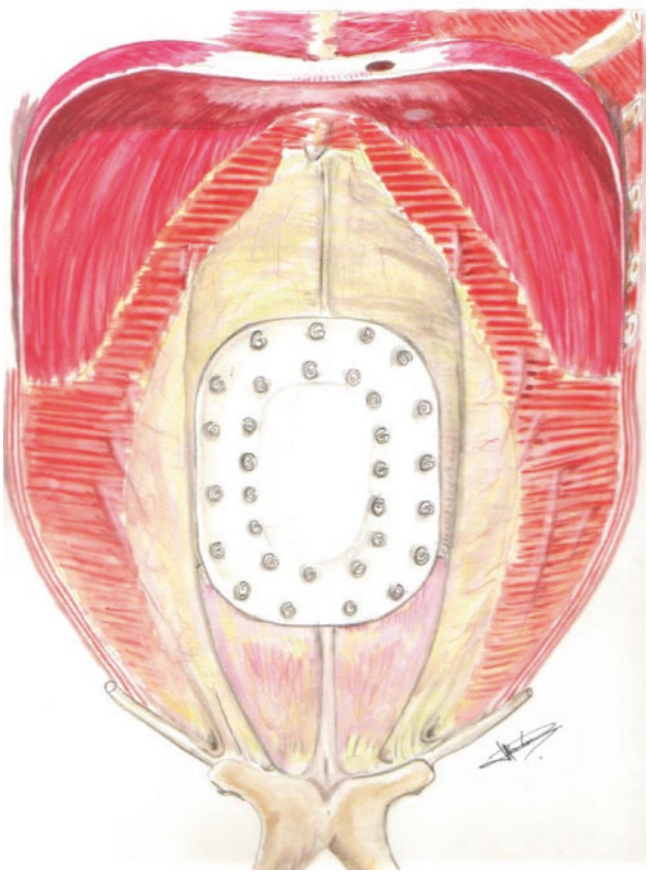

Fig. 6.2 Double crown technique

Finishing the Procedure Once the procedure is completed, the abdomen is deflated and the 12-mm trocars must be closed. A compression bandage is placed at the level of the hernia sac to reduce the space between the mesh and the sac and to prevent seroma, avoiding the use of drains. This bandage is kept on for 1 week and is withdrawn at the 7-day follow-up visit to remove the skin sutures.

6.3.5 Postoperative Management

Once the procedure is completed, we start the patient on fluid intake about 6–8 h after surgery, continuing to solid foods as tolerated. The patient is normally discharged within 24–48 h of the surgery. In terms of physical activity, we do not establish any limitation for the patient and only recommend gradual resumption of regular daily activities based on the patient's progress during postoperative recovery. Patient follow-up is carried out at 1 month, 3 months, 6 months and 1 year, with yearly visits thereafter.

6.4 Complications After Laparoscopic Hernia Repair

6.4.1 Postoperative Pain

Different studies published show that the method used for mesh fixation (sutures, tacks, both) makes no differences on acute postoperative pain, although a recent prospective randomized trial published by F Muysoms et al. shows that Double Crown technique has less pain than the use of transfascial sutures, and this sutures incurs a significantly longer operation time in comparison to fixation by tacks [3]. On the other hand, the absorbability of the suture material used for mesh fixation is not related to the incidence of postoperative pain, as well as the type of mesh used. The role of glues on fixation during LVHR still has to be established, some authors has demonstrated that in umbilical hernias with a defect size up to 5 cm, mesh fixation by glue results in less acute postoperative pain compared to fixation by tacks. In the meantime, and since the incidence of acute postoperative pain correlates significantly with the number of tacks used, glues could help to decrease the numbers of tacks used to fix the mesh.

Chronic pain is defined by pain lasting at least 3/6 months postoperatively. Different studies have tried to find any possible correlation between different fixation techniques (transfascial sutures and tacks, sutures only, tacks only) and the incidence of chronic postoperative pain. The median percentage incidence of chronic pain in the suture and tack fixation group were 2.75 %, 3.75 %, 6,35 % respectively showing no statistical differences.

6.4.2 Mesh Shrinkage

Beldi et al. has publishes a study by conventional abdominal X-ray examination comparing tacker (single crown technique) versus suture fixation of a mesh with an overlap of at least 5 cm, at the 2nd postoperative day, after 6 weeks and 6 months postoperatively. A significant decrease of mesh size was detected in horizontal direction in the tacker group, whereas no significant differences were found in vertical direction and mesh surface area. On the other hand, Schoenmaeckers et al. studied mesh shrinkage after use double crown fixation technique of ePTFE-meshes by CT measurements. A shrinkage rate of 7.5% was found at 17.9 months postoperatively. Different studies have observed a high proportion of reduction of the size of the mesh in animals observed, while clinical studies in humans have shown less shrinkage.

6.4.3 Tack Hernia

Several case reports have been published how fixation device have induced incisional hernias. The first report in 2003 published by LeBlanc concerned the development of an incisional hernia at the site of a penetrating tacker and described as a "tack hernia". On the other hand, further reports by Muysoms et al., Khandelwal et al. and Barzana et al. have also described incisional hernias after suture fixation.

6.4.4 Recurrences

Since no differences has been found on hernia recurrence based on the method of fixation (Double Crown vs. sutures) other factors has been related to these recurrences. A proper overlap, of at least 5 cm in all directions, and the proper fixation of the mesh at the side of the initial trocar are factors that influence also in the presence of recurrences.

New hernias below original hernias have been described as a factor of recurrence after open repair. This factor has been also described after laparoscopic approach what has led to recommend to cover the entire incision even in those cases in which a weak area is not detected, since this damaged tissue could be involved in the presence of a new hernia. At present, it appears evident that when undertaking laparoscopic repair of an incisional hernia, adhesiolysis must cover the entire area of the previous scar in order to identify possible wall defects at this level, other than those originally destined to be repaired. This is precisely one of the advantages of laparoscopy over traditional open repair. Defects that were not identified during the clinical examination and that were the cause of recurrence or appearance of a new defect after open repair can be detected and repaired in the same surgical procedure.

6.4.5 Seroma

Seroma, defined as serous fluid retention between the mesh and the anterior abdominal wall, is presence in most of the cases after LVHR, as different series that analyzed its presence by radiological exams shows. Its presence cannot be considered a complication since patients do not even detect them in most of the cases. For these reasons, it is important to defined that seroma must be considered an incident after this surgery that may lead to complications. A new clinical classification of seroma has been published by S. Morales-Conde in order to establish the real incidence of seroma and its clinical significance [4].

The potential complications related to seroma formation include pain, discomfort to the patient, cellulites, being the most important complication of them the possibility of getting infected. The infection of a seroma is considered one of the most challenging complications since it might lead to mesh removal and recurrence. Seroma could also be related to recurrence, since the weight of this serous fluid between the mesh and the anterior abdominal wall could increase the tensile strength on the fixation of the mesh and therefore desattach tackers from its original fixation to the anterior wall and be responsible of an improper anchoring of the mesh right after surgery, which may influence in the presence of recurrence in the future.

The real importance of seroma formation and the influence of them in the quality of life in the postoperative period of the patient are also still to be determined. But it can be concluded that seroma is not really a key factor in the postoperative period after this surgery and its simple presence cannot be considered a complication. But, it would be better to avoid it since, in some cases, could be responsible for some of the complications described.

6.4.6 Missed Bowel Perforation

Lysis of adhesions is considered to be the most dangerous and rate limiting aspect of laparoscopic ventral hernia repair. Adhesiolysis must be performed with extreme care since missed bowel perforation could be life-threatening for the patient. The incidence of enterotomy during laparoscopic ventral hernia repair has been reported to be 1–6%. But adhesiolysis complications are not only associated with laparoscopic surgery. Cases of intestinal perforation have also been reported after open surgery, with consequences similar to those occurring after laparoscopic surgery. In fact, in studies comparing laparoscopic and open surgery for the treatment of ventral hernias, higher rates of intestinal perforation due to adhesiolysis were reported in the open surgery group than in the laparoscopy group.

Minimal use of energy sources during adhesiolysis has been advocated to avoid bowel injury. Monopolar cautery is acceptable as long as it is not used in close proximity to any viscera.

6.4.7 Adhesions, Fistulas and Bowel Occlusion

Different factors have been related to this complication: inappropriate mesh being placed intra-abdominally in contact with the bowel and poorly positioned tacks will lead to adhesion, as it has been shown in different experimental studies, and could cause these major complications in the future.

It has been published a current review of the literature regarding safety measures such as adhesions, fistulas, and infections after LVHR. The only real concern based in this analysis is about using pure PPM in the intraperitoneal position. The use of intra-peritoneal PPM to repair incisional hernia has been demonstrated in clinical and experimental studies that carries the risk of adhesions and damage to the intra-abdominal viscera. Polypropylene is a material widely used in surgery but, because of its association with formation of enterocutaneous fistulae and adhesions, direct contact between mesh and intestine should be avoided. This study clearly points a very few mesh-related complications after a proper mesh placed intraperitoneally, and shows that experimental studies and theoretical considerations may argue for using a covered mesh, i.e., a composite mesh, or e-PTFE for LVHR in humans, although it is stressed that there are no human data at the moment to support this. Clinical information based on reoperative findings available in the literature about adhesions to prosthetic materials shows different data, but this information related to implanted e-PTFE mesh at reoperation in patients who had previously undergone LVHR shows no or minimal formation of adhesions in 91 % of cases, and no severe cohesive adhesions were found.

References

1. LeBlanc KA, Booth WV. Laparoscopic repair of incisional abdominal hernias using expanded polytetrafluoroethylene: preliminary findings. Surg Laparosc Endosc. 1993;3(1):39–41.
2. Morales-Conde S, Cadet H, Cano A, Bustos M, Martín J, Morales-Mendez S. Laparoscopic ventral hernia repair without sutures--double crown technique: our experience after 140 cases with a mean follow-up of 40 months. Int Surg. 2005;90(3 Suppl):S56–62.
3. Muysoms F, Vander Mijnsbrugge G, Pletinckx P, Boldo E, Jacobs I, Michiels M, Ceulemans R. Randomized clinical trial of mesh fixation with “double crown” versus “sutures and tackers” in laparoscopic ventral hernia repair. Hernia. 2013;17(5):603–12.
4. Morales-Conde S. A new classification for seroma after laparoscopic ventral hernia repair. Hernia. 2012;16(3):261–7.