World J Surg (2011) 35:1496–1499
DOI 10.1007/s00268-011-1028-4

World Journal of Surgery

Laparoscopic Ventral Hernia Repair

W. Scott Melvin · David Renton

Published online: 22 March 2011

Abstract Ventral hernias, whether naturally occurring or the result of previous surgery, comprise one of the most common problems confronting general surgeons. As many as 25% of laparotomy incisions develop a hernia over long-term follow-up, which is a difficult problem with many treatment algorithms. Laparoscopic ventral hernia repair has improved over the last decade and has proven to be an effective treatment option. With fewer wound complications and low recurrence rates, it is a useful tool in the surgeon's armamentarium. Care should be taken regarding patient selection, operative technique, and mesh size to ensure adequate repair of the hernia, thereby preventing recurrence at a later date. The first attempt at a hernia repair has the highest chance of long-term success, so it is important that the surgeon take all the factors into mind before proceeding with operative repair.

Introduction

The ventral hernia, whether naturally occurring or the result of previous surgery, is one of the most common problems confronting the general surgeon. As many as 25% of laparotomy incisions develop a hernia over long-term follow-up, which is a difficult problem with many treatment algorithms [1]. Patients can present with acute incarceration, pain, obstruction, or simply an unsightly bulge. Hernias enlarge over time, so prompt treatment, if possible, is most efficacious [2]. Patient selection is important when choosing the operative technique for repairing a ventral hernia.

When evaluating the patient with a ventral hernia, several points must be considered. First, it must be determined whether the hernia is incarcerated or it can be reduced. Incarcerated hernias are associated with a high operative rate of morbidity and mortality [3–5]. If incarceration is found on physical examination, it must be determined if the hernia contents are strangulated. If this condition is suspected, emergent surgical repair is needed to prevent further complications. Loss of domain must also be determined before deciding on the operative approach for repair of the ventral hernia. If loss of domain is present and it is not feasible to gain sufficient overlap on the hernia edges with mesh for laparoscopic repair, a component release may be the best option for the patient [6, 7].

Previous open mesh repairs were based on one of three techniques. When the mesh was fixed atop a closed fascial defect, it was called an onlay technique. This method places the mesh directly under the skin, which means that if a wound infection occurs the mesh may become infected. A Rives-Stoppa technique placed the mesh between the posterior sheath and the rectus muscle after these planes underwent wide dissection [8, 9]. An underlay technique placed the mesh in the abdominal cavity, under closed fascia [10]. This method takes advantage of the abdominal forces and can have a mechanical advantage over the other two repair techniques [11]. This technique, combined with a large overlap of the mesh on either side of the defect, is utilized during a laparoscopic ventral hernia repair. There are three main steps to a laparoscopic hernia repair, and each is addressed herein: (1) initial entry and port placement; (2) lysis of adhesions; (3) mesh placement and fixation.

W. S. Melvin · D. Renton (✉)
Department of Surgery, The Ohio State University, 395 West 12th Avenue, Columbus, OH 43210-1267, USA
e-mail: David.renton@osumc.edu

For some ventral hernias, patient positioning must be considered before preparing the patient in the operating room. If the hernia is below the umbilicus, tucking the arms next to the patient can help the surgeon, who will be facing toward the patient's feet during most of the operation. For hernias below the umbilicus, a Foley catheter should be placed to decompress the bladder. If the mesh is to be placed against the patient's skin to help mark transfacial suture positions or to measure overlap, a clear barrier should be used to prevent contact of the mesh with the patient's skin during the operative procedure. Care should be taken to drape the patient with enough lateral exposure to place trocars in the far lateral abdominal wall.

Initial trocar placement

Initial trocar placement for a laparoscopic ventral hernia repair is done in one of three ways. The best technique is the one with which the surgeon is most comfortable. The initial trocar should be one of sufficient size to accommodate placing the mesh in the abdomen later in the procedure. The first choice for placement is in the left upper quadrant in the mid-axillary line, two fingerbreadths below the costal margin—unless contraindicated because of the patient's previous surgery and hernia location, among other factors [12, 13]. With all three techniques, gastric tube decompression should be achieved before attempting initial trocar placement. Blind Veress needle entry into the left upper quadrant is an established technique and is useful for initial entry into the abdomen with midline adhesions [14]. Once pneumoperitoneum is achieved, blunt trocar placement using a dilating trocar or an optical view trocar can be achieved. If Veress needle entry is unsuccessful, or contraindicated, visualized entry using an optical trocar can be performed initially [15]. The final method for entry is a direct cut-down through the abdominal wall until safe entry is directly visualized [16]. Once this is achieved, either a Hasson or balloon trocar can be inserted to maintain a seal for pneumoperitoneum. Bladed trocars should never be used for the initial entry into the abdomen for ventral hernia repair. Again, the initial choice for entry into the abdomen should be the one with which the surgeon is most comfortable and familiar to ensure patient safety.

Lysis of adhesions

Once safe entry has been achieved, subsequent trocar placement can take place. An angled scope, usually 30°, can help visualize the abdomen with dense adhesions. Once the abdominal wall is visualized, accessory 5-mm trocars are placed to assist in the lysis of adhesions. For the midline hernia, these trocars should be placed as laterally as possible. Four trocars, including the initial one, are generally placed with one in each quadrant. Adequate visualization of the abdominal wall must be obtained to accomplish the placement. As already stated, an angled scope can facilitate this, as well as moving the scope between the trocars that are already placed to gain the best view of the free abdominal wall. Because of the movement of the camera between trocars, a 5-mm scope should be used, as it gives the surgeon the most options for placing the camera during the operation.

Once trocars have been placed safely, the surgeon can begin the lysis of adhesions. Sharp dissection is used close to the abdominal wall. Traction of the abdominal contents should be gently applied using atraumatic graspers to facilitate creation of a plane between the abdominal wall and the viscera. The use of energy including ultrasonic energy and bovie cautery should be limited, as it can lead to inadvertant injury of the bowel [17]. Thermal injury of the bowel may not be evident during the operation but may present as a full-thickness injury later in the patient's postoperative course [18]. Bleeding, edema, and adhesions can obscure the surgeon's view of the developing plane, so care must be taken to avoid injuring the bowel. If no plane can be developed between the abdominal wall and the viscera, the surgeon should sacrifice abdominal wall where needed to stay clear of injuring the abdominal contents [19].

If the patient has undergone a previous mesh repairs for a hernia, it may be encountered while lysing the adhesions. If there is ingrowth of the bowel serosa into the mesh, the mesh should be cut and left against the bowel [20]. Reduction of hernia contents can be challenging in patients who have long-standing hernia disease. The use of internal traction and external manual compression can aid in the reduction and visualization of abdominal contents. In the most extreme of cases, the surgeon can incise the hernial defect and create a larger opening, which will ease reduction of the abdominal contents. For incisional hernias, the lysis of adhesions should continue for the entire length of the incision. The falciform ligament may need to be taken down to expose the abdominal wall at its superior edge.

Adhesion lysis is often the most difficult portion of a laparoscopic ventral hernia repair. Several maneuvers can be employed to facilitate safe exposure of the abdominal wall and reduction of the abdominal contents. If no progress is being made in one quadrant of the abdomen during lysis, the camera should be moved to another trocar and work begun on another area of the adhesions. Reduction of contents and lysis of adhesions in one quadrant can change the tension profile of the adhesions in another quadrant, facilitating lysis in a previously difficult area. Adhesions

that are filamentous in nature can be taken down using blunt sweeping maneuvers instead of sharp dissection. Care must be taken when doing this to prevent inadvertant injury to the bowel.

Mesh placement and fixation

Once the abdominal wall has been cleared, and the bowel has been inspected to ensure that there was no injury during the lysis of the adhesions, the defect must be assessed to determine the mesh size needed. Accurate defect measurement can be difficult. The curve of the abdominal wall is exaggerated when insufflated, and external measurements may be grossly inaccurate, which can lead to inaccurately sized mesh being placed in the abdomen. To overcome this potential problem, the external abdominal wall can be marked at the borders of the defect in the north, south, east, and west positions. The abdomen can then be desufflated and measurements taken to determine the width and length of the defect. Alternatively, a sterile flexible ruler can be sized to fit through a trocar, and direct measurements can be taken internally. Ruler manipulation can be difficult, and care must be taken to gain accurate measurements. Alternatively, a silk suture can be used to measure the defect in different aspects, which is then removed from the abdomen and measured externally. If this method is used, a knot should be placed near one end of the suture to help orient it both in the abdomen and externally for accurate measurements. Accurate assessment of the area affected by the hernia is essential for mesh sizing and placement.

If multiple hernias exist, as is the case with many incisional hernias, one piece of mesh should be used that covers all defects. Occasionally, the defects are far apart, and two pieces of mesh are needed. However, it should be noted that during incisional hernia repair the entire incision should be covered with mesh, regardless of whether a hernia is currently present, to prevent hernia formation along the incision in the future. When sizing the mesh, there should be at least a 4-cm overlap onto healthy abdominal wall in all directions around the hernia defect [21]. If needed, the mesh should be oriented as to superior and inferior with markings before placement in the abdomen to facilitate intraabdominal orientation. If the texture of the mesh is similar on both sides, orienting it for visceral and abdominal sides may be useful as well.

Once the mesh has been chosen, stay sutures are placed. To do this, the mesh is placed on the abdominal wall, and marks are made on the mesh with corresponding marks on the abdomen. As already noted, a clear barrier should be used when draping the patient to prevent contact of the mesh with abdominal skin. These marks provide guidance when the stay sutures are brought transfascially. Four, monofilament, nonabsorbable sutures are placed at the north, south, east, and west positions of the mesh and the positions are marked on the abdominal wall. If more than four sutures are used initially, there can be confusion as to which suture is which when the mesh is placed in the abdomen [21]. The mesh can now be placed through the left upper quadrant trocar and into the abdomen.

Once the mesh has been placed in the abdomen, correct orientation is essential. Thus, arrows or other orienting drawings can be drawn on the mesh before intraabdominal placement. Once the mesh is oriented, the fixation sutures can be brought transfascially using the device with which the surgeon is most comfortable. It is important to place the suture passer through the same skin defect on each pass but to angle it differently to ensure that there is fascia between the suture when it is tied down. When placing the lateral (east and west) sutures, it is important to try to visualize the inferior epigastric vessels. It can be done by tracing their course along the interior abdominal wall if they are visible or trying to shine light through the abdominal wall with the laparoscope and visualize their course on the exterior abdominal wall. Once the suture passer is passed safely for the first suture in these lateral positions, the next pass should be either superiorly or inferiorly, not laterally, as this mimics the course of the inferior epigastric vessels and helps prevent injury to them. If the epigastric vessels are injured during suture passage, it can be controlled by dissecting them free of the surrounding abdominal wall and clipping them or by passing sutures transabdominally around them both superiorly and inferiorly and suture-ligating them in this fashion. When all four fixation sutures have been passed through the abdominal wall, they are pulled taut. The surgeon then has to determine if the mesh is adequately placed so there is no slack in the mesh but not too tight. Occasionally, the transfascial sutures must be repositioned to gain optimal mesh placement in the abdomen.

Once the mesh is placed and the transfascial sutures are tied down, the mesh can be tacked circumferentially. The surgeon must assess the trocars at this time to see if any will fall under the mesh when it is tacked in place. If this is the case, as it often is with large pieces of mesh, the trocars that will be overlapped with mesh should be used first in the tacking. They can then be removed when the mesh is tacked on their side. Tacking should proceed in 1-cm gaps at 1 cm from the mesh edge [22]. Care should be taken not to leave edges of the mesh folded under on the sides, as it would expose the nonvisceral side of the mesh to the abdominal contents. When circumferential tacking has been achieved and after desufflation of the abdomen, the trocars can be removed. Some surgeons advocate the use of anchoring sutures every 3 to 6 cm along the edge of the

mesh. This can be accomplished with the suture-passing device before desufflation and trocar removal [21].

Conclusions

Laparoscopic ventral hernia repair has improved during the last decade and has proven to be an effective treatment option [23, 24]. With fewer wound complications and low recurrence rates, it is a useful tool in the surgeon's armamentarium. Care should be taken during patient selection, when choosing the operative technique, and with mesh sizing to ensure adequate repair of the hernia, thereby preventing recurrence at a later date. The first attempt at hernia repair has the highest chance of long-term success, so it is important that the surgeon take all of the factors into consideration before proceeding with the operative repair.

References

1. Mudge M, Hughes L (1985) Incisional hernia: a 10-year prospective study of incidence and attitudes. Br J Surg 72:70–71
2. Flum Dr, Horvath K, Koepsell T (2003) Have outcomes of incisional hernia repair improved with time? Ann Surg 237:129–135
3. Bucknall TE, Cox PJ, Ellis H (1982) Burst abdomen and incisional hernia: a prospective study of 1120 major laparotomies. Br Med J (Clin Res Ed) 84:931–933
4. Kulah B, Duzgun AP, Moran M et al (2001) Emergency hernia repairs in elderly patients. Am J Surg 182:455–459
5. Sowula A, Groele H (2003) Treatment of incarcerated abdominal hernia. Wiad Lek 56:40–44
6. Ramirez OM, Ruas E, Dellon AL (1990) Components separation method for closure of abdominal wall defect: an anatomic and clinical study. Plast Reconstr Surg 86:519–526
7. Kingsnorth A (2006) The management of incisional hernia. Ann R Coll Surg Engl 88:252–260
8. Louis D, Stoppa R, Henry X et al (1985) Postoperative eventration: apropos of 247 surgically treated cases. J Chir 122:523–527
9. Bauer JJ, Harris MT, Gorfine SR et al (2002) Rives-Stoppa procedure for repair of large incisional hernias: experience with 57 patients. Hernia 6:120–123
10. Trupka AW, Hallfeldt KK, Schmidbauer S et al (1998) Management of complicated incisional hernias with underlay-technique implanted polypropylene mesh: an effective technique in French hernia surgery. Chirurg 69:766–772
11. Turner PL, Park AE (2008) Laparoscopic repair of ventral incisional hernias: pros and cons. Surg Clin North Am 88:85–100
12. Patsner B (1999) Laparoscopy using the left upper quadrant approach. J Am Assoc Gynecol Laparosc 6:323–325
13. Tulikangas PK, Nicklas A, Falcone T et al (2000) Anatomy of the left upper quadrant for cannula insertion. J Am Assoc Gynecol Laparosc 7:211–214
14. Yerdel MA, Karayalcin K, Koyuncu A et al (1999) Direct trocar insertion versus Veress needle insertion in laparoscopic cholecystectomy. Am J Surg 177:247–249
15. Berch BR, Torquati A, Lutfi RE et al (2006) Experience with the optical access trocar for safe and rapid entry in the performance of laparoscopic gastric bypass. Surg Endosc 20:1238–1241
16. Vilos GA, Ternamian A, Dempster J et al (2007) Laparoscopic entry: a review of techniques, technologies, and complications. J Obstet Gynaecol Can 29:433–465
17. Tucker RD, Voyles CR (1995) Laparoscopic electrosurgical complications and their prevention. AORN J 62:51–53
18. Wu MP, Ou CS, Chen SL et al (2000) Complications and recommended practices for electrosurgery in laparoscopy. Am J Surg 179:67–73
19. LeBlanc KA (2005) Incisional hernia repair; laparoscopic techniques. World J Surg 29:1073–1079
20. Clark JL (2001) Ventral incisional hernia recurrence. J Surg Res 99:33–39
21. Heniford BT, Park A, Ramshaw BJ et al (2003) Laparoscopic repair of ventral hernias: nine years' experience with 850 consecutive hernias. Ann Surg 238:391–400
22. Koehler RH, Voeller G (1999) Recurrences in laparoscopic incisional hernia repairs: a personal series and review of the literature. JSLS 3:293–304
23. Hawn MT, Snyder CW, Graham LA, et al (2010) Long-term follow-up of technical outcomes for incisional hernia repair. J Am Coll Surg 210:648–657
24. Hwang CS, Wichterman KA, Alfrey EJ (2009) Laparoscopic ventral hernia repair is safer than open repair: analysis of the NSQIP data. J Surg Res 156:213–216