Robotic transabdominal preperitoneal Morgagni hernia repair: surgical technique

Jihad R. Salameh[1,2]^

[1]Department of Surgery, Georgetown University School of Medicine, Washington, DC, USA; [2]Department of Surgery, VHC Health, Arlington, VA, USA

Correspondence to: Jihad R. Salameh, MD, FACS, FASMBS. Department of Surgery, Georgetown University School of Medicine, Washington, DC, USA; Physicians - General and Bariatric Surgery, Department of Surgery, VHC Health, 1851 N. George Mason Dr Suite 4-C, Arlington, VA 22207, USA. Email: jrsalameh@gmail.com.

Abstract: A Morgagni hernia is a rare congenital anterior diaphragmatic hernia that is often diagnosed in adults and requires surgical repair in order to avoid complications. A preoperative computerized tomography (CT) scan is recommended to assess the size of the defect and the contents of the hernia. There are various transabdominal and transthoracic surgical options for repairing these hernias but minimally invasive transabdominal approaches are usually recommended, with robotic surgery gaining popularity. The wristed instruments of the robotic platform facilitate the surgery, by allowing increased dexterity for working in the anterior mediastinum and suturing to the anterior portion of the diaphragm. We describe in detail the technical steps of robotic transabdominal preperitoneal surgical repair including peritoneal flap creation, hernia sac reduction, defect closure and mesh placement. We prefer using the self-gripping polyester mesh in this location. Placing the mesh extraperitoneally has the added advantage of allowing minimal to no suture fixation of the mesh to the diaphragm in addition to minimizing intraperitoneal visceral adhesions. This approach is associated with reduced length of stay, faster recovery and quicker return to work. Standardization of the technique will allow better assessment of the short-term and long-term outcomes of the surgical management of this uncommon condition.

Keywords: Morgagni hernia; robotic surgery; transabdominal preperitoneal repair

Received: 27 November 2023; Accepted: 17 April 2024; Published online: 22 April 2024.
doi: 10.21037/jovs-23-44
View this article at: https://dx.doi.org/10.21037/jovs-23-44

Introduction

Background

A Morgagni hernia is a rare congenital anterior diaphragmatic hernia caused by the failure of the pars tendinalis part of the costochondral arches to fuse with the pars sternalis on the right side (1). It was first described by Giovanni Battista Morgagni, an Italian anatomist and pathologist in 1769, during a postmortem examination of a head injury patient (2). When the hernia occurs on the left side, it is called a Larrey hernia and is much less common due to the pericardial attachments to the diaphragm that provide protection and support on that side. In rare cases, the hernia can be bilateral. Morgagni-Larrey hernias present later in life and are diagnosed either incidentally on imaging or intraoperatively, or when a viscus, such as the omentum, stomach or colon, herniates through the defect causing gastro-intestinal or respiratory symptoms.

^ ORCID: 0000-0002-2819-3241.

Rationale

Repair of Morgagni-Larrey hernias is recommended, even when asymptomatic, to avoid future complications, such as incarceration or strangulation. Surgical treatment options include transabdominal and transthoracic approaches. The laparoscopic technique often consists of hernia defect closure with possible reinforcement with an intraperitoneal mesh that have to be secured circumferentially to the abdominal wall and the diaphragm. Placing the mesh extraperitoneally however may be more advantageous as it allows less suture fixation, better mesh integration and less visceral adhesions; such an approach would be challenging to perform laparoscopically due to the difficult angles for working in the anterior mediastinum and anterior diaphragm, but it is greatly facilitated by the robotic platform.

Objective

In this article and accompanying video (*Video 1*), we describe the robotic-assisted laparoscopic transabdominal preperitoneal repair technique for repair of Morgagni hernia, using the da Vinci Xi surgical system (Intuitive Surgical, Sunnyvale, CA, USA) with standardization of the surgical steps. I present this article in accordance with the SUPER reporting checklist (available at https://jovs.amegroups.com/article/view/10.21037/jovs-23-44/rc).

Highlight box

Surgical highlights

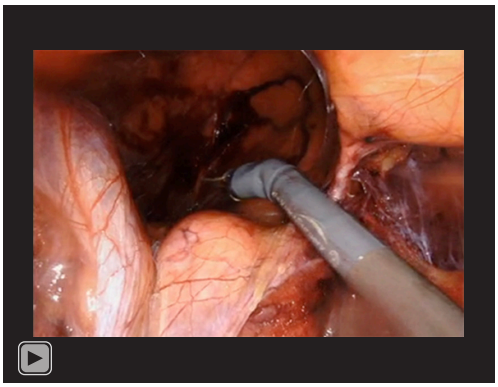
- The transabdominal preperitoneal technique for repairing Morgagni hernia uses the robotic platform to develop a peritoneal flap, reduce the hernia sac, close the defect, reinforce it with a mesh then close the flap.

What is conventional and what is novel/modified?

- Conventional laparoscopic surgical techniques often use primary defect closure with possible intra-peritoneal mesh placement.
- The preperitoneal repair technique allows minimal to no mesh suture fixation to the diaphragm in addition to minimizing intraperitoneal visceral adhesions.

What is the implication, and what should change now?

- The robotic platform allows easier performance of a Morgagni hernia repair through a transabdominal preperitoneal approach, which may become the preferred technique in expert hands.



Video 1 Robotic transabdominal preperitoneal Morgagni hernia repair.

Preoperative preparations and requirements

A chest radiograph may diagnose a Morgagni hernia if bowel herniation is present, showing a radiolucent paracardiac shadow that is retrosternal on lateral images. Preoperative cross-sectional imaging is required to assess the size of the defect and the contents of the hernia. We favor a computerized tomography (CT) scan of the chest and/or abdomen and pelvis (*Figure 1*). In addition, imaging allows to rule out any concomitant pathology. No other specific preoperative testing is needed beside what is required to ensure that the patient is properly medically optimized for surgery.

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this manuscript, the accompanying image and the video. A copy of the written consent is available for review by the editorial office of this journal.

Step-by-step description

Abdominal access and trocar placement

Abdominal access is obtained using an optical entry technique in the left upper quadrant and pneumoperitoneum is established up to 15 mmHg. The trocars are placed across the upper abdomen about 15 cm below the xiphoid (*Figure 2*). We utilize three 8-mm trocars with the middle one, placed

Figure 1 Representative image of a coronal reconstruction of the CT scan of the abdomen and pelvis of the patient presented here, showing a portion of the transverse colon (white arrow) herniating through an anterior defect in the diaphragm (black arrows). CT, computerized tomography.

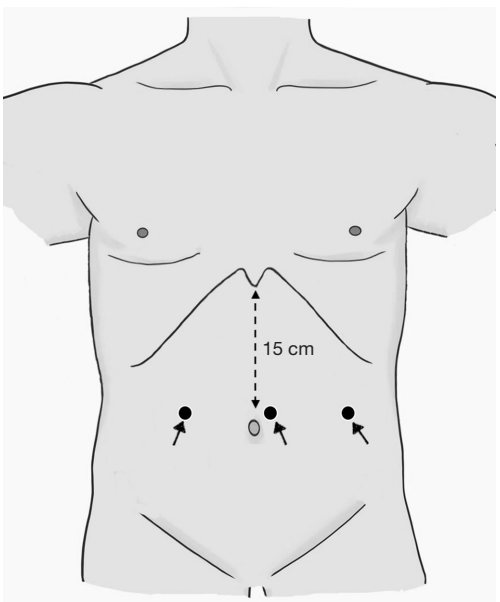


Figure 2 Trocar configuration. Black arrows point to the 8-mm robotic trocars.

slightly to the left of the midline, used for the 30-degree scope, angled up. We use the da Vinci Xi surgical system (Intuitive Surgical). An additional assist port may be used if desired. The patient is placed in a reverse Trendelenburg position.

Peritoneal flap creation and hernia sac reduction

The hernia contents are first reduced. A peritoneal incision

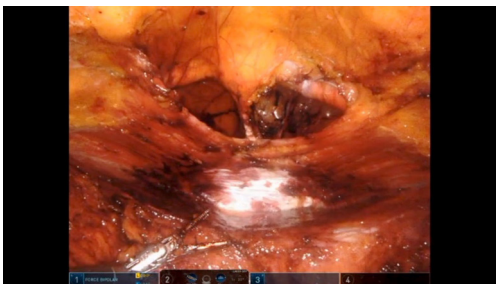


Figure 3 Completed preperitoneal dissection showing the Morgagni hernia defect and the exposed diaphragmatic muscle fibers and central tendon.

is made transversely 7–8 cm from anterior edge of the hernia defect and coming across the falciform ligament. The preperitoneal space is developed superiorly using sharp and blunt dissection. The hernia sac is then encountered and reduced along with any herniated preperitoneal fat. The preperitoneal dissection continues for 6–7 cm beyond the posterior edge of the defect, dissecting the peritoneum off the diaphragmatic muscle fibers and central tendon. The preperitoneal pocket extends at least 5 cm on each side of the defect. *Figure 3* shows the completed dissection.

Defect closure

The hernia defect is closed transversely using slowly absorbable barbed sutures (2-0 V-Loc^{TM} 180 on GS-22 needle, Medtronic, New Haven, CT, USA). We favor slowly absorbable sutures for all fascial closures including diaphragm, specially when a mesh is also used. Great care is made to ensure proper bites of muscle and fascia. Starting sutures from each end of the defect and gradually tightening them allows closure of larger defects; the sutures are overlapped in the middle and do not require to be tied together. If needed, the pressure of the pneumoperitoneum may be reduced at this stage to reduce tension and facilitate closure of wider defects.

Mesh placement and flap closure

An appropriately-sized mesh is placed over the repair with 4–5 cm overlap with normal fascia in all directions. We use the initial size of the defect prior to closure to determine the size of the mesh; in the case presented here, the defect measured 3 cm × 7 cm so the mesh was sized at 12 cm × 16 cm. Any non-coated macroporous permanent mesh is adequate but we prefer the self-gripping polyester mesh

(ProGrip™ Laparoscopic Self-fixating Mesh, Medtronic, New Haven, CT, USA) in this location in order to avoid any suturing to the diaphragm. If a standard mesh is used, only a few interrupted absorbable sutures, such as 2-0 polyglactin 910, are used to keep the mesh in place. The peritoneal flap is then closed with a running barbed absorbable suture (3-0 V-Loc™ 180 on CV-15 needle, Medtronic, New Haven, CT, USA); the peritoneum may need to be trimmed when a very large hernia sac is present. Before starting flap closure, we like to introduce a Veress needle percutaneously into the developed preperitoneal space in order to aspirate the carbon dioxide from that space once the flap closure is completed and ensure the mesh stays flat and in proper position.

The total operative time for the case presented here was 160 minutes and the blood loss was minimal.

Postoperative considerations and tasks

Most patients are discharged home on the first postoperative day. Some amount of subcutaneous crepitus is expected. No postoperative imaging is required if the patient is asymptomatic. Most patients are able to return to work within a week, unless they have a physically demanding job. We restrict patients from doing any heavy lifting or strenuous work-outs for 6 weeks after surgery.

Tips and pearls

Developing the peritoneal flap on the anterior abdominal wall is usually straightforward as this area has a significant amount of fatty tissue. The flap development on the diaphragm can be challenging and requires more careful dissection. It is important to always make sure no muscle fibers are coming down with the flap. Small tears in the flap can be closed with absorbable sutures. If there is significant tearing of the flap or if the flap cannot be developed, the procedure can be converted to an intraperitoneal repair with reduction and excision of the hernia sac, defect closure as describe above and placement of a sublay coated mesh sutured circumferentially in place.

Discussion

Surgical highlights

With this step-by-step video demonstration, we highlight the technique of robotic transabdominal preperitoneal Morgagni hernia repair. This approach allows for reduction of the hernia sac, primary repair of the hernia defect and reinforcement with an uncoated mesh. The robotic platform facilitates such repair compared to traditional laparoscopy as it takes advantage of wristed instruments to navigate the technical challenges of working on the anterior diaphragm and mediastinum and accomplishing complex tasks in a confined space.

Strengths and limitations

The transabdominal preperitoneal Morgagni hernia repair obviates the need for circumferential mesh fixation to the diaphragm which carries a risk of iatrogenic injuries. Given the preperitoneal mesh placement, we would expect better mesh tissue integration while also protecting the intraperitoneal viscera from any mesh adhesions. This technique is obviously limited by the access to the robotic platform and its associated increased cost, as well as the availability of the technical expertise in more complex robotic-assisted procedures.

Comparison with other surgical techniques and researches

There are a number of surgical techniques available to repair Morgagni hernias including open abdominal approach via laparotomy, open thoracic approaches via median sternotomy or thoracotomy and minimally invasive techniques, including laparoscopy and thoracoscopy. The first laparoscopic repair was described by Kuster *et al.* in 1992 (3). Given the shorter length of stay with similar recurrence rates as compared to laparotomy and thoracotomy (4), the laparoscopic approach became the preferred approach for repair of Morgagni hernias. In the past few years, there has been increasing reports on the feasibility of repairing Morgagni hernias in adults with robotically-assisted laparoscopy (5-13). Although all these reports are retrospective studies, they have consistently shown that such approach is safe and effective along with minimal postoperative pain, minimal length of stay and durable long-term results.

The initial descriptions of laparoscopic repairs recommended against removing the sac due to concern for creating massive pneumomediastinum with potential respiratory and circulatory complications (3). However, it is currently recommended to excise the hernia sac in order to reduce the risk of recurrence or mediastinal cyst formation (14); pneumomediastinum and subcutaneous

emphysema are common but are usually inconsequential.

The use of mesh is controversial. One study reported successful repair of 36 Morgagni hernias via laparotomy and thoracotomy without mesh and with no recurrence noted (15). Although repair of a small Morgagni hernia may be done primarily, mesh repair is recommended for larger defects in most modern series given the tension on the primary repair. Laparoscopic repairs (14,16,17) and many robotic repair series (5,6,9,12), use an intraperitoneal sublay mesh to either reinforce the repair closure or as a bridge.

Gergen *et al.* compared robotic intraperitoneal versus preperitoneal sublay mesh repair of Morgagni hernias in nine patients (10). They found longer operative times in the preperitoneal repair group but shorter length of stay, reduced post-operative pain and reduced time to return to work with no difference in complications, 30-day readmissions or recurrence of hernia between the two groups.

Implications and actions recommended

Robotic trans-abdominal preperitoneal has the potential of becoming the preferred technique for Morgagni hernia repair for the advantages stated here. Large prospective randomized studies comparing various robotic approaches are not possible given the rarity of this condition. However, standardization of the technique will allow better assessment of the short-term and long-term outcomes of the surgical management of this hernia.

Conclusions

The robotic transabdominal preperitoneal repair of Morgagni hernias appear to provide durable repair with the advantage of shorter length stay, reduced operative pain and quicker return to work. The robotic platform facilitates this approach as compared to laparoscopy. Placing the mesh extraperitoneally has the added advantage of allowing minimal to no mesh suture fixation to the diaphragm in addition to minimizing intraperitoneal visceral adhesions.

Acknowledgments

Funding: None.

Footnote

Provenance and Peer Review: This article was commissioned by the Guest Editors (Raul Caso and John F. Lazar) for the series "Challenging Robotic Foregut and Diaphragm Procedures" published in the *Journal of Visualized Surgery*. The article has undergone external peer review.

Reporting Checklist: The author has completed the SUPER reporting checklist. Available at https://jovs.amegroups.com/article/view/10.21037/jovs-23-44/rc

Peer Review File: Available at https://jovs.amegroups.com/article/view/10.21037/jovs-23-44/prf

Conflicts of Interest: The author has completed the ICMJE uniform disclosure form (available at https://jovs.amegroups.com/article/view/10.21037/jovs-23-44/coif). The series "Challenging Robotic Foregut and Diaphragm Procedures" was commissioned by the editorial office without any funding or sponsorship. The author has no other conflicts of interest to declare.

Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this study and the accompanying image and the video. A copy of the written consent is available for review by the editorial office of this journal.

References

1. Loong TP, Kocher HM. Clinical presentation and operative repair of hernia of Morgagni. Postgrad Med J 2005;81:41-4.
2. Morgagni GB. The seats and causes of diseases

investigated by anatomy. London: A. Millar, T. Cadell, Johnson and Payne; 1769;3:205.
3. Kuster GG, Kline LE, Garzo G. Diaphragmatic hernia through the foramen of Morgagni: laparoscopic repair case report. J Laparoendosc Surg 1992;2:93-100.
4. Young MC, Saddoughi SA, Aho JM, et al. Comparison of Laparoscopic Versus Open Surgical Management of Morgagni Hernia. Ann Thorac Surg 2019;107:257-61.
5. Arevalo G, Harris K, Sadiq A, et al. Repair of Morgagni Hernia in Adults with Primary Closure and Mesh Placement: First Robotic Experience. J Laparoendosc Adv Surg Tech A 2017;27:529-32.
6. Wei B, Pittman BC Jr. Robotic Morgagni hernia repair: an emerging approach to a congenital defect. J Robot Surg 2019;13:309-13.
7. Sioda N, Liu S, Janowski C, et al. A novel approach for the treatment of Morgagni hernias: robotic transabdominal preperitoneal diaphragmatic hernia repair. Hernia 2022;26:355-61.
8. Gergen AK, Frankel JH, Weyant MJ, et al. A novel technique of robotic preperitoneal approach for Morgagni hernia repair. Asian J Endosc Surg 2021;14:648-52.
9. Cubas R, Garcia M, Mukherjee K. Robotic repair of incarcerated morgagni hernia in an adult on the acute care surgery service. Rev Fac Cien Med Univ Nac Cordoba 2021;78:91-4.
10. Gergen AK, Frankel JH, Weyant MJ, et al. Comparison of a novel preperitoneal sublay repair with traditional onlay repair of morgagni hernia: a tale of two techniques. J Robot Surg 2021;15:821-6.
11. Machado MAC, Epstein MG, Lobo Filho MM, et al. Robotic repair of Morgagni hernia in adult patient. Arq Gastroenterol 2022;59:549-50.
12. Pulle MV, Asaf BB, Puri HV, et al. Robotic Morgagni's hernia repair in adults - A single centre experience. Asian Cardiovasc Thorac Ann 2023;31:253-8.
13. Schubert A, Ramos MG. Robotic assisted transabdominal preperitoneal approach for repair of Morgagni hernia in elderly female. J Surg Case Rep 2023;2023:rjac486.
14. Godazandeh G, Mokhtari-Esbuie F. Laparoscopic Repair of Morgagni Hernia: Three-Case Presentation and the Literature. Case Rep Surg 2016;2016:4268539.
15. Aghajanzadeh M, Khadem S, Khajeh Jahromi S, et al. Clinical presentation and operative repair of Morgagni hernia. Interact Cardiovasc Thorac Surg 2012;15:608-11.
16. Leeflang E, Madden J, Ibele A, et al. Laparoscopic management of symptomatic congenital diaphragmatic hernia of Morgagni in the adult. Surg Endosc 2022;36:216-21.
17. Kao AM, Ayuso SA, Huntington CR, et al. Technique and Outcomes in Laparoscopic Repair of Morgagni Hernia in Adults. J Laparoendosc Adv Surg Tech A 2021;31:814-9.

doi: 10.21037/jovs-23-44
Cite this article as: Salameh JR. Robotic transabdominal preperitoneal Morgagni hernia repair: surgical technique. J Vis Surg 2024.