Robotic-assisted endoluminal gastric leiomyoma resection: a novel surgical technique for benign gastroesophageal junction tumors

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Contributions: (I) Conception and design: All authors; (II) Administrative support: None; (III) Provision of study materials or patients: MA Adam; (IV) Collection and assembly of data: None; (V) Data analysis and interpretation: None; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

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Abstract: Gastric leiomyomas are rare, benign smooth muscle tumors that arise from the muscularis propria and can be found in any part of the stomach. The American College of Gastroenterologists recommends resection only for symptomatic leiomyomas, which can often present with bleeding, abdominal pain, or dyspepsia. Notably, symptomatic leiomyomas that arise at the gastroesophageal (GE) junction, especially those that are large, pose unique challenges. Specifically, total gastrectomy with esophagojejunostomy is often necessary, which can be associated with a compromised quality of life and possible complications such as anastomotic stricture or reflux esophagitis. In this context, we present the case of a young, male patient with a large symptomatic leiomyoma at the GE junction who was offered a robotic-assisted endoluminal leiomyoma resection. By placing endoluminal trocars and utilizing the Da Vinci® robot, we were able to carefully excise the tumor without perforating the stomach or causing GE junction stenosis. This allowed the patient to preserve his stomach and avoid a high-risk anastomosis. Another notable highlight of the case included the use of the endoscope as both a bougie and a source of insufflation. The patient had an uncomplicated postoperative course and a rapid recovery, highlighting the feasibility of this approach for patients with benign GE junction tumors.

Keywords: Gastric leiomyoma; gastroesophageal junction tumors (GE junction tumors); robotic surgery; endoluminal robotic surgery; endogastric resection

Submitted Sep 30, 2023. Accepted for publication Jan 12, 2024. Published online Feb 01, 2024.
doi: 10.21037/cco-23-112
View this article at: https://dx.doi.org/10.21037/cco-23-112

Introduction

Background

Gastric leiomyomas are rare, benign smooth muscle tumors that arise from the muscularis propria. They can be found in any part of the stomach and can grow extra- or intra-luminally. The prevalence of gastric leiomyomas is not well documented, although one report estimates that they comprise only 2.4% of gastric neoplasms. They are more common in women and their peak incidence is between the ages of 50 to 59 years (1). A diagnosis of gastric leiomyoma can be suspected with its characteristic computed tomography (CT) scan findings and is confirmed histologically by endoscopic ultrasound (EUS), fine needle aspiration (FNA) or biopsy (2). Most gastric leiomyomas are asymptomatic and found incidentally during other

procedures (3), although they can cause symptoms such as bleeding, abdominal pain, or dyspepsia (1). Of note, due to their benign nature, the American College of Gastroenterologists recommends resection only for symptomatic leiomyomas (4).

Rationale

Historically, open gastrectomy was the treatment of choice. Over the past 20 years, several combined laparoscopic and endoscopic approaches have been developed to manage submucosal gastric masses. These newer techniques include primarily laparoscopic approaches such as endoscope-assisted wedge resection (EAWR) (5,6), endoscope-assisted laparoscopic transgastric resection (EATR) (7,8), laparoscopic intragastric surgery (LIGS) (9), and single-incision laparoscopic intragastric surgery (sLIGS) (10) as well as primarily endoscopic approaches such as laparoscopy-assisted endoscopic resection (LAER) (11). There are currently no widely accepted guidelines regarding which of the aforementioned techniques is superior, although several groups have proposed guidelines for resection based on the anatomic location of the tumor (12,13). Importantly, special consideration needs to be given to tumors at the gastroesophageal (GE) junction, as resections at or near this location carry a high risk of GE junction compromise and the need for total gastrectomy.

Highlight box

Surgical highlights

- In this challenging case involving a large 8.5 cm symptomatic leiomyoma at the gastroesophageal (GE) junction, a robotic-assisted endoluminal resection was successfully employed to excise the tumor precisely, eliminating the need for total gastrectomy.

What is conventional and what is novel/modified?

- Conventional methods of treating symptomatic leiomyomas at the GE junction often involve a total gastrectomy with esophagojejunostomy, a procedure that can lead to a compromised quality of life and complications. In contrast, the proposed approach al-lows for safe tumor excision at the GE junction, thus preserving the patient's stomach, and avoiding the need for total gastrectomy.

What is the implication, and what should change now?

- This novel technique is a suitable option for removing leiomyomas at the GE junction, particularly for younger patients who face a higher risk of long-term impact from total gastrectomy or GE junction stenosis.

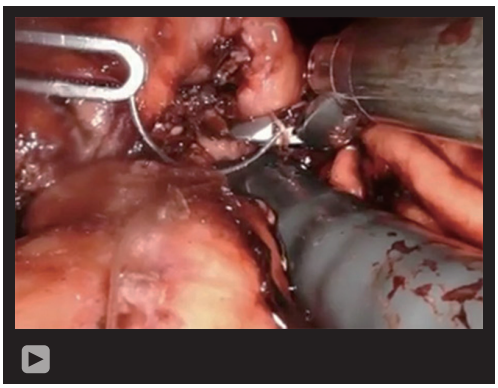
Ultimately, total gastrectomy with esophagojejunostomy is often performed, which is a major surgery associated with complications such as anastomotic stricture or reflux esophagitis (14). Furthermore, patients report having reduced quality of life after total gastrectomy due persistent issues such as nausea, vomiting, diarrhea, and difficulties eating (15). Thus, there is a need for an innovative surgical approach that can effectively resect GE junction leiomyomas while avoiding the morbidity of total gastrectomy.

Objective

We present the case of a 47-year-old male patient who presented with an 8.5 cm symptomatic GE junction leiomyoma and underwent a successful robotic-assisted endoluminal gastric resection of the mass with endoscopic assistance. The procedure was performed with curative intent. Similar to other LIGS procedures, we inserted trocars into the gastric lumen to facilitate an intraluminal resection. However, the unique aspect of this approach was that we were able to successfully enucleate the leiomyoma and thus spare the patient from undergoing a total gastrectomy with esophagojejunostomy. In this technical report, we review the preoperative, intraoperative, and postoperative considerations of this approach. We present this article in accordance with the SUPER reporting checklist (available at https://cco.amegroups.com/article/view/10.21037/cco-23-112/rc).

Preoperative preparations and requirements

The patient was a 47-year-old male with a history of asthma who presented with a symptomatic gastric mass to the University of California, San Francisco Medical Center, which is an academic, tertiary care hospital. Due to the large size of the tumor (5.3 cm × 8.5 cm × 4.4 cm) and its location at the GE junction, a partial or total gastrectomy was initially recommended. However, EUS and FNA demonstrated a bland spindle cell neoplasm, consistent with leiomyoma. In addition, the mass was unresectable endoscopically. After the patient was presented at a multidisciplinary tumor board, the decision was made to proceed with a robotic-assisted endoluminal resection of the mass with endoscopic assistance, given the benign nature of the mass, with the goal of preserving the patient's stomach. All procedures performed in this study were in accordance with the ethical standards of the institutional



Video 1 Robotic-assisted endoluminal gastric leiomyoma resection: a novel surgical technique for benign gastroesophageal junction tumors.

and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for the publication of this article and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

The primary surgeon (M.A.A.) is a board-certified, fellowship trained surgical oncologist with extensive experience in minimally invasive surgery (MIS). The team also consisted of a bedside assistant, anesthesiologist, circulating nurse, and a surgical technologist. In terms of special surgical equipment, the daVinci Surgical System (Intuitive Surgical, Mountain View, CA, USA) was used as the robotic platform. After obtaining informed consent, the patient was brought to the operating room. General anesthesia was administered, and the airway was secured with an endotracheal tube. An orogastric tube was placed, and preoperative antibiotics were administered. The patient was positioned supine and the abdomen was then prepped and draped in the standard fashion.

Step-by-step description

After accessing the abdominal cavity, three 8-mm robotic ports were then placed at the level of the umbilicus. Upper endoscopy was then performed, which visualized a 5.3 cm × 8.5 cm × 4.4 cm lobular mass originating from the GE junction. The stomach was insufflated, after which the robot was docked at the level of the umbilicus. Using monopolar scissors, three gastrotomies were made for the endoluminal ports at the greater curvature of the stomach. Three 15-mm balloon ports were then inserted in the left upper quadrant and into the stomach. The balloons were inflated to tack the stomach to the abdominal wall. Bariatric length robotic ports were placed within the balloon ports, and the robot was then undocked from the umbilical ports and docked onto the gastric ports.

The leiomyoma was visualized upon entry. The endoscope remained in the stomach for the duration of the case to provide insufflation and also served as a bougie. The mucosa surrounding the mass was excised using hook cautery and then dissected away from the muscle layer using a combination of blunt, sharp, and electrocautery dissection. This was carried out circumferentially, taking care to both preserve the GE junction and avoid making a full-thickness defect in the stomach.

Once the mass was completely excised, the musculomucosal defect was repaired. Of note, multiple interrupted 3-0 Vicryl sutures were used to close the mucosal defect by the GE junction to reduce the risk of stenosis. Further away from the GE junction, a 3-0 V lock absorbable suture was used to close the mucosal and muscular defect in a running fashion.

The specimen was then placed into a large EndoCatch bag for later retrieval. The robot was undocked from the endoluminal ports and re-docked onto the abdominal ports, and the balloon ports were removed under direct visualization from the stomach. To remove the specimen from the stomach, a 4 cm gastrotomy incision was created, connecting the space between the two most medial endoluminal ports. The bagged specimen was then placed into another EndoCatch bag to minimize intraperitoneal contamination. The gastrotomy defect was closed in two layers, using 3-0 V lock sutures in a running fashion followed by 2-0 silk Lembert sutures. Finally, a piece of omentum was tacked onto the gastrotomy closure site using 2-0 silk sutures.

The specimen was removed via a Pfannenstiel incision, and the fascia, soft tissue, and skin were closed in the standard fashion. Of note, the endoluminal port incisions were closed using skin staples to reduce the risk of infection. The total operative time was 586 min due to the extensive size of the tumor, which necessitated additional operative time. No blood products were transfused during the procedure. This procedure is also reviewed in its entirety in *Video 1*. Notably, although this procedure was successfully performed in a minimally invasive fashion, conversion to an open approach may be required in certain circumstances; examples include significant bleeding, injury of adjacent

organs, or other complications that cannot be managed expeditiously with an MIS approach or failure to progress the case in a reasonable timeframe.

Postoperative considerations and tasks

The patient had an uncomplicated postoperative course and did not require additional monitoring beyond the standard of care. He was started on IV pantoprazole immediately after surgery, and on postoperative day (POD) 1 his nasogastric tube was removed and he was started on a clear liquid diet. He was transitioned to oral lansoprazole on POD 2 and advanced to a full liquid diet by POD 3. Notably, his postoperative pain was minimal and managed effectively with acetaminophen and gabapentin. The patient was discharged on POD 3, progressed to a blenderized diet by POD 10, and resumed a regular diet within 1 month after surgery. After discharge, the patient was seen for routine follow up at 1 week, 1 month, and 1 year after surgery without any issues. Final pathology confirmed leiomyoma, and a follow-up endoscopy performed 1 year after surgery was unremarkable with no evidence of disease recurrence or GE junction stenosis. The patient required no further follow up after this point.

Although this patient had an uneventful postoperative course, some potential complications that providers may encounter include those relevant to all procedures, such as surgical site infection or bleeding, as well as those specific to this surgery, such as GE junction stenosis. The former should be managed per standard of care, such as source control and/or antibiotics for infection and monitoring, transfusion, and/or invasive intervention for bleeding. In regard to GE junction stenosis, endoscopic dilation is a reasonable approach.

Tips and pearls

There are several tips and pearls to be noted for this case. First, three silk sutures were placed along the greater curvature of the stomach during placement of the endoluminal ports; this allowed the surgeon to maintain tension, which facilitated both the creation of the gastrotomies as well as the placement of the endoluminal ports. In addition, the endoscope was left in the stomach for the duration of the case to provide insufflation and serve as a bougie. This was particularly useful during suture repair of the mucosal defect to reduce the risk of subsequent GE junction stenosis. To further minimize the chances of GE junction stenosis, the proximal aspect of the mucosal defect was closed with interrupted 3-0 Vicryl sutures. Finally, a couple tips are worth mentioning to reduce the risk of postoperative infection. During specimen extraction, the tumor was double bagged—once in the stomach and again in the peritoneum—to reduce the risk of intra-abdominal contamination. In addition, the endoluminal port incisions were closed using skin staples.

Discussion

In summary, we presented a successful case of a robotic-assisted endoluminal gastric resection of a large GE junction leiomyoma. Per our review, this is one of the first reports of such a procedure. Importantly, we believe that our approach can address some of the limitations associated with existing minimally invasive surgical approaches, especially in cases where the lesion is large (>5 cm) and located at the GE junction.

Surgical highlights

A key highlight of this procedure was the ability to preserve the stomach and avoid a total gastrectomy, potentially sparing the patient from serious complications and allowing him to maintain a high quality of life. From a technical perspective, the use of the robot allowed the patient to reap the benefits of a minimally invasive surgical procedure, such as decreased postoperative pain and shorter length of stay, while also granting the surgeon improved dexterity, vision, and range of motion as compared to a traditional laparoscopic approach. Specifically, the patient was discharged on POD3, did not require narcotics during his recovery, and remains complication-free nearly a year after his surgery.

Strengths and limitations

A unique strength of this case is that we utilized both the robot and the endoscope to facilitate the procedure. Specifically, compared to the traditional laparoscopic approach, the robot offers such advantages as improved visualization, greater dexterity, three-dimensional imaging, tremor filtration, and articulated instruments (16). This allowed the surgeon to perform a meticulous dissection close to the GE junction without perforating the stomach or causing GE junction stenosis. In addition, as previously mentioned, the endoscope was used for insufflation and

also served as a bougie. These strengths allowed for the successful resection of the leiomyoma, allowing the surgeon to preserve the stomach and sparing the patient from a much more morbid procedure.

This approach also has limitations. First, robotic surgery is cost and resource-intensive, which may preclude some centers from accessing such technology. However, although the intraoperative costs of this approach may be significantly higher than a laparoscopic or open approach, the patient had an uncomplicated recovery and was quickly discharged from the hospital. Thus, especially compared to a total gastrectomy, this procedure likely saved costs in terms of hospital length of stay or potential readmissions for complications. In order to avoid unnecessarily increasing costs, careful consideration of the safety and viability of other more cost-effective approaches should be done on a per patient basis before selecting this approach. Finally, this approach would not be appropriate for malignant gastric tumors, as it does not provide an oncologic resection.

Comparison with other surgical techniques and researches

In the past, open gastrectomy served as the primary treatment for cases like the one discussed. However, total gastrectomy with esophagojejunostomy leads to complications, such as anastomotic stricture or reflux esophagitis (14) and reduced quality of life for patients. Unlike subtotal or total gastrectomy, laparoscopic wedge resection allows for the preservation of the cardia and pylorus without necessitating anastomosis and reconstruction, making it a valuable option for resecting gastric tumors. However, laparoscopic wedge resection can be challenging for large tumors located near the GE junction. In contrast, our novel approach allows for the safe and effective resection of a GE junction tumor without resecting any portion of the stomach.

Endoscopic surgeries, such as submucosal tunneling endoscopic resection, have been also utilized to treat benign gastric tumors, especially those proximal to the GE junction (17). However, the technique demands superior endoscopic skills and is primarily suited for gastric tumors of limited diameter. Furthermore, several combined laparoscopic and endoscopic approaches have been developed to manage submucosal gastric masses in various locations (18). However, tumors at the GE junction pose a unique challenge as surgical manipulation in this area is difficult. Therefore, certain combined laparoscopic and endoscopic approaches such as clean no-exposure technique (CLEAN-NET) (19) and non-exposed endoscopic wall inversion surgery (NEWS) (20) may not be suitable for GE junction tumors. Our novel approach combines robotic surgery with endoscopy and not only minimizes resection of the healthy stomach tissue but also enables the treatment of benign tumors of various sizes near the GE junction. Of note, a prior case report described the resection of a GE junction leiomyoma via a purely laparoscopic transgastric approach (21). Although this patient also had a successful surgery and no postoperative complications, the described mass was significantly smaller at 5 cm.

Implications and actions recommended

This technical report demonstrates the feasibility of this approach when treating patients with large, benign tumors at high-risk locations such as the GE junction. Of note, such procedures should ideally be performed by surgeons who are well-versed in robotic assisted surgery and at institutions that have the adequate infrastructure and staff to support such surgeries. In addition, it is essential that the patient be adequately counseled prior to surgery, as there is a possibility of converting to a total gastrectomy if the endoluminal gastric approach is deemed infeasible or unsafe intraoperatively. However, with adequate resources and appropriate patient selection, this technique has excellent patient outcomes. Future studies that document similar approaches will be essential to both describe other surgeons' experiences as well as to help refine this technique.

Conclusions

In summary, we described the case of a young patient with a large, symptomatic GE junction leiomyoma who underwent a successful robotic-assisted endoluminal gastric resection with endoscopic assistance. This technique may be particularly well-suited to address benign tumors at the GE junction, as it ultimately spared the patient from undergoing total gastrectomy.

Acknowledgments

Funding: This work was supported by the University of California, San Francisco, Noyce Initiative Computational Innovator Postdoctoral Fellowship Award (to J.J.W.).

Footnote

Reporting Checklist: The authors have completed the SUPER reporting checklist. Available at https://cco.amegroups.com/article/view/10.21037/cco-23-112/rc

Peer Review File: Available at https://cco.amegroups.com/article/view/10.21037/cco-23-112/prf

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://cco.amegroups.com/article/view/10.21037/cco-23-112/coif). J.J.W. was supported by the University of California, San Francisco, Noyce Initiative Computational Innovator Postdoctoral Fellowship Award. The other authors have no conflicts of interest to declare.

Ethical Statement: The authors are 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 article and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

References

1. Davis GB, Blanchard DK, Hatch GF 3rd, et al. Tumors of the stomach. World J Surg 2000;24:412-20.
2. Sharzehi K, Sethi A, Savides T. AGA Clinical Practice Update on Management of Subepithelial Lesions Encountered During Routine Endoscopy: Expert Review. Clin Gastroenterol Hepatol 2022;20:2435-2443.e4.
3. Crouthamel MR, Kaufman JA, Billing JP, et al. Incidental gastric mesenchymal tumors identified during laparoscopic sleeve gastrectomy. Surg Obes Relat Dis 2015;11:1025-8.
4. Jacobson BC, Bhatt A, Greer KB, et al. ACG Clinical Guideline: Diagnosis and Management of Gastrointestinal Subepithelial Lesions. Am J Gastroenterol 2023;118:46-58.
5. Lim SG, Hur H, Han SU, et al. Laparoscopy-assisted endoscopic full-thickness resection for gastric subepithelial tumors originated from the muscularis propria layer: a pilot study with literature review. Scand J Gastroenterol 2017;52:257-63.
6. Novitsky YW, Kercher KW, Sing RF, et al. Long-term outcomes of laparoscopic resection of gastric gastrointestinal stromal tumors. Ann Surg 2006;243:738-45; discussion 745-7.
7. Wilhelm D, von Delius S, Burian M, et al. Simultaneous use of laparoscopy and endoscopy for minimally invasive resection of gastric subepithelial masses - analysis of 93 interventions. World J Surg 2008;32:1021-8.
8. Huang JL, Zheng ZH, Wei HB, et al. Endoscopy-Assisted Laparoscopic Resections for Gastric Gastrointestinal Stromal Tumors: A Retrospective Study. J Laparoendosc Adv Surg Tech A 2017;27:110-4.
9. Hara J, Nakajima K, Takahashi T, et al. Laparoscopic intragastric surgery revisited: its role for submucosal tumors adjacent to the esophagogastric junction. Surg Laparosc Endosc Percutan Tech 2012;22:251-4.
10. Katsuyama S, Nakajima K, Kurokawa Y, et al. Single-Incision Laparoscopic Intragastric Surgery for Gastric Submucosal Tumor Located Adjacent to Esophagogastric Junction: Report of Four Cases. J Laparoendosc Adv Surg Tech A 2018;28:78-82.
11. Qiu WQ, Zhuang J, Wang M, et al. Minimally invasive treatment of laparoscopic and endoscopic cooperative surgery for patients with gastric gastrointestinal stromal tumors. J Dig Dis 2013;14:469-73.
12. Privette A, McCahill L, Borrazzo E, et al. Laparoscopic approaches to resection of suspected gastric gastrointestinal stromal tumors based on tumor location. Surg Endosc 2008;22:487-94.
13. Min JS, Seo KW, Jeong SH. Choice of LECS Procedure for Benign and Malignant Gastric Tumors. J Gastric Cancer 2021;21:111-21.
14. Levine MS, Fisher AR, Rubesin SE, et al. Complications after total gastrectomy and esophagojejunostomy: radiologic evaluation. AJR Am J Roentgenol 1991;157:1189-94.
15. Muir J, Aronson M, Esplen MJ, et al. Prophylactic Total

Gastrectomy: a Prospective Cohort Study of Long-Term Impact on Quality of Life. J Gastrointest Surg 2016;20:1950-8.
16. Köckerling F. Robotic vs. Standard Laparoscopic Technique - What is Better? Front Surg 2014;1:15.
17. Zhou DJ, Dai ZB, Wells MM, et al. Submucosal tunneling and endoscopic resection of submucosal tumors at the esophagogastric junction. World J Gastroenterol 2015;21:578-83.
18. Namikawa T, Hanazaki K. Laparoscopic endoscopic cooperative surgery as a minimally invasive treatment for gastric submucosal tumor. World J Gastrointest Endosc 2015;7:1150-6.
19. Inoue H, Ikeda H, Hosoya T, et al. Endoscopic mucosal resection, endoscopic submucosal dissection, and beyond: full-layer resection for gastric cancer with nonexposure technique (CLEAN-NET). Surg Oncol Clin N Am 2012;21:129-40.
20. Mitsui T, Yamashita H, Aikou S, et al. Non-exposed endoscopic wall-inversion surgery for gastrointestinal stromal tumor. Transl Gastroenterol Hepatol 2018;3:17.
21. Taniguchi E, Kamiike W, Yamanishi H, et al. Laparoscopic intragastric surgery for gastric leiomyoma. Surg Endosc 1997;11:287-9.

Cite this article as: Yin H, Ganjouei AA, Wang JJ, Romero-Hernandez F, Nakakura E, Alseidi A, Adam MA. Robotic-assisted endoluminal gastric leiomyoma resection: a novel surgical technique for benign gastroesophageal junction tumors. Chin Clin Oncol 2024;13(1):6. doi: 10.21037/cco-23-112