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Case Report

Clinical Efficacy of a Giant Paraesophageal Hernia Robotic Repair

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Abstract

Recent years have demonstrated significant advances in the utilization of robotic surgery for a wide-ranging variety of cases including paraesophageal hernias. Type IV paraesophageal hernias are of known high risk due to the threat of injuring herniated abdominal viscera during hernia reduction. Currently, the gold standard for repair of Type IV paraesophageal hernias is laparoscopy with or without hiatal mesh placement. Laparoscopy provides good two-dimensional visualization of the esophageal hiatus and posterior mediastinum, however, limits the ability of the surgeon regarding instrument movement. In comparison, robotic-assisted laparoscopy allows for excellent three-dimensional visualization in addition to wristed instrument movement and the ability of multiple surgeons to work comfortably in a tight space. We present a patient with multiple prior abdominal surgeries who presented to our institution with a Type IV paraesophageal hernia containing the stomach, pancreas, and duodenum. He underwent robotic-assisted laparoscopy for reduction and repair of his Type IV paraesophageal hernia using robotic-assisted laparoscopy. We utilized a dual-console da Vinci* robot to allow simultaneous work of a thoracic and general surgeon, both experienced in robotic surgery. In this report, we discuss the safety and advantages of dual-station robotic-assisted laparoscopy with a multidisciplinary surgical team over the current gold standard for repair of complex paraesophageal hernias.

Keywords: Paraesophageal hernia; Robot-assisted laparoscopy; Dual-console

Abbreviations

GPEH: Giant Paraesophageal Hernia; PEH: Paraesophageal Hernia; RAL: Robot-Assisted Laparoscopy

Introduction

Paraesophageal Hernias (PEHs) comprise approximately 5%-10% of all hiatal hernias, however, are growing increasingly common with the current expansion of the U.S. elderly population [1]. Within the classification of PEH, three subtypes exist: type II, type III, and type IV [2]. Type IV PEHs occur when there is a large defect in the phrenoesophageal membrane, leading to the displacement of additional viscera into the hernia sac [2,3]. Type IV PEHs are often referred to as Giant Paraesophageal Hernias (GPEHs), although the term is not well-defined in the literature [1-5].

Historically, these GPEHs were repaired through thoracotomy and laparotomy until the advent of laparoscopic technology in the last 30 years, which revolutionized recovery intervals and perioperative complication rates [1]. With advancing methods over the first ten years of use, laparoscopy quickly became the standard of treatment, with consistently fewer reported hernia recurrences [6]. Robot-Assisted Laparoscopy (RAL) has now presented another potential advancement in the treatment of PEH repair. There is a current scarcity of literature describing the use of RAL for the treatment of GPEHs, with no studies investigating long-term outcomes. RAL with da Vinci*, specifically, demonstrates clear advantages of increased instrument maneuverability, wider visual fields, and 3-dimensional visualization of internal body cavities [7-9]. We believe that with these clear advantages and preliminary data showing promise of superior outcomes, RAL is the next standard level of care for repair of GPEHs and should be further investigated [10]. Our case report describes the use of dual-station RAL for the treatment of an exceptionally complex GPEH in an adult male with a history of prior inguinal and ventral hernia repairs.

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Case Presentation

A 50-year-old male presented to the clinic with a 2-year history of progressive bloating, nausea, vomiting, hiccups, and chest discomfort without clinical signs of reflux and was eventually diagnosed with a Giant Paraesophageal Hernia. The patient had an extensive prior history of femoral, umbilical, and inguinal hernias. At the time of his most recent umbilical hernia repair in 2018, a chest radiograph visualized a fluid level above the phrenoesophageal membrane consistent with a hiatal hernia (Figure 1). At the time, the patient was asymptomatic and was assigned no treatment. The hernia worsened after this initial evaluation until additional imaging in December of 2020 (Figures 2 and 3). Endoscopic evaluation of the hernia showed an enlarged, tortuous esophagus, a paraesophageal hernia, and mild gastritis.

Due to absence of reflux symptoms and the complex hiatal anatomy seen on imaging, we decided to forego additional esophageal functional evaluation including pH testing and manometry. The patient was taken to the operating room for Robot-Assisted Laparoscopic Repair of his GPEH using a dual-station da Vinci* system, operated

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by a general and thoracic surgeon, each with extensive robotic surgery experience.

A total of four robotic ports and two assisting ports were placed starting with one 5-millimeter (mm) port placed 1 centimeter (cm) inferior to Palmer's point. The remaining ports were placed under direct visualization to include the following: 5 mm assistant port in the right lower quadrant, two 8 mm ports in the right upper quadrant below the costal margin, one 8 mm supraumbilical port, one 8 mm port in the left upper quadrant, and one 12 mm port in the left midclavicular line at the level of the umbilicus.

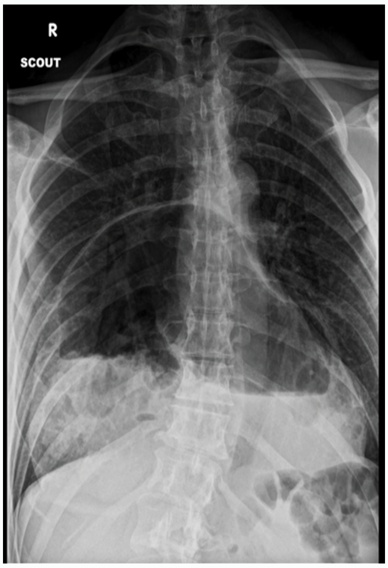

Figure 1: Preoperative plain chest film.

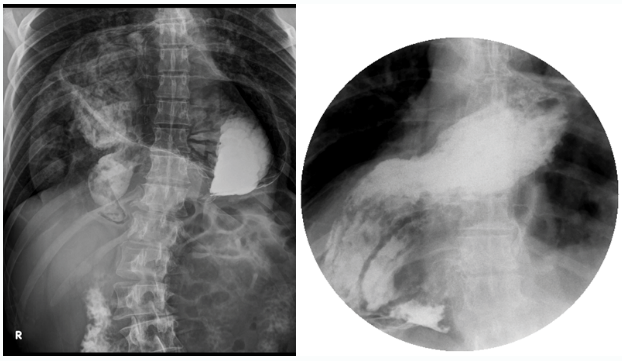

Figure 2: Preoperative upper GI study.

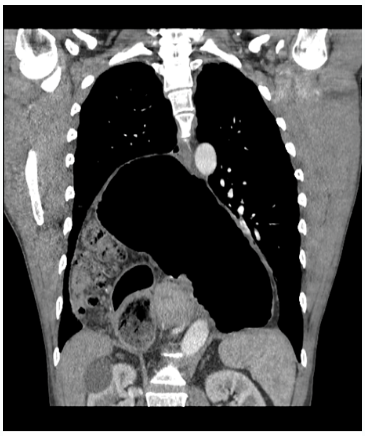

Figure 3: Preoperative CT evaluation.

The patient was positioned in 22-degree steep reverse Trendelenburg and the da Vinci* robot was docked and targeted. A snake retractor was placed through the right upper quadrant 5 mm incision for anterior elevation of the left lobe of the liver. A massive hiatal hernia defect was immediately visible with a direct view into the chest from an angled scope. A significant portion of abdominal structures was visualized in the chest including the stomach, colon, duodenum, jejunum, and the head of the pancreas. During initial dissection, the visceral contents were noted to be directly fused with the hernia sac in some locations. Utilizing a combination of blunt and sharp dissection aided by bipolar energy devices, the hernia sac, and the visceral contents were meticulously dissected free from the adjacent mediastinal structures including the pericardium, pleura, vertebral fascia, and aorta.

The distal esophagus was circumferentially dissected from the diaphragmatic crus. A complete dissection and mobilization of the esophagus were performed cephalad to the level of the carina, allowing 4cm of tension-free intra-abdominal esophagus. Upper endoscopy at this time revealed normal conformal relation of Z-line, diaphragmatic crural impression, and the angle of His upon retroflexion and an intact lower esophageal sphincter, hence precluding the need for fundoplication.

Diaphragmatic cruroplasty was completed with 0 Ethibond sutures in a figure of eight fashion along with the use of pledgets. The patient's robust crural musculature allowed for a tension-free cruroplasty without mesh reinforcement. Using 0 Ethibonds in a simple interrupted fashion, gastropexy was completed along the greater curvature to the left hemidiaphragm and lateral abdominal wall. Excess hernia sac was excised and removed from the abdomen.

Completion upper endoscopy revealed a fully intact and competent LES. There were no noted intra-operative complications with estimated blood loss of less than 50 mm. The total procedure time was 438 minutes with a robotic surgeon console time of 294 minutes.

Post-operative x-rays revealed complete reduction of hernia and no pneumothorax (Figure 4). The following morning a water-soluble esophagogram demonstrated normal flow of contrast across the Gastro-Esophageal (GE) junction and minor residual contrast at the distal esophagus which resolved on repeat chest x-ray 2 and 4 hours later (Figures 5-7).

The patient required only minimal PO pain medications postoperatively and was begun on a clear liquid diet upon completion of his esophagogram. The patient was discharged on post-op day 3 tolerating liquids with adequate return of bowel function. Upon discharge, he was advised to begin a soft diet in 72 hours then advance as tolerated. On his first clinic follow-up visit 10 days post-op, the patient reported tolerating a regular diet with no requirement for pain medications. His only complaint at that time was 2 episodes of hiccups on postoperative day 4 and 5 that resolved spontaneously. He is now engaging in light exercise with no further respiratory complaints.

Discussion

Within the classification of PEH, three subtypes exist: type II,

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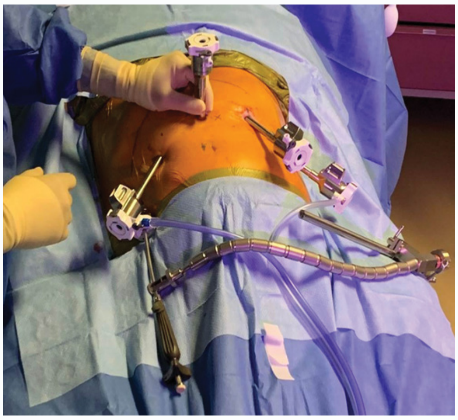

Figure 4: Port placement with liver retractor.

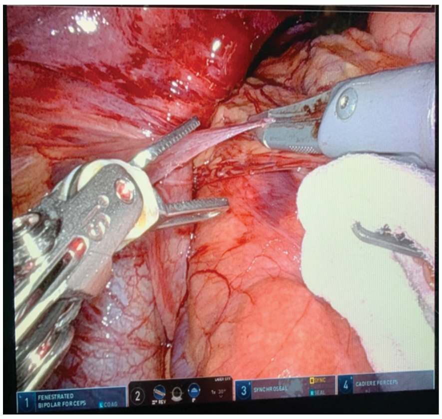

Figure 5: Dissection of hernia sack containing colon, stomach, duodenum, and pancreas.

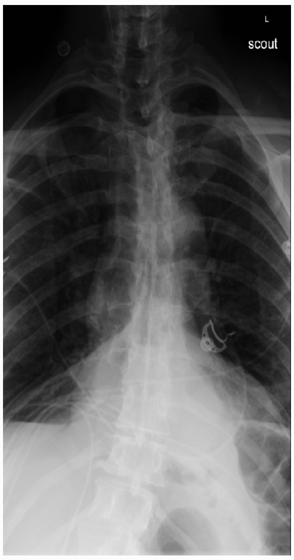

Figure 6: Postoperative plain chest film.

type III, and type IV [2]. In type II PEHs, the gastric fundus works as a lead point for a portion of the stomach to herniate through the phrenoesophageal membrane, alongside the esophagus, while the GE

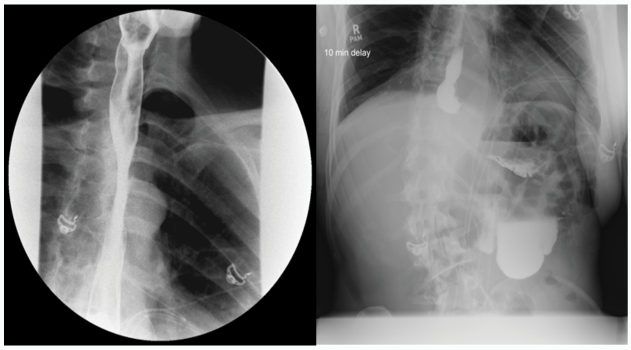

Figure 7: Postoperative esophagogram.

junction remains fixed [1,2]. Type III PEHs present with progressive enlargement of a defect in the phrenoesophageal membrane that leads to a “sliding” element, where the GE junction becomes displaced and both the cardia and the fundus herniate through the defect as well [2,3]. Unlike the previously mentioned types, Type IV PEHs occur when there is a large defect in the phrenoesophageal membrane, allowing the displacement of additional abdominal viscera into the hernia sac [2,3]. These hernias are associated with a significant degree of discomfort and morbidities for affected patients.

Early on in use, RAL was on par with laparoscopy for efficacy in treating various abdominal hernias, but RAL has quickly become standard for many abdominal procedures by addressing many of laparoscopic surgery’s shortcomings [7-11]. Advancements in the technologic features of RAL, increased frequency in use of RAL, and improved surgeon technical skills have propelled improvements in outcomes [7,8]. In initial studies, RAL has been associated with similar rates of blood loss and postoperative complications as laparoscopy for PEH repairs [9].

For our case, we uniquely utilized the dual console to allow two surgeons to work in concert to repair a GPEH. Traditionally, the second console is used for visual training of surgical residents, allowing real-time visualization of the case being performed by the operating surgeon. Normally, the operating surgeon is capable of controlling one robotic arm per hand and a third robotic arm controlled by the left foot pedal, usually reserved for the camera. The right foot can be given additional utility such as cautery or suction as well. This allows the surgeon to only be able to simultaneously utilize three robotic arms of the four possible. By adding an experienced surgeon to the second console and engaging the motor functions of this console, we were able to unlock new surgical approaches. The dual console approach can allow simultaneous use of all four arms of the robot. The presence of an additional surgeon allows two surgeons of different specializations to be engaged in the operation simultaneously, opening the door for a collaborative approach to complex surgeries. This avoids the need for multiple surgeries, makes the case more efficient, and serves to improve patient outcomes.

Surgeries involving multiple surgeons would be cumbersome without the robotic approach, as surgeons are standing on either side of the patient, looking from different perspectives which can often disrupt intraoperative communication and impede each surgeon’s maneuverability. With the robotic approach, surgeons can use a single scope to offer the same vantage point when identifying key structures and pathologies during the procedure. Either surgeon can be given

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control of the camera and the robotic arms between consoles, allowing each surgeon to quickly take over depending on the stage of the procedure. Control over the robotic arms can be distributed as either surgeon using three arms with the other using one, or each using two. With each robotic arm accessing the patient through a different port, the ability for either surgeon to access the most well-positioned arm saves precious time in the OR. This user flexibility allows for seamless transitions in control, streamlining the procedure.

Conclusion

This case suggests that the repair of GPEHs can be performed effectively with RAL using a dual-console approach. The presentation of GPEHs can appear benign but has been associated with complications leading to potentially significant morbidity. In consulting multiple surgeons with experience in robotic surgery, a methodical surgery guided by an interprofessional team of experts can contribute to strong post-operative outcomes.

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