

Robot-assisted giant paraesophageal hernias repair in a fourth level hospital in Bogotá, Colombia, Shaio Clinic: Case series and literature review

Reparación de hernias paraesofágicas gigantes asistida por robot en un hospital de cuarto nivel en Bogotá, Colombia, Clínica Shaio: serie de casos y revisión de la literatura

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Abstract

Background: Giant paraesophageal hernias have a surgical indication in case of symptoms. Since twenty years ago robot-assisted repair was incorporated to overcome the limitations of the laparoscopic surgery, and to offer new advantages. **Objective:** The objective of the study was to report the experience on repairing giant paraesophageal hernias assisted by robot in a fourth level hospital in Bogotá, Colombia, Shaio Clinic. **Methods:** Retrospective and descriptive study of five cases of giant paraesophageal hernia type III or IV, taken to robotic correction during August 2016 to June 2018 evaluation of post-surgery outcomes. **Results:** Five paraesophageal robot-assisted repairs were performed. Mean surgical time was 146 min, one conversion to open surgery, the average intraoperative bleeding was 100 mL, hospital stay time of 2.2 days. Morbidity, mortality, and recurrence percentages in the short time were equal to 0%. **Conclusions:** Robot-assisted repair of giant paraesophageal hernias has shown advantages that overcome the limitations of the laparoscopic approach such as dissections in difficult-to-reach angles, increased accuracy, ergonomics, three-dimensional, and closer view of the workspace. In addition, robot-assisted repair promotes better surgical and postoperative outcomes; these advantages have been demonstrated mainly in the repair of giant paraesophageal hernias.

Keywords: Laparoscopic surgery. Robotic surgery. Paraesophageal hernia. Giant paraesophageal hernia.

Resumen

Antecedentes: Las hernias paraesofágicas gigantes tienen indicación quirúrgica en caso de ser sintomáticas. Hace 20 años se incorporó la reparación asistida por robot debido a las ventajas que ofrece sobre las limitantes de la laparoscopia. **Objetivo:** Reportar la experiencia en reparación de hernias paraesofágicas gigantes asistida por robot en un hospital de cuarto nivel en Bogotá, Colombia, Fundación Clínica Shaio. **Método:** Estudio retrospectivo, descriptivo, de cinco casos de hernia paraesofágica gigante tipo III o IV, llevados a corrección robótica, de agosto de 2016 a junio de 2018, con evaluación de los desenlaces posoperatorios. **Resultados:** Cinco pacientes fueron sometidos a reparación asistida por robot, el tiempo quirúrgico fue de 146 minutos, se realizó una sola conversión a cirugía abierta, la media de sangrado fue de 100 ml, el tiem-

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po de estancia hospitalaria de 2.2 días, y los porcentajes de morbilidad, mortalidad y recurrencia a 1 año fueron del 0%. **Conclusión:** La reparación de este tipo de hernias asistida por robot ha mostrado ventajas sobre el abordaje laparoscópico, como realizar disecciones en ángulos de difícil acceso, precisión aumentada, ergonomía y vista tridimensional y más cercana del espacio de trabajo. Además, promueve mejores desenlaces quirúrgicos y posoperatorios, ventajas evidenciadas principalmente en la reparación de hernias paraesofágicas gigantes.

Palabras clave: Cirugía laparoscópica. Cirugía robótica. Hernia paraesofágica. Hernia paraesofágica gigante.

Introduction

Paraesophageal hernias account for 5-10% of all hiatal hernias¹⁻⁴. There is no established definition, but herniation of more than 30-50% of the stomach or those with a hernia ring of 5 cm or more are regarded as giant paraesophageal hernias¹. For this type of hernia, conservative treatment (observation) is an alternative in asymptomatic patients^{1,4}, while surgical repair is indicated for symptomatic patients, given that these cases are associated with life-threatening complications (torsion, perforation, hemorrhage, and gangrene)^{1,2,5}.

Laparoscopy is the most widely used approach^{2,3,5-8} due to its lower rate of complications related to the incision, surgical time, hospital stay, and recovery time^{1-3,8}. However, it has limitations, such as reduced dexterity and poor visual control, which must be taken into account when repairing this type of hernias⁹. Since the 1990s, robotic systems were introduced, which have demonstrated superiority over these limitations of laparoscopy⁹ by providing three-dimensional high-definition images^{2,5,7-11}, stable operating arms^{2,3,7-9}, and better ergonomic conditions^{3,5,8,9,12}, which minimizes intraoperative complications⁷.

Some studies with low statistical power indicate that the robotic approach is not superior to laparoscopic approach^{2,7,8,13}. However, it has been shown to be associated with a lower rate of recurrence^{2,4,5} and fewer complications^{2,3}. Said studies have been carried out with a small number of patients and with relatively short follow-up², which is why larger trials comparing both approaches are required to establish recommendations with regard to efficacy, results and cost-effectiveness^{2,3,7,8,10}. Herein, we describe our experience in the robotic management of giant paraesophageal hernias at a fourth-level hospital in Bogota, Colombia, and perform a critical review of the literature.

Methods

A retrospective and descriptive study was carried out, including all patients with type III or IV giant

paraesophageal hernia undergoing scheduled or emergency robotic correction from August 2016 to June 2018 at a fourth-level hospital in Bogota, Colombia, Shaio Clinic. Age, gender, bleeding, infections, complications, conversion to laparoscopy, conversion to open surgery, surgical time, intensive care unit stay, hospital stay, and mortality were evaluated.

The study protocol was approved by the institutional ethics committee. The protocol was implemented in accordance with the provisions of the Declaration of Helsinki and the Good Clinical Practice Guidelines, thus guaranteeing the same management procedures regardless of the institution and the patient.

Since this was a retrospective observational cohort study, data analysis was performed using the Statistical Package for the Social Sciences (SPSS) 1, version 22.0, with ranges, medians, minimum and maximum values and percentages being calculated.

Patients were positioned in the supine position with both arms tucked. The procedure was carried out using five ports. A 12-mm Optiview trocar with a 0° laparoscope was placed in supraumbilical position to gain access to the peritoneal cavity under direct visualization, and a pneumoperitoneum was created with carbon dioxide at a pressure of 12-15 mmHg. A 5-mm port was placed in the epigastrium, and through it, a liver retractor was inserted to retract the hepatic left lobe and expose the esophageal hiatus. A second 12-mm port (used as auxiliary port) was placed in the left subcostal area. Two other 8-mm ports were placed, one to the right of the navel and the other on the left midclavicular line, which served as robotic working ports. After this, the robot was docked over the patient's left shoulder. All instruments were inserted under direct vision to prevent inadvertent injury to abdominal viscera. Dissection was then started by the surgeon from the robotic console. The hernia content was reduced to expose the hiatus. The gastrohepatic ligament was removed, with aberrant hepatic vasculature being preserved, and the right crus being exposed. Sac dissection was started at the right crural

pillar and was separated from mediastinal tissue with atraumatic dissection, while circumferentially dividing it at the hiatal orifice. The short gastric vessels were dissected and sectioned to expose the left crural pillar and complete circumferential dissection of the sac, to completely reduce it toward the abdomen, with no portion or content of the sac being left in the intrathoracic cavity. Subsequently, a retroesophageal window was created and a Penrose drain was advanced, completely surrounding the esophagus to use it for atraumatic esophageal traction. Esophageal dissection was completed until the esophagus was completely mobilized and good intra-abdominal length was achieved, about 3 cm. Subsequent crural repair was carried out, with separate anti-tension stitches, using no. 2 synthetic suture of braided multifilament polyester (Ethibond®, Ethicon, Inc., Cincinnati, USA), with intracorporeal knotting, with the hiatus being calibrated with a 60-Fr bougie. A collagen-coated polyester mesh (Parietex™ Composite Hiatal, Medtronic Inc., Minneapolis, USA) of the onlay type was placed, reinforcing the previously-repaired defect, surrounding the intra-abdominal esophagus, which was fixed to the diaphragm with simple cardinal stitches using no. 2 braided multifilament polyester synthetic suture (Ethibond®, Ethicon, Inc., Cincinnati, USA), with intracorporeal knotting. In case esophageal length was insufficient, a Collis gastroplasty was added. Finally, a 360° Nissen floppy fundoplication was performed around the 60-Fr esophageal bougie, with three separate single stitches with no. 2 braided multifilament polyester synthetic suture (Ethibond®, Ethicon, Inc., Cincinnati, USA), with gastric fundus-esophagus-gastric fundus intracorporeal knotting. In all patients who had gastric volvulus, a gastrostomy tube was placed for gastropepy. Hemostasis was managed and monitored. On completion, the robot was undocked after removing the liver retractor. The ports were removed under direct vision, pneumoperitoneum was removed and the aponeurosis was closed with no. 0 polydioxanone suture (PDS®, Ethicon, Inc., Cincinnati, USA) separate single stitches at the 8 and 12 mm ports. The skin was closed with no. 3 polypropylene (Prolene®, Ethicon, Inc., Cincinnati, USA) intradermal stitches. At 24 h postoperatively, an upper GI tract examination with water-soluble contrast was performed, and oral route was started with a liquid diet. Hospital discharge was at second day and a new upper GI tract examination with water-soluble contrast was carried out one month later, with clinical follow-up on an outpatient basis.

Results

Between August 2016 and June 2018, five patients underwent robotic-assisted giant paraesophageal hernia (type IV) repair. Patient mean age was 57 years and 60% were women. All patients had symptoms secondary to this pathology. In four of them, surgery was carried out electively, and in one it was performed as an emergency procedure. Mean surgical time was 146 min, including the robot docking time (Table 1). One conversion to open surgery took place due to anatomical difficulties; there was no conversion to laparoscopic surgery. Average bleeding was 100 mL. There were no immediate postoperative complications or over 30 days of follow-up. Morbidity, mortality and recurrence rates at 1 year were 0%, and mean hospital stay was 2.2 days.

Discussion

Hiatal hernias are relatively common surgically-resolved conditions and are classified into four groups, depending on gastroesophageal junction location, content, and presence of an hernia sac, as shown in table 2^{2,5,8,11}. Giant hiatal hernias are mixed hernias (paraesophageal and sliding) in which more than 30-50% of the stomach is located within the intrathoracic cavity¹.

Giant paraesophageal hernias can be primary or secondary to a surgical procedure, such as anti-reflux surgery, hiatal hernia correction, or esophagectomy. Laparoscopy is one of the identified risk factors for its occurrence¹. They are favored by negative thoracic pressure and abdominal positive pressure¹.

Clinical presentation can range from an asymptomatic condition to an acute or chronic presentation¹. From 0.7 to 7% of patients experience symptoms of acute presentation (chest pain, vomiting, and dyspnea), which are due to complications such as gastric volvulus, hemorrhage, strangulation, or perforation¹. Symptoms of chronic presentation are related to gastric or esophageal obstruction, or to the presence of gastroesophageal reflux¹. These symptoms include dysphagia, dyspnea, nausea, vomiting, and anemia¹. All the presented patients were symptomatic, which is why they underwent surgical repair.

Upper GI tract investigations provide information on the size and type of hernia, esophagogastric junction location, the presence of esophageal obstruction, and esophageal length¹. These diagnostic procedures include endoscopy and esophageal manometry (completely

Table 1. Surgical intervention results

Surgical time	146 min
Hospital stay	2.2 days
Conversion rate, n (%)	1 (20)
Complications, n (%)	0 (0)
Recurrence, n (%)	0 (0)
Mortality, n (%)	0 (0)

Table 2. Hiatal hernias classification¹³

Type 1	Sliding hiatal hernia (95% of cases). The gastroesophageal junction slides up into the thorax
Type 2	Paraesophageal hernia. The gastric fundus rises into the thorax and the cardia remains in normal position
Type 3	Mixed hernia. The cardia and gastric fundus slide up into the thorax
Type 4	Giant paraesophageal hernia. Hiatal hernia that contains the stomach or other abdominal structure.

performed in < 50% of patients)¹. In acute cases, computed tomography and chest X-ray can rule out perforation, pneumomediastinum and pneumoperitoneum, and the hernia type and location and gastric wall perfusion can be observed¹.

Initial management of stable patients includes gastric decompression, which is carried out with a nasogastric tube under endoscopic guidance, to assess for esophagogastric junction patency and absence of ischemia¹. In case of instability or signs of ischemia or gastric perforation, surgery cannot be delayed and laparoscopic approach should be tried as first option¹, in which hernia reduction, hernia sac resection, esophageal mobilization, esophagogastric junction repositioning, crural repair, and anti-reflux procedure should be performed⁶. In our patients, the procedure that was carried out started with hiatus exposure and continued with hernia reduction, diaphragmatic crural pillars dissection, esophageal hiatus closure, and crural pillars repair reinforcement with mesh (Fig. 1).

Robotic surgery is increasingly being used in general surgery, which is substantiated by publications that report about the safety and feasibility of this type of approach in procedures such as cholecystectomy, gastrectomy, colorectal surgery and pancreatic surgery³. Reports in the literature on robotic paraesophageal hernias repair date back approximately 20 years¹.

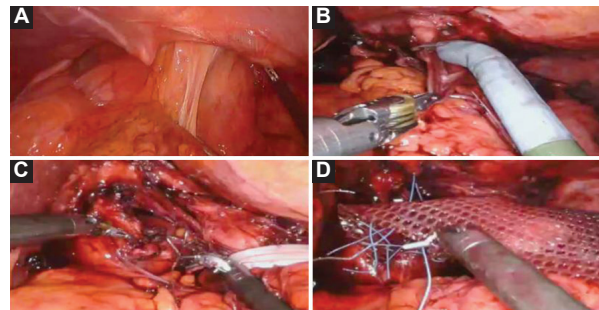


Figure 1. Robotic-assisted paraesophageal hernia repair. A: esophageal hiatus exposure. **B:** diaphragmatic crural pillars dissection. **C:** esophageal hiatus closure. **D:** crural pillars repair reinforcement with mesh.

Some studies¹ have made comparisons between the open and laparoscopic approach routes, and have shown that laparoscopic repair is related to a shorter hospital stay (3.7-4.2 vs. 8.3-8.5 days), a significant decrease in the rate of intraoperative injuries and hospital mortality (0.6 vs. 3.0%), lower requirement of admission to the intensive care unit (13 vs. 35%), lower percentage of complications (2.7 vs. 8.4%), fewer readmissions within the first 30 days (1.4 vs. 3.4%), and cost reduction (\$15,227 vs. \$24,263); with a p-value < 0.01.

Regarding robotic-assisted repair, Ruurda et al.⁹ point out that hernia sac dissection and crural repair are easier according to their 4-year experience in robotic-assisted repair. These authors indicate that, on average, surgical time was 130 min (range: 82-210) and hospital stay was 5 days (range: 2-39). They reported three cases of conversion, a rate of complications of 0-28% and a reoperation rate of 12.5%. In addition, they had three cases of reoperation at early post-operative period, due to open abscess drainage, esophageal perforation repair and failed cruroplasty with new stomach herniation, respectively. When compared with our experience, we reported a similar surgical time, shorter hospital stay and lower conversion and recurrence rates.

Gehrig et al.⁸ compared open, laparoscopic, and robotic-assisted repairs. They found no significant difference with regard to surgical time. The rate of intraoperative and postoperative complications was lower with the robotic approach (16.7%) and with laparoscopic approach (17.6%) in comparison with the open approach (58.3%)⁸. In this study, hospital stay was significantly shorter for minimally-invasive procedures.

Using robotic-assisted correction, a surgical time of 125-212 minutes (range: 80-258), bleeding of 25-50 mL

(range: 0-700), hospital stay of 1.4-4.5 days (range: 1-39), 5% of intraoperative complications (liver laceration and esophageal perforation), 12.5% of postoperative complications (related to the learning curve), and 7.5% of reoperations within 30 days (strangulated hernia, esophageal perforation, and hiatal hernia recurrence due to hiatoplasty dehiscence) have been observed. Symptoms of dysphagia were recorded in 15.6% of patients after the operation, and 91% were satisfied with the surgery results at one year^{4,10,12}. In our cases, surgical time is observed to be within range, as well as hospital stay, but the complication rate is lower.

Tolboom et al.¹¹ carried out an observational study in which they compared laparoscopic with robotic-assisted redo hiatal hernia repair. In the robotic-assisted group, there was lower conversion to laparotomy (1/45 vs. 5/30; $p = 0.035$) and shorter hospital stay (3 [2-6] vs. 4 [3-7] days; $p = 0.042$). There was no significant difference with regard to hospital stay or postoperative symptoms between both groups. These authors indicate that redo surgery is more demanding, due to the presence of adhesions or anatomical or plane changes, which is why they benefit from the robotic-assisted approach.

Conclusions

So far, the recommended route of approach for paraesophageal hernias repair is laparoscopy, but robotic-assisted repair has been shown to offer advantages that promote better surgical and post-operative outcomes in cases of giant hernias, with upside-down stomach, recurrence or even in emergency situations (incarceration or strangulation), thanks to the possibility to perform dissections at difficult-to-access angles, its increased accuracy, better ergonomics, and a three-dimensional and closer view of the workspace. However, comparative studies with large samples and long-term follow-up are required to confirm these findings.

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Conflicts of interest

The authors declare that they have no conflicts of interest to disclose.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this research.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained informed consent from the patients and/or subjects referred to in the article. This document is in the possession of the corresponding author.

References

1. Dallemagne B, Quero G, Lapergola A, Guerriero L, Fiorillo C, Perretta S. Treatment of giant paraesophageal hernia: pro laparoscopic approach. *Hernia*. 2018;22:909-19.
2. Seetharamaiah R, Romero RJ, Kosanovic R, Gallas M, Verdeja JC, Rabaza J, et al. Robotic repair of giant paraesophageal hernias. *JSLs*. 2013;17:570-7.
3. Vasudevan V, Reusche R, Nelson E, Kaza S. Robotic paraesophageal hernia repair: a single-center experience and systematic review. *J Robotic Surgery*. 2018;12:81-6.
4. Draaisma WA, Gooszen HG, Consten EC, Broeders IA. Mid-term results of robot-assisted laparoscopic repair of large hiatal hernia: a symptomatic and radiological prospective cohort study. *Surg Technol Int*. 2008;17:165-70.
5. Morelli L, Guadagni S, Mariniello MD, Pisano R, D'Isidoro C, Belluomini MA, et al. Robotic giant hiatal hernia repair: 3 year prospective evaluation and review of the literature. *Int J Med Robot*. 2015;11:1-7.
6. Brenkman HJ, Parry K, van Hillegersberg R, Ruurda JP. Robot-assisted laparoscopic hiatal hernia repair: promising anatomical and functional results. *J Laparoendosc Adv Surg Tech A*. 2016;26:465-9.
7. Galvani CA, Loelb H, Osuchukwu O, Samamé J, Apel ME, Ghaderi I. Robotic-assisted paraesophageal hernia repair: initial experience at a single institution. *J Laparoendosc Adv Surg Tech A*. 2016;26:290-5.
8. Gehrig T, Mehrabi A, Fischer L, Kennigott H, Hinz U, Gutt CN, et al. Robotic-assisted paraesophageal hernia repair — a case-control study. *Langenbecks Arch Surg*. 2013;398:691-6.
9. Ruurda JP, van Vroonhoven TJ, Broeders IA. Robot-assisted surgical systems: a new era in laparoscopic surgery. *Ann R Coll Surg Engl*. 2002;84:223-6.
10. Dunnican WJ, Singh TP, Guptill GG, Doorly MG, Ata A. Early robotic experience with paraesophageal hernia repair and Nissen fundoplication: short-term outcomes. *J Robotic Surg*. 2008;2:41-4.
11. Tolboom RC, Draaisma WA, Broeders IA. Evaluation of conventional laparoscopic versus robot-assisted laparoscopic redo hiatal hernia and antireflux surgery: a cohort study. *J Robot Surg*. 2016;10:33-9.
12. Sarkaria IS, Latif MJ, Bianco VJ, Bains MS, Rusch VW, Jones DR, et al. Early operative outcomes and learning curve of robotic assisted giant paraesophageal hernia repair. *Int J Med Robot*. 2017;13:10.1002/rcs.1730.
13. Villareal R, Bernal F, Cabrera LF, Sánchez Ussa S, Pedraza M. Hernia hiatal mixta con vólvulo gástrico intratorácico: reporte de caso y revisión de la literatura. *Rev Hispanoam Hernia*. 2018;6:186-90.