



Robotic Repair of Giant Hiatal Hernia Using Phaxis Mesh: A Case Report and Technical Description

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Abstract: Background: Giant hiatal hernia is a complex surgical condition associated with distorted anatomy, significant symptoms, and high recurrence rates. Robotic-assisted surgery has emerged as an alternative to conventional laparoscopy, particularly in complex cases. Case Presentation: We report the case of an 79-year-old woman with long-standing gastrointestinal and respiratory symptoms secondary to a giant hiatal hernia, with intrathoracic migration of approximately 25% of the stomach and a hiatal defect of approximately 10.5 cm. The patient underwent elective robotic-assisted repair using the Da Vinci X system, including complete hernia reduction, anterior and posterior hiatoplasty with barbed and polyester sutures, reinforcement with a Phasix™ P4HB biosynthetic mesh in an inverted-C configuration, intraoperative endoscopy, and a floppy 360° Nissen fundoplication. Results: The procedure was completed without intraoperative complications. Postoperative recovery was uneventful, with resolution of reflux symptoms and significant improvement in dyspnea. At 6-month follow-up, no mesh-related complications or anatomical recurrence were observed. Conclusion: Robotic-assisted giant hiatal hernia repair with biosynthetic P4HB mesh reinforcement was safe and feasible in this elderly patient, providing excellent short- to mid-term outcomes. This represents one of the first reported cases in Colombia using P4HB mesh in robotic hiatal repair. Further studies are needed to define its long-term benefits.

Keywords: Giant hiatal hernia, Robotic surgery, Absorbable biosynthetic mesh, Nissen fundoplication, Case report.

INTRODUCTION

Giant hiatal hernia is defined as a condition in which at least one third of the stomach migrates into the thoracic cavity through the esophageal hiatus, and in more advanced cases may also involve other abdominal viscera (1). This condition represents a surgical challenge due to anatomic distortion, the risk of complications such as gastric volvulus, strangulation, and obstruction, as well as the high recurrence rate following repair (2).

The minimally invasive approach, particularly the laparoscopic technique, has demonstrated benefits including reduced postoperative pain, shorter hospital stay, and faster recovery compared with open surgery (3). However, large or complex hiatal defects may hinder adequate approximation of the diaphragmatic crura and secure mesh fixation,

which has led to the adoption of robot-assisted surgery. The robotic platform offers technical advantages such as high-definition three-dimensional visualization, greater instrument range of motion, and enhanced suturing precision, which may optimize cruroplasty tension and mesh placement (4).

The use of biologic or synthetic meshes to reinforce hiatal repair remains a matter of debate; some studies report lower rates of anatomic recurrence, whereas others warn of potential complications such as erosion, migration, or stenosis (5).

This case represents a documented experience at our center using robotic surgery for the repair of a giant hiatal hernia reinforced with mesh, constituting a relevant contribution to the national literature. To date, only one previous report has been published in Colombia, corresponding to a case series of robot-assisted repair of giant paraesophageal hernias performed at the Clínica Shaio in Bogotá, which demonstrated the feasibility and early outcomes of this approach in our setting (6). Therefore, the present report represents the second published case in the country, providing additional evidence regarding the applicability of this surgical strategy in our context. Despite increasing adoption of robotic platforms, evidence regarding the safety and outcomes of biosynthetic mesh reinforcement, particularly P4HB with hydrogel barrier, remains limited, especially in elderly patients with multiple comorbidities (7).

MATERIALS AND METHODS

This case report aims to provide a detailed technical and clinical evaluation of robotic-assisted repair of giant hiatal hernia using biosynthetic mesh reinforcement, describing the surgical technique, postoperative course, and follow-up outcomes.

The patient, a 79-year-old woman, was evaluated by the General Surgery Department and scheduled for elective robotic repair of a giant hiatal hernia. The case was deemed elective given the absence of acute complications at presentation, despite the magnitude of the hernia and the associated cardiopulmonary comorbidities, which required thorough preoperative optimization and interdisciplinary planning.

Clinical follow-up was conducted for 6 months postoperatively, with outpatient visits at 2, 6, and 12 weeks, and at 6 months, assessing gastrointestinal symptoms, physical examination findings, and chest radiography to rule out anatomic recurrence. Written informed consent was obtained from the patient, who authorized the anonymous use of clinical information and images for academic and publication purposes.

CASE PRESENTATION

A 79-year-old female patient with a history of well-controlled arterial hypertension, hypothyroidism, Sjögren's syndrome, rheumatoid arthritis, osteoporosis, osteoarthritis, diverticulosis, insomnia, and allergic rhinitis presented with a long-standing clinical picture characterized by severe epigastric pain, postprandial regurgitation, abdominal fullness, progressive partial dysphagia to solids and liquids, chronic cough, and progressive dyspnea. Her surgical history included resection of a right retroauricular lesion, resection of carcinoma of the right nasal ala, left knee replacement in 2023, and ophthalmologic surgery with intraocular lens implantation.

The patient had experienced digestive symptoms for more than 10 years, with a negative impact on her quality of life. Imaging studies reported a giant hiatal hernia with intrathoracic displacement of a large portion of the stomach: the fundus located toward the left hemithorax, the body in the midline, and only the proximal antrum along with the first portion of the duodenum remaining within the abdominal cavity; resulting in passive atelectasis of the left lower lobe. The esophagus appeared tortuous but demonstrated adequate bolus progression and no evidence of gastroesophageal reflux. Chest computed tomography revealed a large sliding hiatal hernia with intrathoracic displacement of two thirds of the stomach, producing a mass effect and passive atelectasis of the left lower lobe, in addition to residual-appearing calcified granulomas in the lower pulmonary lobes. Upper gastrointestinal endoscopy reported monilial esophagitis without additional endoluminal lesions, confirming the inflammatory impact of the condition. **Figure 1.**

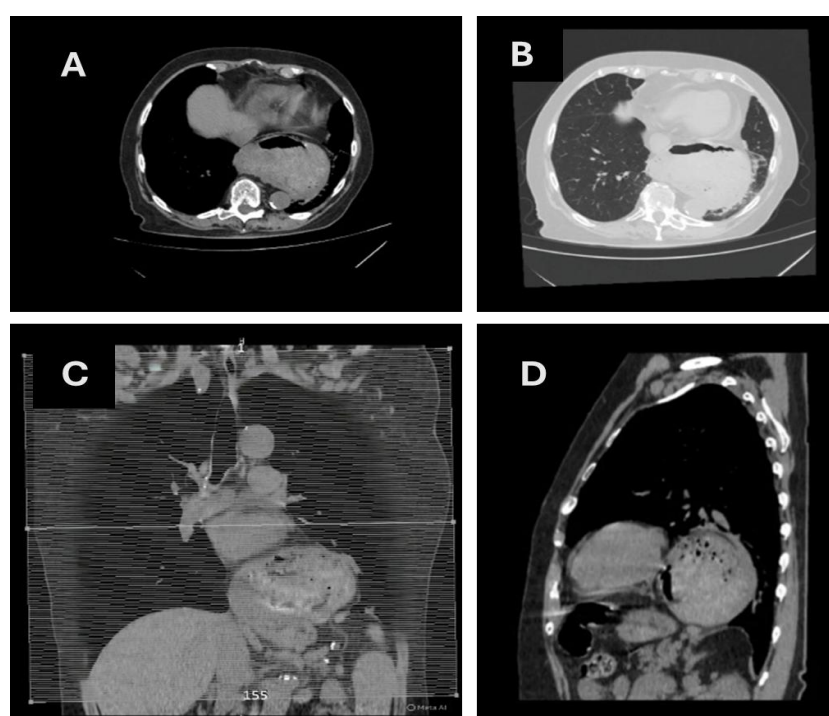


Figure 1: Computed tomography of the chest and abdomen, multiple sections, in a patient with giant hiatal hernia and intrathoracic stomach.

(A), (B), axial sections arranged in a cephalocaudal sequence: the fundus and antrum are located within the thoracic cavity, with passive atelectasis of the left lower lobe, in addition to residual-appearing calcified granulomas in the lower pulmonary lobes. (C) Coronal view identifying a sliding hiatal hernia with intrathoracic displacement of two thirds of the stomach. (D) Lateral view demonstrating a mass effect.

On functional respiratory assessment, spirometry revealed a mild restrictive ventilatory defect with a positive bronchodilator response, consistent with acute bronchitis and suggestive of a reversible inflammatory component responsive to bronchodilator therapy.

On physical examination, hypoventilation of the left hemithorax was noted; the abdomen was soft and depressible, without tenderness. Laboratory studies showed renal

function and complete blood count within normal limits. On cardiologic evaluation, transthoracic echocardiography demonstrated left ventricular dilatation with an ejection fraction of 56%, severe mitral regurgitation of mixed mechanism, mild aortic regurgitation, and mild tricuspid regurgitation. Electrocardiography revealed sinus bradycardia, first-degree atrioventricular block, and complete right bundle branch block.

Urgent surgical correction was indicated due to the high risk of complications associated with the giant hiatal hernia and the patient's comorbidities. Following interdisciplinary evaluation by the Thoracic Surgery, General Surgery, and Anesthesiology teams, a minimally invasive repair assisted by the Da Vinci X robotic system was planned, with placement of a 7 × 10 cm Phasix mesh and antireflux fundoplication.

SURGICAL PROCEDURE

Under balanced general anesthesia and in the supine position, with slight reverse Trendelenburg inclination (20°) and legs abducted, an orogastric tube was placed for gastric decompression. A strict aseptic-antiseptic protocol was followed, and pneumoperitoneum was established using an open (Hasson) technique through a supraumbilical incision. Trocar placement followed the standardized configuration for robotic hiatal surgery: a supraumbilical 8-mm optical trocar was inserted under direct visualization in the midline epigastrium. Two lateral 8-mm robotic ports were placed on the left and right sides of the patient, 8 cm from the midline, under direct vision. A 5-mm port was inserted for a hepatic retractor. A 12-mm assistant port was placed on the left lateral side under direct visualization.

The Da Vinci X system (4th generation) was docked with three robotic arms: arm 1 held a fenestrated bipolar forceps, arm 2 the camera, and arm 3 a vessel-sealing energy device. This instrument configuration provided high-definition three-dimensional visualization and precise hemostatic dissection throughout the procedure. Upon entry, a giant hiatal hernia was confirmed, with an estimated hiatal defect of approximately 10.5 cm in its major diameter. Approximately 25% of the stomach had migrated into the mediastinum, and a large hernia sac was found adhered to both pleural surfaces and the anterior wall of the aorta, with elongation of the left gastric vessels and short gastric vessels. Intraoperative upper gastrointestinal endoscopy was performed, confirming the presence of the giant hiatal hernia with Forest-class gastric ulcers in the fundus, antral erythematous gastritis, and an active prepyloric ulcer without active bleeding. The endoscope tip was left positioned in the antrum throughout the procedure to serve as an intraoperative esophageal calibrator. Complete reduction of the herniated stomach was performed. Mobilization of the gastric fundus was carried out with section of the short gastric vessels using the energy sealer. The left diaphragmatic crus base was dissected, followed by dorsoventral dissection and mobilization of the hernia sac, proceeding to the anterior face of the hiatus and transecting the elongated phrenoesophageal membrane. Complete dissection of the right diaphragmatic crus with identification of the crura and complete resection of the hernia sac (sent for pathology) were performed. Thoracic esophageal dissection yielded 6 cm of intra-abdominal esophagus. Retroesophageal dissection was completed, and an umbilical tape was passed behind the gastroesophageal junction to facilitate esophageal retraction and exposure.

Esophageal mobilization was extended until a tension-free intra-abdominal esophageal length of 6 cm was obtained, a key criterion to minimize recurrence. The esophageal hiatus was adequately exposed. Both anterior and posterior hiatoplasty were performed using a running barbed 2-0 suture combined with interrupted 2-0 polyester sutures, approximating the diaphragmatic crura to achieve a firm, anatomic, and tension-free closure.

Given the magnitude of the hiatal defect (approximately 10.5 cm), reinforcement with an absorbable biosynthetic P4HB mesh with hydrogel barrier (Phasix™, 7×10 cm) was performed. The mesh was pre-cut intraoperatively according to a template tailored to the esophageal diameter and the dimensions of the hiatal defect, resulting in an inverted-C configuration with the opening positioned to the right, allowing the esophagus to pass through without circumferential encasement. The mesh was (**Figure 2**), fixed to the right diaphragmatic crus and to the diaphragm with interrupted polyester sutures, avoiding direct contact with the esophagus.

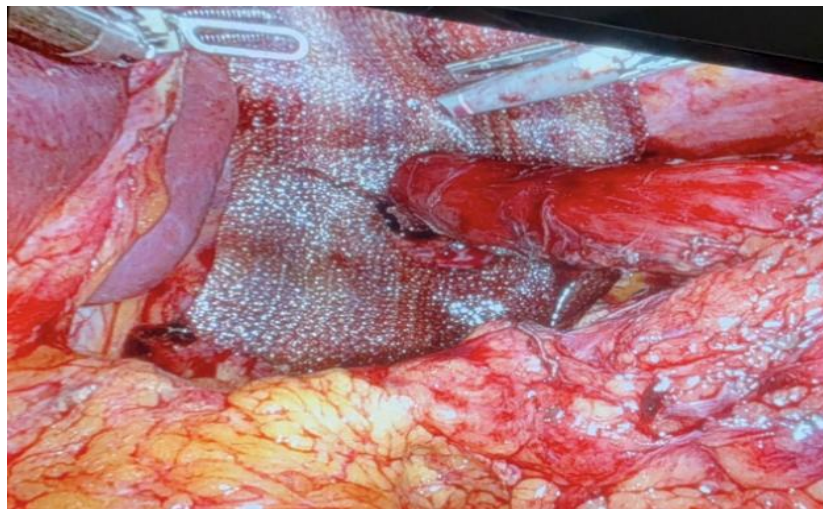


Figure 2: Mesh fixation using interrupted simple polyester sutures anchored to the diaphragm and the hiatal margins.



Figure 3: Absorbable synthetic mesh composed of polyhydroxybutyrate and polyglycolic acid (7 × 10 cm), coated on its abdominal surface with a hydrogel barrier.

The inverted-C configuration was chosen specifically to provide mechanical reinforcement of the crural closure while minimising the risk of postoperative dysphagia and esophageal erosion associated with circumferential mesh placement. This strategy combined principles of anatomic repair with selective prosthetic reinforcement, seeking a balance between structural durability and tissue safety. **(Figure 3).**

As the final reconstructive step, a floppy 360° Nissen fundoplication was fashioned using three interrupted 2-0 polyester sutures anchored to the anterior wall of the esophagus. **(Figure 4).** The decision to perform a floppy 360° Nissen fundoplication rather than a partial Toupet fundoplication was based on intraoperative esophageal calibration using the endoscope as a sizing guide, which confirmed an adequate luminal diameter and satisfactory esophageal compliance, supporting a complete wrap without increased risk of functional obstruction. Upon completion of the repair, intraoperative endoscopy was repeated and confirmed: an optimal-appearing 360° fundoplication, no esophageal or gastric intraoperative lesions, correction of the hiatal hernia, and a mildly reduced but patent gastroesophageal junction lumen without resistance. Gastric and esophageal air was evacuated and the endoscope was withdrawn. An autonomic block with 0.5% bupivacaine and dexamethasone 8 mg was applied. Hemostasis was confirmed and all instruments were removed under laparoscopic visualization. The 12-mm port fascia was closed with 2-0 polyglactin suture and skin was approximated with 3-0 poliglecaprone 25.

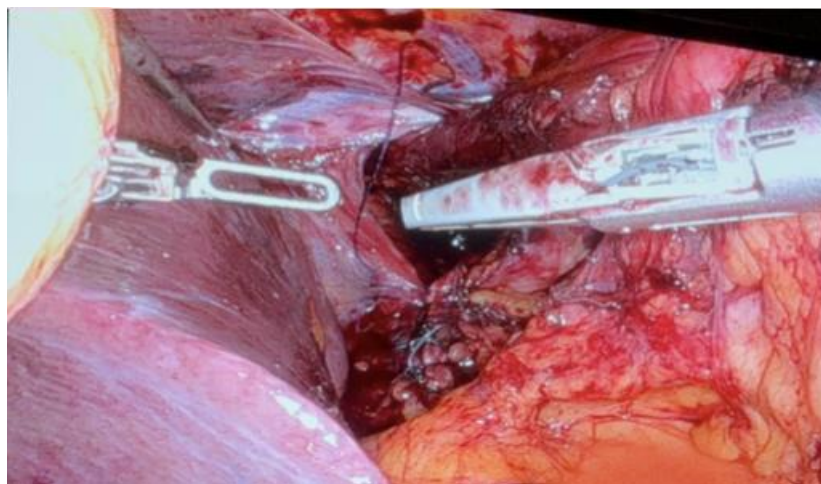


Figure 4: 360° Nissen fundoplication with fixation of 2-0 polyester sutures to the anterior wall of the esophagus.

The trocars were removed under direct visualization, the port sites were closed according to anatomic planes, and sterile dressings were applied. The patient was transferred to the recovery unit in a hemodynamically stable condition, without adverse intraoperative events. Total operative time was 150 minutes, console time 116 minutes, docking time 6 minutes, anesthesia 28 minutes.

RESULTS

The patient underwent elective robotic-assisted repair of a giant hiatal hernia using the Da Vinci X system (4th generation), with complete reduction of the intrathoracic stomach,

thoracic esophageal dissection with 6 cm of intra-abdominal esophagus obtained, anterior and posterior hiatoplasty, reinforcement with an absorbable biosynthetic P4HB (Phasix™) mesh with hydrogel barrier in an inverted-C configuration, and floppy Nissen fundoplication. Intraoperative endoscopy confirmed the findings and validated the repair.

Operative Outcomes: The procedure was completed without intraoperative complications, with adequate hemostasis and preservation of critical structures. Total operative time was 150 minutes (console time 116 minutes, docking time 6 minutes, anesthesia induction 28 minutes). Estimated blood loss was minimal and did not require transfusion. No conversion to laparoscopic or open surgery was required.

Postoperative Course: The immediate postoperative course was uneventful, without the need for prolonged critical care. The patient initiated a progressive liquid-to-soft diet without difficulty and was discharged on postoperative day 2 in stable clinical condition. No 30-day complications were recorded.

Follow-up: At clinical follow-up at 2, 6, and 12 weeks, and at 6 months, the patient reported complete resolution of heartburn, regurgitation, and abdominal fullness, as well as significant improvement in previously limiting dyspnea. No persistent dysphagia or mesh-related complications were documented. Chest radiography at 6 months showed no evidence of anatomic recurrence. Functional outcomes were assessed clinically at each visit; a standardized GERD-specific quality-of-life questionnaire (GERD-HRQL) was not formally applied at this institution during the reported follow-up period, which is acknowledged as a limitation of this report.

DISCUSSION

Giant hiatal hernia represents one of the most complex entities in upper gastrointestinal surgery due to marked anatomic distortion, intrathoracic migration of abdominal viscera, and the high postoperative recurrence rates reported in the literature. These patients frequently present with long-standing digestive and respiratory symptoms, significantly impacting quality of life and carrying the risk of potentially severe complications such as gastric volvulus, strangulation, hemorrhage, or chronic respiratory compromise. Despite advances in minimally invasive surgery, controversies persist regarding the optimal surgical approach and the strategy for reinforcement of large hiatal defects.

In this context, robotic-assisted surgery has emerged as a technically valid alternative to conventional laparoscopy, particularly in giant or complex hiatal hernias. The advantages of the robotic platform include high-definition three-dimensional visualization, enhanced instrument articulation, tremor filtration, and improved suturing precision, which are particularly useful during mediastinal dissection, esophageal mobilization, and posterior cruroplasty. These features enable a more controlled and potentially less tensioned anatomic reconstruction, key factors in the prevention of early recurrence (8).

These findings are consistent with recent literature. Armijo et al. reported that robotic repair of paraesophageal hernias is associated with low long-term anatomic recurrence rates (approximately 9% at 5 years), as well as sustained improvement in patient quality of life, supporting the durability of the robotic approach in experienced centers. Similarly, Schizas et al., in a series of 113 patients with giant hiatal hernia, demonstrated that the robotic technique is feasible and safe, with early mortality below 2% and a mean

hospital stay of 5.8 days, outcomes comparable or superior to those described with conventional laparoscopic surgery (9).

Although comparative studies between robotic and laparoscopic approaches do not always demonstrate statistically significant differences in major complications or anatomic recurrence, recent meta-analyses suggest that robotic surgery may offer additional benefits, particularly in complex scenarios. Mauvais et al. demonstrated a reduction in hospital stay and a trend toward lower postoperative morbidity in the robotic group. Likewise, a large multicenter analysis including more than 8,000 patients showed lower symptomatic recurrence and reduced intensive care unit admissions among those undergoing robotic repair, reinforcing the potential added value of this platform in the management of complex hiatal hernias (10).

Although laparoscopic repair remains the standard approach for giant hiatal hernia, robotic surgery may provide a technical advantage in large hiatal defects, particularly in facilitating precise crural closure under reduced tension. The enhanced visualization and instrument articulation of the robotic platform appear especially beneficial in the confined mediastinal operative field required for these complex repairs.

The use of mesh reinforcement for cruroplasty in large hiatal defects remains controversial. The choice of mesh material continues to be debated: permanent synthetic meshes have been associated with risks of erosion and esophageal stenosis, while biologic meshes may lack long-term structural durability. Biosynthetic P4HB mesh may represent a reasonable compromise, offering temporary mechanical reinforcement while allowing gradual tissue integration over time. In the present case, the use of a U-shaped absorbable biosynthetic P4HB mesh with hydrogel barrier, carefully fixed without direct contact with the esophagus, allowed reinforcement of the hiatal closure without associated complications during six months of follow-up (11). Recent studies have indicated that when biologic or biosynthetic materials are used with meticulous fixation techniques, the risk of erosion, migration, or esophageal stenosis is significantly reduced, while maintaining the benefit of decreasing crural tension and potentially reducing mid- and long-term anatomic recurrence (12).

Regarding the decision to perform a floppy 360° Nissen fundoplication in this patient, preoperative high-resolution esophageal manometry was performed using the Chicago Classification 4.0 protocol (GutMedica, Bogotá). The study demonstrated: normal relaxation of the esophagogastric junction (IRP 10.6 mmHg supine; IRP 3.1 mmHg upright), 100% failed peristalsis, inadequate peristaltic reserve on multiple rapid swallows (MRS), and a conclusive diagnosis of absent contractility per Chicago 4.0 criteria. Despite this significant motility disorder and acknowledging that absent contractility is generally considered a relative contraindication to a complete 360° wrap the decision to proceed with a floppy Nissen was based on the following individualized considerations: (1) normal EGJ relaxation with no evidence of outflow obstruction; (2) absence of clinical symptoms attributable to dysmotility no progressive solid dysphagia, no nutritional compromise; (3) adequate intraoperative esophageal calibration confirmed by the endoscope; and (4) use of a floppy wrap technique with only three sutures and minimal tension, specifically to reduce functional obstruction risk in the context of impaired peristalsis. A partial Toupet fundoplication would have been an equally valid alternative, and this decision was individualized based on the full clinical and intraoperative context. Close postoperative

surveillance for dysphagia was maintained throughout follow-up, with no dysphagia reported at any visit through 6 months.

Nevertheless, it is essential to recognize that despite meticulous surgical technique, strict adherence to hiatal reconstruction principles, and the use of advanced technology, surgical failure after giant hiatal hernia repair remains a recognized and multifactorial phenomenon. As widely described in the literature on antireflux and hiatal surgery, anatomic recurrence and suboptimal outcomes are not exclusively dependent on technical factors, but also on patient-related characteristics such as advanced age, poor tissue quality, esophageal motility disorders, chronic elevation of intra-abdominal pressure, and comorbidities that negatively affect wound healing and hiatal integrity. Yadlapati et al. emphasize that even in high-volume centers with standardized techniques, significant rates of recurrence and functional failure persist, reinforcing the concept that giant hiatal hernia repair represents a dynamic interaction between surgical reconstruction and host biology, rather than an outcome solely dependent on the surgical approach or technology employed (13). This report is additionally limited by its single-case design, short follow-up duration of six months, and the lack of standardized functional outcome measures such as the GERD-HRQL questionnaire or pH monitoring, all of which restrict the generalisability of the findings. Long-term surveillance beyond 12 months is required to definitively assess the durability and surgical success of this technique, particularly given the documented absent esophageal contractility on preoperative manometry.

This report represents a documented experience at our center with robotic surgery for giant hiatal hernia repair. Despite the inherent limitations of a single case and an intermediate follow-up of six months, the results reinforce the feasibility and safety of the procedure in an elderly patient with multiple comorbidities, representing a relevant contribution to the national literature. Future studies with larger patient cohorts and longer follow-up will be necessary to more precisely define the impact of the robotic approach and prosthetic reinforcement on repair durability, as well as to identify patient subgroups who may benefit most from this surgical strategy.

CONCLUSIONS

Robotic-assisted repair of giant hiatal hernia using biosynthetic P4HB mesh appears to be a safe and technically advantageous approach in selected patients. In this case, the Da Vinci X system enabled precise mediastinal dissection, adequate esophageal mobilization, and tension-free posterior cruroplasty with mesh reinforcement, yielding excellent clinical outcomes and no anatomic recurrence at six months of follow-up.

The robotic platform provides relevant technical advantages (three-dimensional visualization, enhanced instrument articulation, and suturing precision) that are particularly valuable in complex hiatal defects. Biosynthetic P4HB mesh reinforcement, applied without direct esophageal contact, demonstrated a favorable safety profile. Larger prospective studies with long-term follow-up and standardized functional outcome measures are required to validate the role of this approach compared to conventional laparoscopic techniques.

DECLARATIONS

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Conflicts of interest / Competing interests

The authors declare that they have no conflicts of interest.

Ethics approval

Ethical approval was waived for this case report according to institutional policies, as no experimental interventions were performed and patient anonymity was preserved.

Consent to participate

The clinical case has written informed consent from the patient, who expressly authorized publication of the clinical information and corresponding images, with full respect for privacy and confidentiality.

Written consent for publication

Written informed consent was obtained from the patient for publication of this case report and accompanying images.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Code availability

Not applicable.

Authors' contributions

Study conception and design: E.G.N., M.L.L.R.

Data acquisition: C.V.J.G., A.H., J.A.R.P.

Manuscript drafting: E.G.N., M.L.L.R.

Critical revision and final approval: C.V.J.G., J.A.R.P., A.H.

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