Hernia (2021) 25:809–815
https://doi.org/10.1007/s10029-020-02328-x

HOW-I-DO-IT

Robotic Sugarbaker parastomal hernia repair: technique and outcomes

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Received: 18 August 2020 / Accepted: 26 October 2020 / Published online: 13 November 2020

Abstract

Purpose To present a novel technique for the repair of parastomal hernias.

Methods A total of 15 patients underwent parastomal hernia repair. A robotic Sugarbaker technique was utilized for repair. The fascial defect was closed prior to robotic intraperitoneal placement of the mesh. Baseline demographics of the patients were obtained, and intra-operative and post-operative outcomes were tracked.

Results The etiology of the ostomies was oncologic in all but three patients. Five of the stomas were urostomies (33.3%). Patient characteristics were as follows: age 64.9.1 $\pm$ 9.3 years, BMI 30.1 $\pm$ 4.7 kg/m^2, smoking history 60.0%, and diabetes 6.7%. The mean size of the hernia defect was 46.0 $\pm$ 40.1 cm^2 with a mesh size of 372.0 $\pm$ 101.2 cm^2. The mean operative time was 182.0 $\pm$ 51.9 min. In seven patients, an inferolateral preperitoneal flap was created for mesh placement. Intraoperatively, only one enterotomy was made during dissection, which was repaired without complication. The mean length of stay was 4.2 $\pm$ 1.9 days. There was only one hernia recurrence (6.7%). There were no wound complications, surgical site infections, or mesh infections. A mean follow-up time of 14.2 $\pm$ 9.4 months was achieved.

Conclusions Robotic Sugarbaker parastomal hernia repair is a safe and effective technique. The results demonstrate the feasibility of fascial closure with this technique and a low recurrence rate. The authors propose this technique should be widely considered for parastomal hernia repair.

Keywords Robotic · Hernia · Parastomal · Sugarbaker

Introduction

In the United States, approximately 135,000 stomas are created annually [1]. An estimated 30–50% of stomas that are created will go on to develop a parastomal hernia [1, 2]. Risk factors for the development of parastomal hernias include obesity, age, malignancy, inflammatory bowel disease, wound infection, steroid use, diabetes, loop ostomy and emergent surgery [3]. Parastomal hernias may significantly affect the patients' quality of life, lead to physical discomfort, interfere with daily activity, and potentially cause bowel obstructions [4]. Although they are ventral hernias, parastomal hernias have many indications for repair beyond chronic pain and obstruction, many of which center around patient quality of life. Patients may present with bothersome leakage from stoma site, peristomal skin breakdown, or inability to perform daily activities [5]. Repair of parastomal hernias with fascial closure alone has resulted in hernia recurrence rates as high as 70%; when parastomal hernia recurrences do occur, they may be associated with significant pain, skin excoriation and can lead to re-obstruction [6]. The placement of mesh, with or without fascial closure, is now the recommended approach to minimally invasive parastomal hernia repair [7]. Although parastomal repairs are most frequently repaired using an open approach, minimally invasive repair is becoming increasingly utilized. The rate of hernia recurrence in laparoscopic repair has proven more favorable than open repair, with recurrence rates as low as 11.6% in comparison to 20% for open repairs [8]. The laparoscopic Sugarbaker technique (Fig. 1) is more effective than the laparoscopic Keyhole technique with recent meta-analysis yielding a recurrence rate of 11.6% for the Sugarbaker technique [8, 9]. The use of laparoscopy does, however, pose

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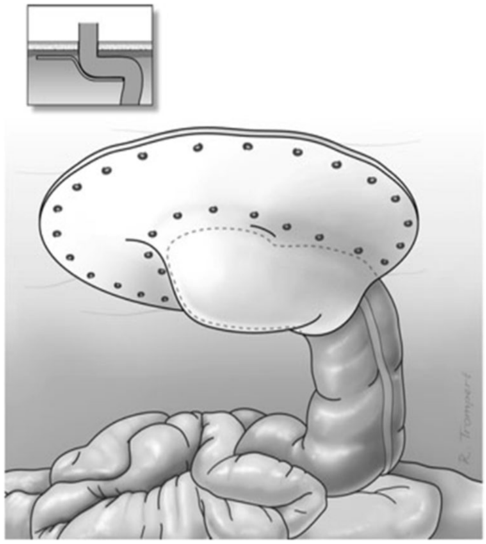

Fig. 1 The Sugarbaker technique for repair of parastomal hernias is highlighted. The mesh is tacked in an intraperitoneal manner, and the bowel is lateralized in a tunnel created by the mesh

Fig. 2 An occlusive dressing is constructed using gauze and a Tegaderm™. Placing an occlusive dressing over the stoma prevents spillage during the case and minimizes potential for contamination

challenges to the surgeon, the most troublesome of which is closure of the fascial defect using conventional laparoscopic instruments. There are not currently any studies that describe a laparoscopic technique in which the fascia is consistently closed in conjunction with mesh placement.

Concurrent fascial closure with mesh placement has led to improved recurrence rates in laparoscopic repair of ventral hernias when compared to mesh placement alone [10]. Considering that most laparoscopic parastomal hernia repairs are done without closure of the hernia defect, adding the closure should improve outcomes as it has in laparoscopic ventral hernia repair [11]. The use of a robotic platform is ergonomically favorable and can lead to consistent fascial closure along with intraperitoneal mesh (IPOM) placement. Repair of ventral hernias using robotic IPOM has demonstrated a 40% higher rate of fascial closure in comparison to laparoscopic IPOM [12]. Thus far, using a robotic platform for parastomal hernia repair has not been widely popularized. Here, the authors aim to describe a novel technique utilizing a robotic Sugarbaker repair of parastomal hernias with fascial closure.

Surgical technique

Decision-making regarding who is appropriate for an operation and what the potential benefits are is an important process a surgeon needs to consider prior to proceeding with parastomal repair. A thorough history, physical examination, and adequate workup including preoperative imaging (with measurement of defect size) and lab work is performed prior to consenting a patient for an elective parastomal hernia repair. For all patients, reversal of the stoma, if possible, is considered prior to proceeding with a parastomal hernia repair. Patients with history of malignancy or complaints associated with possible intraluminal disease will undergo endoscopic evaluation and imaging prior to the operation. Patients are preoperatively cleared for operation as needed depending on their medical comorbidities. All patients are counseled on risk factors that are known to increase risk of postoperative complications [13]. Weight loss prior to operation is encouraged as it decreases the intraabdominal volume and is considered to help with decreasing hernia recurrence [14]. Diabetic patients are counseled on preoperative glucose control with a target A1C set below 7.2, and patients who smoke are counseled and offered surgical repair after they quit smoking for at least 4 weeks [15]. The Carolinas Equation for Determining Associated Risks (CeDAR) app is used to assist the surgeon in calculating the patient's risk for wound complication postoperatively [16].

The patient is positioned supine so that the umbilicus overlies the table break, and the table is flexed to ensure maximum exposure to the abdomen and increase working room for the robotic arms. The arm contralateral to the stoma is tucked to allow for the best range of motion for the robotic arms. The stoma is temporarily closed with sutures, gauze and an occlusive to prevent contamination during the case (Fig. 2). For patients with a urostomy, a sterile Foley catheter is placed and then secured laterally on the abdomen. All patients receive prophylactic antibiotics prior to the operation. Entry to the abdomen is most frequently obtained using an Optiview trocar (Ethicon Endo-Surgery, Cincinnati, OH) in the upper quadrant opposite to the stoma.

A total of three ports, two 8-mm ports and a 12-mm port, are used for the operation as demonstrated in Fig. 3. These ports are spaced at minimum 8 cm apart along the lateral abdominal wall in a line and are typically placed through the transversus abdominus muscle. A 12-mm port is placed so a large mesh can be inserted. The robot, a DaVinci Si or Xi (Intuitive Surgical, Sunnyvale, CA, USA), is then docked from the side of the stoma. The camera is inserted, and after visualizing the hernia site, mesh and sutures may be inserted at this time if the defect is easily accessible and measurable.

Under direct visualization, a nontraumatic grasper is inserted for the left hand and a monopolar scissors for the right hand. Once the abdomen has been inspected for other abnormal findings, attention is turned to the parastomal hernia. Adhesiolysis is done with a combination of blunt and sharp dissection, using a bipolar and scissors. Adhesiolysis is performed as needed and the contents of the hernia as well as the parastomal hernia sac are reduced into the abdomen. Care is taken not to injure the stoma during this dissection. For patients with a urostomy, special attention should be paid to avoid ureteral injury.

A preperitoneal pocket is developed in the inferolateral direction from the site of the fascial defect. The preperitoneal pocket is developed to increase mesh overlap of the defect inferiorly with the hope of reducing recurrence (Fig. 4). The fascial defect for the stoma is then narrowed with a 1–0 V-Loc™ permanent barbed suture(s) (Fig. 5). This is done in running fashion with care not to narrow the fascial opening to the point that the stoma outflow is constricted. The mesentery of the bowel heading up to the soma site is pexied to the lateral abdominal wall with a permanent suture as to prevent the same loop of bowel from elongating into the defect leading to re-herniation (VI) (Fig. 6).

A Sugarbaker technique is utilized for formal hernia repair (Fig. 1). A dual-coated PTFE mesh, Gore® DualMesh®, is the mesh used most often by the authors, but mesh choice is not the focus of this paper. If there is any concern for contamination, then a biologic mesh is placed.

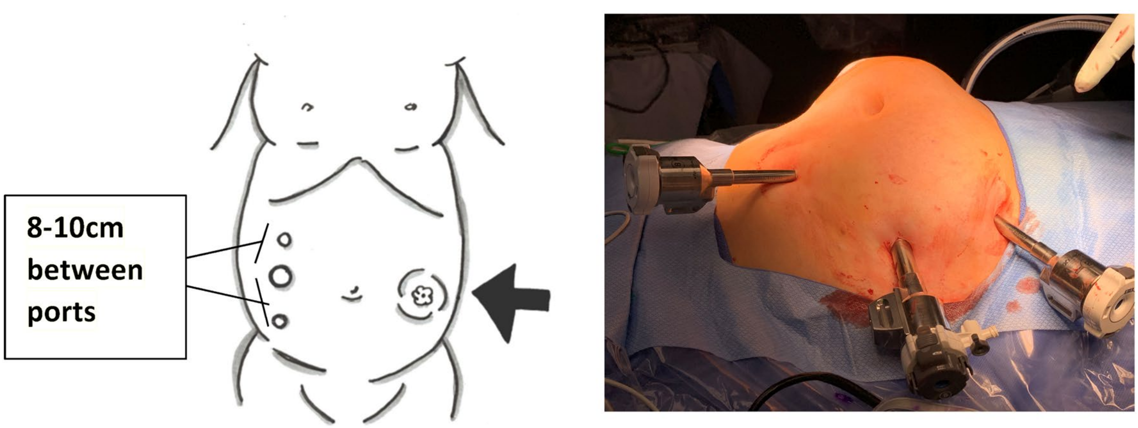

Fig. 3 Three ports are placed on the contralateral side of the stoma. A 12-mm port is at the level of the stoma and then two additional 8-mm ports are placed, one 8–10 cm superiorly and one 8–10 cm inferiorly

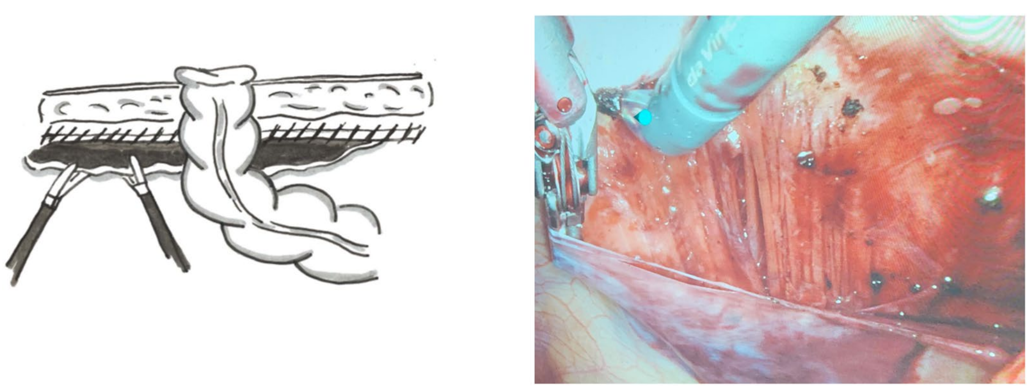

Fig. 4 A preperitoneal flap was developed in the inferolateral direction in some of the patients included in this study. The development of this preperitoneal flap provided more generous mesh overlap

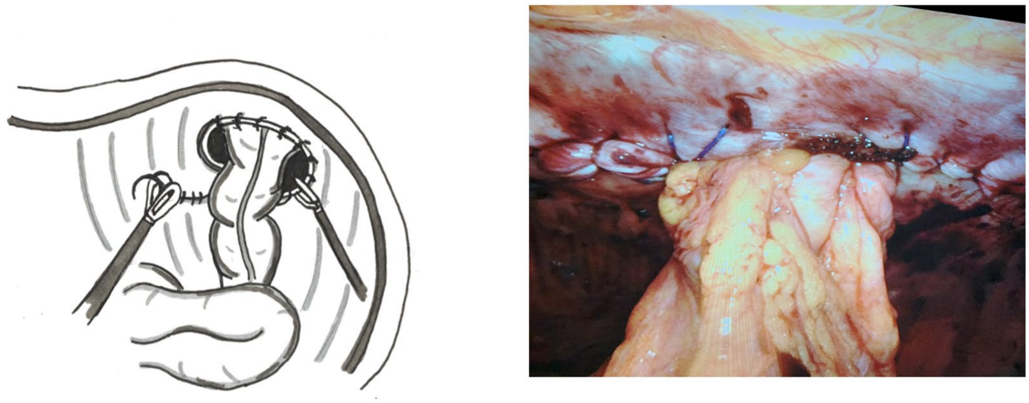

Fig. 5 The fascial defect of the hernia was closed using barbed, V-Loc™ suture. Care was taken not to close the defect too tightly, which would put patients at risk for bowel obstruction

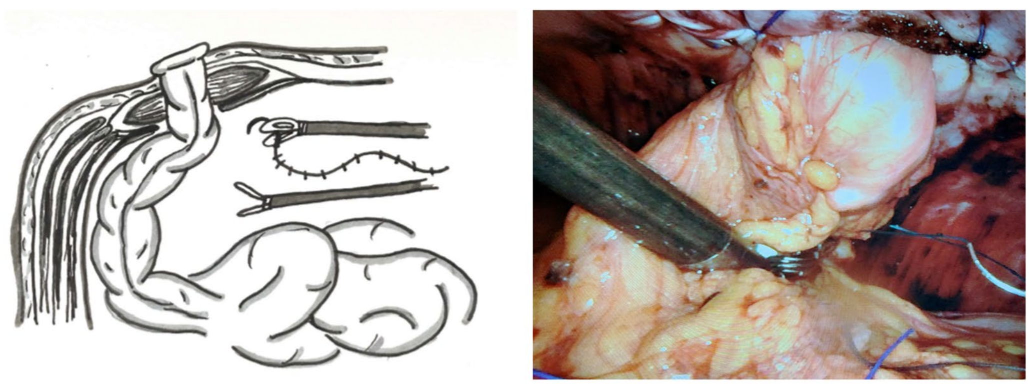

Fig. 6 The bowel was lateralized by securing the mesentery to the abdominal wall. A long tunnel was created by tacking the mesh to the abdominal wall laterally. The presence of a long tunnel prevents bowel from re-herniating into the stomal opening

Technique was standardized regardless of mesh choice. The stomal defect is typically 5–7 cm in diameter after fascial closure. The most common mesh size was 24 × 18 cm, which resulted in a large overlap > 10 cm. Prior to insertion into the abdomen, the mesh is marked for orientation purposes, and several anchoring 0 nonabsorbable, braided sutures are pre-placed in the middle, lateral (opposite stoma), superior, inferior aspects of the mesh with the tails left long. Mesh is passed into the abdomen through a 12-mm port. Using the pre-placed stitches, the mesh is then secured to the abdominal wall. The first suture is the anchoring suture in the middle of the mesh, and this is placed at the medial fascial edge by the stoma. This allows the mesh to be suspended from the abdominal wall and centered to assure adequate overlap laterally. A long Sugarbaker tunnel is created, which is greater than 5 cm in length. At this time, the surgeon may suture the mesh in place circumferentially or transition to laparoscopy and use a tacking device. Given the large size of the mesh, the authors have found conversion to laparoscopic tacking to be time-saving maneuver.

The mesh is secured circumferentially around the lateral edges to ensure no bowel can re-herniate between the mesh and the abdominal wall. It is important to secure the mesh while visualizing both the bowel above and below the mesh and ensure that no bowel injury occurs. The preperitoneal flap is then advanced over the lateral and inferior edges of the mesh and the peritoneum is recurred so that bowel cannot migrate under the flap. The mesh should be taut with the abdominal wall, but it is important not to make the tunnel so tight that it is obstructing the stoma (Fig. 7). After the mesh is properly placed, a transversus abdominis plane block with liposomal bupivacaine may be performed to help with post-operative pain control. The 12-mm trocar site is closed using a suture passer and a 0-vicryl suture. Ports are then removed under visualization, the abdomen is desufflated, and the ports sites are closed using 4-0 absorbable suture. After a sterile dressing is applied, the occlusive dressing is taken off the stoma and the suture closing the stoma is cut. Patients are admitted to the inpatient surgical floor for postoperative monitoring. Postoperative care is standard per

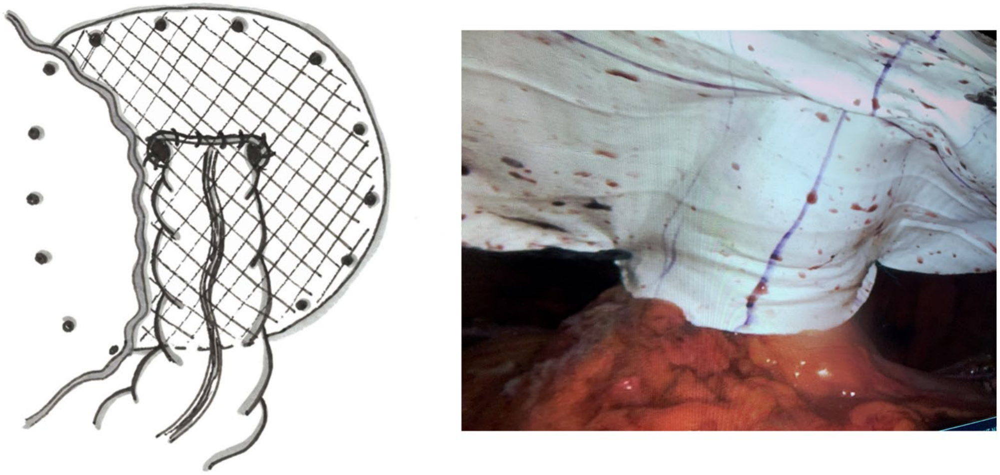

Fig. 7 The mesh is secured with tacks with care not to tack down the bowel. In instances where a preperitoneal pocket was created, the peritoneum was secured with tacks over the mesh in the inferolateral position

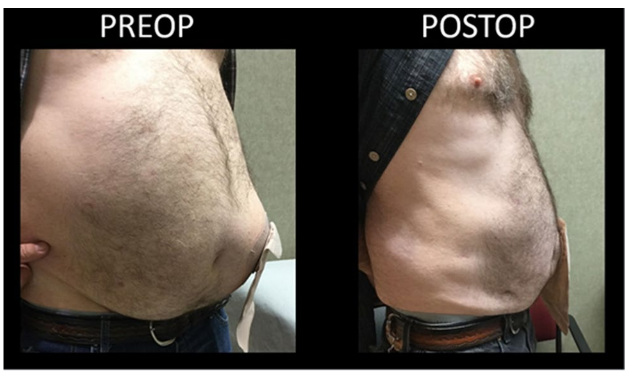

Fig. 8 A before and after sagittal view is shown for one of the patients included in the study. There is a marked reduction in protrusion near the stoma

Table 1 Patient demographics

Age (years)	64.9 ± 9.3
% Male	86.7
BMI kg/m^2	30.1 ± 4.7
Diabetes n (%)	1 (6.7)
Smoking history n (%)	9 (60.0)
Steroids n (%)	3 (20.0)
Hernia defect size (cm^2)	46.0 ± 40.1
Colostomy n (%)	4 (26.7)
Ileostomy n (%)	6 (40.0)
Urostomy n (%)	5 (33.3)
Loop ostomy n (%)	2 (13.3)

our enhanced recovery after surgery (ERAS) pathway, which emphasizes early mobility, multimodal analgesia, and shortening hospital length of stay [17]. A representative before and after photograph of one of the patients operated on is included in Fig. 8.

Results

The baseline characteristics for all fifteen patients, including age, BMI, gender, medical comorbidities, size of defect, and type of stoma prior surgeries, are listed in Table 1. All but two of the ostomies were end ostomies. The etiology of the ostomies was oncologic in all but three patients, all of whom had ulcerative colitis. Five of the ostomies were urostomies and were constructed as part of a prior cystectomy–ileal conduit operation for bladder cancer.

Half of the patients had CDC Class II and half of the patients had CDC Class III wound types [18]. In two patients, a biological mesh was placed: one for an enterotomy and one for a redo uretero-enteric anastomosis. There were five patients (33.3%) included who had concurrent hernias fixed, such as ventral, umbilical, or flank hernias, which contributed to the mean operative time. For all patients, the fascial defect was successfully closed in conjunction with a robotic-intraperitoneal mesh for Sugarbaker repair. The seven patients who were operated on most recently had a preperitoneal flap developed in the inferolateral position to provide increased mesh overlap. A change in technique was made to include the preperitoneal flap after we had a patient experience recurrence of in the inferolateral portion of the stomal defect. Current SAGES guidelines for laparoscopic ventral hernia repair demonstrate a lower recurrence rate with overlap that is greater than 5 cm and favor an increased mesh-defect ratio, so this was performed with

Table 2 Operative outcomes

Operative time (minutes)	182.0 ± 51.9
Intra-operative complications n (%)	1 (6.7)
% Mesh Type n (%)	
Dual mesh (ePTFE)	13 (86.7)
Strattice	2 (13.3)
%Patients with concurrent hernia fixed n (%)	
Ventral	2 (13.3)
Inguinal	2 (13.3)
Umbilical	1 (6.7)
Flank	1 (6.7)
Mesh size (cm^2)	372.0 ± 101.2

Table 3 Postoperative outcomes

Length of stay (days)	4.2 ± 1.9
Wound complications, n (%)	0 (0.0)
Total postoperative complications, n (%)	1 (6.7)
30-Day readmissions, n (%)	0 (0.0)
Mortality, n (%)	0 (0.0)
Recurrence, n (%)	1 (6.7)

our technique [19]. Further intra-operative characteristics are listed in Table 2.

After a follow-up time of 14.2 ± 9.4 months, there was only one patient who developed a recurrent hernia. This patient had a BMI of 38, Type 2 diabetes, and multiple prior parastomal hernia repairs with mesh. Although the average mesh size in this group was 372 cm^2 in this group, it was this hernia recurrence that prompted a change in technique to increase the dissection into the preperitoneal space in the groin area for a more generous inferolateral overlap of the mesh. No wound complications, surgical site infections, or mesh infections occurred (Table 3). The average length of stay in the hospital was 4.2 days. One patient developed a hospital-acquired pneumonia and required an 8-day stay in the hospital. There were no 30-day readmissions or moralities.

Summary

This study describes a novel technique in which robotic parastomal hernia repair is performed with closure of the fascial defect. This study describes a technique that is safe, technically feasible, with low short-term hernia recurrence rates and low complication rates. In all patients, we were able to successfully close the fascial defect and perform a robotic IPOM. The recurrence rate in this study is low (6.7%) and is favorable to the reported recurrence rates for laparoscopic and open repair [8]. The authors propose that the robotic approach should be widely considered for parastomal hernia repairs in appropriately selected patients. Quality of life should be one of the main considerations in decision-making regarding operation. Techniques including fascial closure, mesenteric pexy to the abdominal wall, Sugarbaker technique and large mesh placement may be key to optimizing outcomes related to recurrence and infection. Further studies examining long-term recurrence rates and randomized control trials will be needed for definitive recommendations. Retrorectus parastomal hernia repairs have been practiced open and also robotically [20, 21]. Future studies should investigate the most appropriate techniques to rectify this type of hernia and minimize postoperative complications. Moreover, prophylactic mesh placement at the time of stoma may change the incidence and morbidity associated with stoma creation [22, 23].

Author contributions Study design: Ayuso, Shao, Heniford, and Augenstein. Data acquisition: Ayuso, Shao, and Augenstein. Statistical analysis: Ayuso and Shao. Interpretation of the data: all. Drafting of the manuscript: Ayuso, George, Shao, and Augenstein. Revision and final approval: all.

Funding This work did not receive any funding or financial support.

Data availability Data generated and/or analyzed in this study are not publicly available due to HIPAA compliance laws but are available from the corresponding author upon request.

Code availability Data are stored in a password-protected database for a 10-year period.

Compliance with ethical standards

Conflict of interest Dr. Augenstein has received honoraria for speaking for Medtronic, Allergan, Intuitive, Acelity, and W.L. Gore. Dr. Heniford has been awarded education grants and speaker honoraria from W.L. Gore and Allergan. All conflicts of interest are outside of the scope of the submitted work. Dr. Ayuso, Dr. Shao, Dr. Deerenberg, and Dr. Elhage have no potential conflicts or disclosures.

Ethical approval Ethical approval was agreed by the ethical committee of the institution.

Human and animal rights The study including human participants has been performed in accordance with the ethical standards of the Declaration of Helsinki and its later amendments.

Informed consent For this retrospective series, informed consent is not required.

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