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ORIGINAL ARTICLE

Single-Center Experience With Parastomal Hernia Repair Using Retromuscular Mesh Placement

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Abstract
Background Parastomal hernias (PHs) are frequent complications of enterostomies. We aimed to evaluate our outcomes of open PH repair with retromuscular mesh reinforcement.
Methods From 2006 to 2013, 48 parastomal hernias were repaired in 46 consecutive patients undergoing open retromuscular repair. Surgical technique included stoma relocation, retromuscular dissection, posterior component separation, and retromuscular mesh placement. All stomas were prophylactically reinforced with cruciate incisions through mesh. Main outcome measures included demographics, perioperative details, wound complications (classified according to the CDC guidelines), and recurrences.
Results There were 24 male and 22 female patients with a mean age of 61.8 and body mass index (BMI) of 31.7 kg/m^2. Twenty-four patients had recurrent PH with an average of 3.8 prior repairs. Ostomies included 18 colostomies, 20 ileostomies, and 10 ileal conduits. Thirty-two patients had a concurrent repair of a midline incisional hernia. All patients underwent mesh repair with either biologic (n=29), lightweight polypropylene (n=15), or absorbable synthetic mesh (n=2). There were 15 superficial surgical site infections (SSIs) and 6 deep SSIs. There was one case of an ischemic ostomy requiring surgical revision. No mesh grafts required removal and there were no mesh erosions. At a mean follow-up time of 13 months, five patients (11 %) developed a recurrence; three patients required re-repair.
Conclusion In this largest series of complex open repairs with retromuscular mesh reinforcement and stoma relocation, we demonstrate that this results in an effective repair. This technique should be considered for complex parastomal hernia repair.

Keywords Parastomal hernia · Sublay · Incisional hernia · Posterior component separation · Retromuscular

Introduction

Parastomal hernia (PH), defined as an incisional hernia related to an abdominal wall stoma,[1] is a common and dreaded complication of enterostomy procedures with a reported incidence as high as 50 %.[2,3] While stoma creation has been shown to have a significant negative impact on quality of life,[4] herniation through the stoma site further complicates and impacts the lifestyle of these patients.[5] Despite the frequent occurrence of this problem, the best method for repair of PH has not been identified. Various operative approaches have been described, including laparoscopic versus open repair as well as primary repair versus repair using mesh reinforcement. Primary fascial repair or relocation of the stoma without prosthetic mesh reinforcement has been associated with high recurrence rates and significant morbidity.[6,7] Mesh reinforcement provides a more durable repair; however, outcomes are variable depending on technique.[8]

Based upon the known benefits of prophylactic mesh placement at the time of stoma creation,[9–11] our team has developed a unique approach to parastomal hernia repair. Our technique consists of stoma site repositioning with prophylactic reinforcement of the new stoma site using a keyhole and retromuscular mesh placement with reinforcement of the

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old stoma site and the midline incision. Herein, we report our experience utilizing this technique in a large cohort of patients undergoing complex parastomal hernia repairs.

Methods

A prospectively maintained database was used to identify all patients undergoing open parastomal hernia repair with a retromuscular approach utilizing a posterior component separation between 2006 and 2013 at University Hospitals Case Medical Center. Patients with an anterior component separation (external oblique release) were excluded. Institutional review board approval was obtained for this study.

Medical records were analyzed for patient demographics including age, sex, comorbidities, body mass index (BMI), American Society of Anesthesiologists (ASA) score, number of prior abdominal operations, indications for stoma, and number of prior failed hernia repairs. Perioperative data included intraoperative defect measurements, size and type of mesh, operative times, concomitant procedures performed including technique of component separation, postoperative length of stay, and complications. Outcomes were evaluated for postoperative wound complications, length of follow-up, and hernia recurrence. Wound complications and surgical wound classification were categorized according to the Centers for Disease Control and Prevention (CDCP) 1999 Guideline for Prevention of Surgical Site Infection.[12] Surgical site infections were categorized as superficial, deep, or organ space. Surgical site occurrence was defined based on the modified Ventral Hernia Working Group and included surgical site infection, seroma requiring procedural intervention, dehiscence, and enterocutaneous fistula formation.[13] Hernia recurrence was determined by physical examination and abdominal-pelvic computed tomography (CT) scans. For the purposes of comparison with future studies, the European Hernia Society (EHS) parastomal hernia classification system was also used to classify each hernia.[14]

Our surgical technique has been previously described.[15,16] All patients are marked for alternative stoma sites by a team of enterostomal therapy nurses. Gastrointestinal stomas are oversewn at the beginning of the procedure. Urostomies are intubated with a Foley catheter in a sterile fashion to drain urine and help identify the conduit intraperitoneally. Neither mechanical bowel preparation nor oral antibiotics are utilized. All patients receive appropriate thromboprophylaxis, intravenous second generation cephalosporin, oral gastric decompression, and a Foley catheter. The stoma site is excluded with a small sponge under an iodine-impregnated drape. A generous midline incision is performed and the entire abdominal wall is freed of adhesions. Interloop adhesions are routinely lysed to prevent inadvertent twisting of the stoma as it is repositioned. As mentioned, it is our practice to relocate the stoma to the contralateral abdominal wall. This allows the new stoma site to be reinforced in a prophylactic fashion, thereby converting the old stoma site to a routine incisional hernia repair. Depending on the origin of the stoma, this can involve mobilization of the splenic flexure for left-sided colostomies, to full mobilization of the ureters for ileal conduits. If it is deemed that the stoma cannot obtain adequate mobilization to reach a new site, it is not repositioned. If the stoma is adequately mobilized in preparation for relocation, we prefer to divide the stoma from within the abdomen at the exit site into the abdominal wall with a GI stapler. This limits spillage of stoma contents. The small segment of bowel that remains in the abdominal wall can be excised from the skin without any gross spillage of bowel contents. Next, the abdominal wall reconstruction procedure is performed.

Our approach to performing a posterior component separation with transversus abdominis release has been extensively described.[16] In this situation, there are particular advantages to this approach that deserve mention. The absence of a lipocutaneous flap eliminates many complex wound complications around stomas that have been associated with a standard anterior approach with skin flap creation. This technique also affords a large retromuscular/preperitoneal space to deploy a large prosthetic mesh to adequately cover the lateral aspects of the old stoma site and reinforce the new stoma site prophylactically. One technical issue with repairing any stoma is the risk of kinking the stoma as it exits the abdominal wall through multiple mobile fascial and mesh layers under tension. We prefer to create each cruciate incision in the posterior sheath, mesh, and anterior abdominal wall one layer at a time to adequately orient the stoma tract. In cases in which the stoma could not be repositioned, a lateral incision was made in the mesh to wrap around the stoma and then resewn together in a keyhole fashion. Once completed, the old stoma site skin is closed loosely with a purse string suture and packed for 48 h. The midline skin is closed with staples and the stoma is matured. Drains are placed in the retromuscular space on top of the mesh and removed when output is less than 30 cc/day. Intravenous antibiotics are continued for the first 24 h. The choice of prosthetic mesh material has evolved during this study period. We consider a parastomal hernia repair in which the stoma is repositioned to be a CDC Wound Class 3 (contaminated case). Historically, we have routinely advocated for a biologic mesh in these cases. However, with increasing experience with macroporous synthetic mesh, we have employed midweight synthetic mesh in our more recent cases.

Results

Forty-eight parastomal hernias were repaired in 46 patients, with a mean follow-up of 13 months (range 1–78, 3 lost to follow-up). Two patients had bilateral parastomal hernias. One

patient had both an ileal conduit and ileostomy; another had both an ileal conduit and colostomy. There were 22 women and 24 men with a mean age of 61.8 years (range 29–88), ASA score 3.0 (range 2–4), and BMI 31.7 kg/m^2 (range 18.8–47.2). Patient comorbidities included diabetes mellitus (DM) 11 (24 %), chronic obstructive pulmonary disease (COPD) 4 (9 %), and active smokers 8 (17 %) (defined as smoking within 3 months of surgery). Nine patients (20 %) had a history of Crohn's disease and eight (17 %) had ulcerative colitis. Patients had on average undergone 4.3 (range 1–30) prior abdominal operations. Twenty-five patients (52 %) presented with a recurrent parastomal hernia with an average of 3.8 (range 1–20) prior repairs. Most parastomal hernias were incarcerated (n=35, 76 %). Types of stomas included 18 colostomies, 10 ileal conduits, and 20 ileostomies. Briefly, the EHS parastomal hernia classification defines type I hernias (least complex) as ≤5 cm without a concomitant incisional hernia (cIH), type II hernias as ≤5 cm with cIH, type III hernias as >5 cm without cIH, and type IV hernias as >5 cm with cIH (most complex). In this study, 2 patients had type I hernias (both primary), zero type II hernias, 12 type III (8 recurrent, 4 primary), and 32 type IV (17 recurrent, 15 primary). Tables 1 and 2 summarize the patient and hernia demographics.

Thirty-two (70 %) patients had simultaneous repair of a midline incisional hernia during their PH repair. Twelve patients had a retromuscular repair without release of the transversus abdominis. The remaining 34 (70 %) patients had bilateral transversus abdominis releases. Mesh was placed in the retromuscular space in all cases. Thirty-nine (85 %) patients had their stomas relocated during the repair. Of the seven patients who did not have their stomas relocated, five had ileal conduits and two had colostomies. One patient's surgical wound was classified as dirty infected according to CDCP guidelines. All other cases were classified as contaminated.

The mean hernia defect area was 231 cm^2 (range 25–690). The mean width of the hernia defect was 12.9 cm (range 5–23). The median implanted mesh area was 400 cm^2 (range 265–1000). Mesh utilization included 29 cases of biologic mesh (Strattice n=28, LifeCell, Bridgewater, New Jersey; Surgisis, n=1, Cook, Bloomington, Indiana), 15 permanent synthetic (Soft Mesh n=13, Bard, Covington, Georgia; Ultrapro n=2, Ethicon, Cincinnati, Ohio), and 2 absorbable synthetic (Bio-A, W. L. Gore, Newark, Delaware). Mean operative time was 258 min (range 150–480) and mean blood loss was 142 ml (range 25–500). Five (11 %) patients were admitted to the surgical intensive care unit postoperatively due to elevated plateau pressures after abdominal closure. The mean postoperative length of stay was 10.8 days (range 5–25).

Table 1 Patient demographics

Demographic	Prevalence, no. (%)
Age (mean)	61.8
Female gender	22 (48)
Diabetes mellitus	11 (24)
COPD	4 (9)
Smokers	8 (17)
Crohn's disease or UC	17 (37)
Ostomy	
Ileostomy	20 (42)
Colostomy	18 (37)
Ileal conduit	10 (21)

COPD chronic obstructive pulmonary disease, *UC* ulcerative colitis

Table 2 Hernia characteristics

Hernia characteristic	Prevalence, no. (% or range)
Concurrent incisional hernia	32 (70)
Recurrent hernia	25 (52)
No. of prior failed repairs	3.8 (1–20)
Incarcerated hernia	35 (76)
Hernia defect area (cm^2)	231 cm^2 (25–690)

Among five patients, there were six deep surgical site infections (SSIs), where three had received biologic mesh (Strattice) and two received synthetic mesh (Soft Mesh). Among 15 patients, there were 15 superficial SSIs, where 5 had received synthetic mesh (4 Soft Mesh, 1 Ultrapro), and 10 received biologic mesh (9 Strattice, 1 Surgisis). One morbidly obese patient (BMI 45.1) developed a mucocutaneous separation of the new ostomy, which required negative pressure wound therapy management. Three patients experienced wound dehiscence and two patients developed hematomas. One patient developed an ischemic stoma, which required surgical revision. On reoperation, the complication did not appear to be related to the mesh. There were no events requiring mesh removal or evidence of fistula formation. Tables 3 and 4 list the intervention for each wound complication. There were no mortalities in this series. During the 13-month follow-up period, five patients (11 %) developed recurrence of their hernias, of which three required reoperation. Of the five recurrences, two were in patients with ileal conduits that were not relocated. All recurrences were parastomal (not incisional) and occurred either at the original stoma site in patients who did not have their ostomies relocated or at the new stoma sites in patients who did undergo ostomy relocation.

Discussion

The successful repair of parastomal hernias remains one of the most daunting challenges facing reconstructive surgeons. We

Table 3 Postoperative wound complications and treatment required, not including surgical site infections

Mucocutaneous separation (n=1)	Dehiscence (n=3)	Hematoma (n=2)	Ischemic ostomy (n=1)
Negative pressure wound therapy	Local wound care (3)	IR drainage (2)	Reoperation

Wound VAC vacuum-assisted wound closure system, *IR* interventional radiology (percutaneous)

have reported the largest series to date evaluating the outcomes of open PH repairs utilizing posterior component separation with a retromuscular mesh and stoma repositioning, and have demonstrating its suitability for repair in a challenging cohort of patients with complex parastomal hernias.

A review of the surgical literature shows an abundance of described techniques for repair of parastomal hernias. The majority of these series are small (less than 15 patients), with short term follow-up, and poorly described surgical approaches. It is, however, generally accepted that pure fascial repairs have unacceptably high recurrence rates.[6] Additionally, relocation of the stoma without mesh reinforcement often results in recurrent parastomal, midline, and old stoma site hernias.[7] Our approach utilizes a prosthetic to reinforce all at-risk locations. Interestingly, all of our recurrences have occurred at the re-sited stoma. We feel this is largely due to a technical error during our learning curve. Early in our experience, we feared placing either biologic or synthetic mesh too close to the new stoma due to the risk of erosion or obstruction, and we therefore made a fairly generous opening in the prosthetic material. We have learned that the mesh aperture expands with time, resulting in all of our recurrences. Our current practice involves making a small cruciate incision in the mesh to accommodate the bowel. Since making this adjustment, we have not experienced a hernia recurrence or mesh erosion.

Prior to our study, there have been few published series of sublay mesh repair of parastomal hernias. Longman and Thomson reported a series of 10 patients with parastomal hernias repaired with polypropylene mesh in the sublay position.[17] With an average 30 months of follow-up, they reported no recurrences, no infected mesh, and only one complication of superficial wound breakdown. However, no further data is provided on patient demographics or concomitant ventral hernias. In another series, Kasperk and colleagues reported sublay repair of seven recurrent parastomal hernias.[18] Four of these cases had concomitant incisional hernia repairs.

Table 4 Surgical site infections and treatment required

Superficial SSI (n=15)	Deep SSI (n=6)
Antibiotics (8)	IR drainage (4)
Local I&D (7)	OR debridement (2)

SSI surgical site infection, *I&D* incision and drainage, *IR* interventional radiology (percutaneous), *OR* operating room (surgical)

Two recurrences (28.6 %) were reported after 1 year of follow-up and both were attributed to technical errors. A previous series of 12 patients from our institution focused solely on patients who underwent simultaneous parastomal and incisional ventral hernia repair.[15] Two patients (16.7 %) in this series had recurrences. Unlike the current series, our prior paper represented a multitude of surgical approaches prior to the refinement of our surgical technique as presented here. The current study demonstrates a low recurrence rate with an acceptable incidence of surgical site infection and wound complications in a complex patient population. In addition, this study further demonstrates that mesh placed in the retromuscular position avoids significant mesh-bowel interaction, resulting in no occurrences of mesh erosion.

Other investigators have described alternative techniques to repair parastomal hernias utilizing an onlay approach or even a laparoscopic approach. Steele et al. recently reported their experience with 58 cases accrued over a 14-year period at their institution.[19] While the surgical approach was not standardized, the majority of patients were repaired with an onlay of polypropylene mesh. They reported a recurrence rate of 26 %, with several cases of mesh erosion and bowel obstruction. Although not clearly reported, it seems that the majority of these authors' experience involved a local approach to the parastomal hernia. In our experience, almost three quarters of our patients had a concomitant midline incisional hernia, which would not have been addressed with these authors' technique. Other groups have popularized a laparoscopic approach to parastomal hernia repair. Berger et al. recently presented a large experience of laparoscopic repairs of parastomal hernias in 66 patients.[20] It is notable that the hernia defect size was almost half of the size of the hernias presented in our series. Likely, precise laparoscopic placement of very large sheets of mesh with coverage of both midline and parastomal components is difficult and has limited its application for complex defects. While the laparoscopic approach affords a minimally invasive solution to parastomal hernias, its role in the repair of larger complex parastomal hernias with large midline components is unclear.

Another important consideration when approaching parastomal hernia repair is mesh selection. Historically, biologic mesh has been employed when reinforcing the new stoma site due to the contamination of the surgical field in operations requiring bowel resection and stoma creation or relocation. More recently, however, our group has published our experience with the use of lightweight macroporous

synthetic mesh in clean contaminated and contaminated cases.[21] Given our encouraging findings, we have begun to utilize macroporous synthetic mesh for parastomal hernia repairs. While our experience is still small and follow-up is limited, it is promising that there have been no incidences of mesh erosion or mesh explantation. Based on our experience, further randomized controlled trials are warranted to address the appropriate mesh selection for parastomal hernia repairs.

One of the most encouraging trends in the care of parastomal hernia patients is the possibility of prevention. Wijeyekoon and colleagues reviewed three trials that randomized patients to either no mesh or prophylactic mesh reinforcement with biologic or synthetic mesh at the time of stoma creation. Two of the trials used lightweight macroporous polypropylene mesh placed in the sublay position; the third used biologic mesh in the preperitoneal position.[22] Importantly, there were no occurrences of mesh-related complications in any group. Parastomal herniation rates were 12.3 % in the mesh group compared to 54.7 % in the conventional group. In a 5-year follow-up of a randomized clinical trial comparing conventional stoma creation to the addition of lightweight polypropylene mesh in the sublay position for prophylactic reinforcement at the time of stoma formation, Janes et al. reported no mesh infections or complications necessitating mesh removal.[10] They reported a similar herniation rate of 13.3 % in the mesh group compared to 81 % in the conventional group. The current study further progresses the field of parastomal hernia surgery by demonstrating the continued safety and efficacy of both biologic and synthetic mesh for concurrent repair and reinforcement of stoma sites. Of our five recurrences, only one was in a patient who received synthetic mesh. We did not encounter any instances of mesh erosion or fistula formation, and no mesh required removal.

Conclusion

Repair of the complex parastomal hernia with an open approach utilizing retromuscular mesh reinforcement and stoma relocation results in low recurrence rates and an acceptable complication rate. This technique, when reproduced consistently, avoids occurrence of mesh erosion and fistula formation. Both biologic and synthetic meshes are effective materials for reinforcement. We strongly advocate our approach for consideration in repairs of complex parastomal defects.

Conflict of Interest SR, CCP, CNC, and ASP declare no conflict of interest. YWN declares conflict of interest directly relating to submitted work (consultancy for CR Bard and LifeCell). MJR declares conflict of interest directly relating to submitted work (grant funding from WL Gore, consultancy for CR Bard and LifeCell).

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