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Authors
Hwang, GS
Hanna, MH
Carmichael, JC
et al.

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Repair of complex parastomal hernias

G. S. Hwang • M. H. Hanna • J. C. Carmichael • S. D. Mills • A. Pigazzi • M. J. Stamos

Abstract Development of parastomal hernias (PH) is very common after stoma formation and carries a risk of subsequent bowel incarceration, obstruction and strangulation. The management of PH remains a challenge for the colorectal surgeon, and there are currently no standardized guidelines for the treatment of PH. Even more difficult is the management of complex parastomal hernias (CPH). We conducted a review of the literature to identify recent developments in the treatment of CPH, including analysis of the use of synthetic and biologic mesh prostheses, method of mesh placement and surgical approach.

Keywords Complex parastomal hernia • Treatment • Prevention

Introduction

Parastomal hernia (PH) is defined as an incisional hernia in the context of an abdominal wall stoma [1]. It is one of the most frequent complications following the creation of a stoma. The presence of PH may impair quality of life and contribute to considerable social and psychological difficulties in many patients. Complex parastomal hernias (CPH) include PH with large fascial defects, recurrent PH, PH with associated infections and PH that has resulted in bowel perforations or fistulas. This narrative review discusses the latest developments of parastomal hernia repair (PHR) and addresses the current management of CPH.

The reported incidence of PH varies widely, depending on the definition, the method of detection, the severity and duration of follow-up, but is reported to be as high as 50 % in long-term stomas [2–4]. The lack of a uniform definition in the literature makes it difficult to estimate true rates of PH. The risk of developing PH has been suggested to be lower after ileostomy than after a colostomy (1–28 % for an ileostomy, 4–48 % for colostomy), with high rates of incisional hernias after colostomy closure [2, 3, 5, 6]. Most hernias develop within 2 years of stoma formation [5–7], are asymptomatic and do not require intervention. However, 10–30 % of ostomates have been reported to require surgical intervention [3, 5, 6], and some studies even report rates as high as 70 % [8].

Risk factors for PH are similar to those observed for other hernias of the abdominal wall, including obesity, weight gain after ostomy creation, advanced age, malnutrition, increased intra-abdominal pressure, long-term use of immunosuppressive drugs, chronic lung disease, malignancy, history of large hernias, emergency operation and postoperative infection [1]. Risk of recurrence is also higher in these patients. In addition to these factors, location with respect to the abdominal rectus muscle and size of the fascial opening ([35 mm) [7] are also reported to affect development of PH. Proposed etiology of PH formation includes shifts in collagen ratio from mature type I collagen to immature type III collagen during healing, resulting in loss of tensile strength with increased susceptibility to hernia formation [9].

The indications for repair of PH, as well as CPH, include recurrent peristomal pain, ill-fitting ostomy appliance and emergency situations such as incarceration, strangulation or perforation.

Large fascial defects, contamination, multiple reoperations and general poor fascial quality increase the complexity of the repair. Many patients with CPH have had prior PHR and have comorbidities associated with difficult and recurrent hernias. Emergency surgery for PH is associated with high morbidity and mortality, and inevitable recurrence.

The management of CPH is a significant clinical dilemma, and surgical repair is technically challenging. There are three general surgical approaches to PHR: primary local tissue repair, stoma relocation and reinforcement with prostheses. The patient's medical condition and the ability to tolerate a major abdominal surgery should factor into the method of repair chosen.

Direct tissue repair

Primary local fascial repair is technically simple but has a significant recurrence rate (46–100 %) and is not a generally acceptable treatment method for elective repair [4, 8, 10–12]. Although it was the technique of choice historically, primary fascial repair alone is no longer recommended, especially for complicated PH. However, because it is the simplest form of repair, this option may be considered for select cases (such as multiple comorbidities, short life expectancy, emergency operation or where mesh repair is strongly undesirable).

Stoma relocation

Many earlier studies recommend stoma relocation, which is purportedly associated with lower recurrence rates (24–86 %) [1, 6, 8, 11, 12]. However, this method is associated with a high rate of complications (37–88 %), and introduces the risk of incisional hernia at the original stoma site [6, 11–13]. The risk of recurrent PH at the new site is also at least as high as after primary stoma placement. Moreover, this method may require a laparotomy, which may further increase the risk of incisional/parastomal hernia (68 %) [6], overall morbidity and prolonged hospital stay [14]. Several studies show stoma relocation with laparotomy is associated with higher recurrence and morbidity than without laparotomy (9.1 vs. 18.8 %) [8, 12, 15]. Stoma relocation to the opposite side of the abdomen is associated with lower recurrence (38 vs. 80 %) in a longterm study [15]. Similar to tissue repair, repeat recurrence rates after stoma relocation are high in the long run and should not be considered as first-line repair [6].

Stoma relocation has been used in conjunction with other methods of repair such as component separation [14] and the use of prosthesis [3], with improved results. The operating surgeon should keep in mind that patients who are prone to hernia formation will likely herniate again. Therefore, prophylactic mesh reinforcement at both the new and original stoma sites may be beneficial to decrease hernia risk if stoma relocation is being considered.

Synthetic versus biologic prostheses

The recurrence rate after PHR is considerably reduced with the use of mesh (7–15 %) [4]. However, mesh is associated with its own set of complications (10–30 %) such as infection, adhesions, stenosis, angulation, migration, wound dehiscence, erosion and bowel perforation [4, 16, 17]. Utilization of mesh has evolved over time, and the general trend has been shifting away from using polypropylene mesh to expanded polytetrafluoroethylene (ePTFE) and biologic meshes, resulting in fewer mesh-related complications.

The use of biologic mesh has been advocated due to their ability to resist infection. Bioprosthetic meshes are derived from human or animal tissue, decellularized and processed to allow implantation into humans. Utilization of biologic mesh has shown lower recurrence rate, if not similar, to synthetic mesh. Several biological studies have shown moderate levels of wound infection effectively treated conservatively (3–26 %), low recurrence (13–15 %) and low morbidity [18–22]. The possibility of leaving mesh in situ in an infected field is enticing, but a major argument against its use is cost with biologic mesh reported to be about 10 times more expensive than synthetic mesh [7]. There is still a large knowledge gap regarding comparative costs and functional outcomes between these materials, as well as a dearth of truly longterm outcome data.

In the setting of contaminated or infected fields, biologic mesh is often used due to limited alternatives. There are no studies that specifically address outcomes of PHR in contaminated fields, as many studies evaluated PH in the context of other abdominal hernia surgeries [20, 21, 23–26]. In studies evaluating PHR with biologic mesh collectively with other hernia repairs in contaminated settings, wound-related morbidity ranged widely (17–66 %) as did hernia recurrence (9–33 %); however, there were no meshrelated complications requiring mesh removal [19, 20, 22–24].

Mesh repair of parastomal hernias

Three methods of mesh placement have been described: onlay (on the external oblique in the subcutaneous plane), sublay (on the posterior rectus fascia in the retrorectus space) and intraperitoneal onlay position. The advantages of extraperitoneal repair include the ability to reinforce the local fascial repair and the ability to avoid a laparotomy. Although low recurrence rates have been reported, extraperitoneal approach has often been associated with higher rates of mesh-related complications such as obstruction, erosion and fistulization. Extra-peritoneal repair with mesh results in infection rates as high as 37 %, and infection is the main complication [11, 26, 27]. When comparing onlay and sublay techniques by pooling results from multiple large studies, onlay mesh position is associated with higher recurrence rate (22.3 vs. 4.6 %) [13, 17, 21, 27–32] (Table 1). Rate of wound infection was also higher with sublay mesh placement (likely contributed by more extensive tissue dissection). However, rate of mesh removal was similar (1.0 vs. 1.5 %).

Table 1 Onlay versus sublay mesh position

Study	Year	Mesh type	# Patients (*N*)	Recurrence % (*N*)	Wound infection % (*N*)	Mesh removed % (*N*)	Follow-up months (range)
Onlay mesh							
Heo et al.	2011	PP	17	11.8 % (2)	0	0	29.6 (10–49)
Smart et al.	2011	ADM	27	55 % (15)	3.7 % (1)	0	16 (0.2–39.3)
Luning et al.	2009	PP	16	19 % (3)	6.2 % (1)	6.2 % (1)	33 (6–110)
Guzman-Valdivia et al.	2008	PP	25	8 % (2)	8 % (2)	0	12 (8–24)
Kossen et al.	2004	PP	18	5.6 % (1)	0	0	15 (1–72)
Mean % (*N*)			103	22.3 % (23)	3.9 % (4)	1.0 % (1)	
Sublay mesh							
Fei	2012	PP	11	9.1 % (1)	0	0	23.5 (11–39)
Liu et al.	2010	PP	34	5.9 % (2)	2.9 % (1)	0	32 (6–75)
Longman et al.	2005	PP	10	0	0	0	30 (2–40)
Egun et al.	2001	PP	10	0	20 % (2)	10 % (1)	54 (22–69)
Mean % (*N*)			65	4.6 % (3)	4.6 % (3)	1.5 % (1)	

PP polypropylene mesh, *ADM* acellular dermal matrix

Several descriptions of large PHRs in the literature included patients who had concomitant incisional hernias, and many were able to perform simultaneous repairs with acceptable recurrence (mean 9 %, range 6–33 %) [14, 20, 29, 33–37]. Not surprisingly, many of these patients had multiple risk factors for recurrent hernia (such as obesity and respiratory comorbidities) with a history of multiple abdominal surgeries and/or failed hernia repairs. Many authors found their repairs to be successful using open sublay mesh placement with a recurrence rate of 9 % and no mesh required removal. Incidence of wound infection was high (30 %) but was effectively treated conservatively. We were unable to identify large meaningful studies involving large complicated PH repairs, as many studies identified were case reports or small series (ranging between 1 and 10 patients) [20, 29, 33, 34, 36, 37]. Parastomal hernias are essentially incisional hernias, and similar methods as those used in large complicated abdominal hernia repairs may need to be utilized.

Although not routinely used in PHR, application of more complex repairs, such as component separation technique or the use of double-layer mesh, may be considered for CPH. In a retrospective study with 12 patients with large parastomal and incisional hernias, defects were repaired using biologic mesh in a sublay fashion, and seven of these patients also underwent component separation as deemed necessary by the surgeon [14]. During an average of 14-month follow-up, one patient had a minor wound infection and two patients had asymptomatic recurrence. Another study with 48 patients with large mean fascial defects underwent open CPH, posterior component separation along with insertion of mesh (biologic, polypropylene or absorbable synthetic) in the sublay position [35]. Although surgical site infections were seen in over 60 % of patients, the rate of recurrence was acceptable (11 %) and there were no mesh-related complications.

The use of double-layer mesh in both the onlay and sublay position has been described in the repair of CPH in 13 patients [38]. Rate of recurrence was 15 % (2 patients) and was identified only on imaging with mean follow-up time of 18 months. This technique has been used more frequently in the repair of complex abdominal wall hernias [39, 40]. Rate of recurrence was 0 % in 10 and 50 patients, and average follow-up period was 15.5 months and 48 months. There were no mesh-related problems requiring mesh removal; however, wound infection was rather high in groups with biologic (20, 38.5 %) [38, 39] versus synthetic (2 %) double-layer mesh [40]. We may need to consider similar strategies for PHR, especially in patients with large CPH. However, given the risk of morbidity and mortality in repairing CPHs, elective complex abdominal hernia repair should be reserved for patients with substantial symptoms affecting their quality of life or in the emergency setting.

The intraperitoneal placement of mesh can be performed in one of two ways: the Sugarbaker technique or the keyhole technique. The intraperitoneal approach may be beneficial as it is theoretically an aseptic technique and may be performed laparoscopically. The Sugarbaker method was first introduced in 1980s and consisted of an open intraperitoneal primary fascial repair with a mesh patch secured over the fascial defect and lateralization of the intestinal loop to create a mesh flap valve around the stoma [41]. Advantages include minimizing contact with the stoma opening and covering the fascial defect with mesh. The original series of 7 patients showed no recurrence over 7-year follow-up. Stelzner et al. [42] reported on a series of 20 patients with paracolostomy hernia repaired utilizing the Sugarbaker technique, and recurrence was 15 % in a mean follow-up of 42 months. The Sugarbaker technique has increased in popularity in the recent years and may be a viable option.

The intraperitoneal approach has also been advocated for CPH patients with concomitant incisional hernias [29, 34, 42]. Stelzner et al. [42] utilized the Sugarbaker method with synthetic mesh for PHR in 13 patients with both PH and VHR. Recurrence of PH after 3 years was 15 %, with no mesh infection, low morbidity and no patients needing reoperation. They also recommend the mesh valve method over creating a hole through the mesh as it disrupts the mesh-abdominal unit. Several other studies show similar favorable outcomes, with low recurrence (0–15 %) and no mesh-related complications [34, 43–45]. The keyhole technique is another well-known procedure. In this technique, mesh is placed around the stoma in the intraperitoneal position as reinforcement after primary fascial closure. The mesh is cute in a ‘‘keyhole’’ shape to place around the stoma. Early short-term studies showed a high recurrence rate (56 %) during a mean follow-up time of 24 months, with all failures occurring within 6 months [46]. However, mesh–fascial overlap in their study was only 2–3 cm (which lacks the standard [5 cm guideline currently used in abdominal hernia repair). Several studies evaluating open keyhole technique have shown recurrence rates of 9.4–12.6 % [4, 47], but mesh-related complications were seen in 20 % (mesh migration, severe adhesions [4]). The mechanism for recurrence with the keyhole technique may be through the central aperture and herniation through the mesh openings [16, 41]. In addition, mesh-related infection has been reported where the edge of mesh erodes into bowel requiring mesh removal [16].

Laparoscopic versus open

There has been a widespread increase in the use of laparoscopy in abdominal hernia repair in recent years, as low complication rates and an acceptable recurrence rate have been established [43]. Furthermore, laparoscopy has been associated with a lower risk of infection, a lower risk of postoperative incisional hernias, decreased postoperative discomfort and better tolerance by patients, making it an attractive option in hernia repair [48, 49]. Laparoscopy can help minimize the risk of additional incisional hernias, permit greater mesh overlap, utilize transabdominal fixation and identify hernias not readily seen during open surgery. Currently described approaches for laparoscopy include modified Sugarbaker, keyhole and ‘‘sandwich’’ techniques (combination of both).

The use of laparoscopy in PHR was first described in 1998 by Porcheron et al. [45] and involved primary closure of the fascial defect with sutures, followed by placement of ePTFE mesh. Since this introduction, many have preferred this method as first-line choice with various technical modifications [50]. A systematic review by Hansson et al. [4] has shown that laparoscopic Sugarbaker repairs resulted in a lower rate of recurrence (11.6 %) than laparoscopic keyhole repairs (34.6 %). Laparoscopic sandwich repair had the lowest overall rate of recurrence: 2.1 %. Both the laparoscopic Sugarbaker and keyhole repairs had a very low overall rate of wound infection (2–3 %). Overall morbidity and mortality were similar in both laparoscopic and open groups. Comparing laparoscopic to open, there were no significant differences, with recurrence rate (0–12 %) and overall mesh infection rate (4–14 %) [49, 51–54]. A prospective study using the laparoscopic keyhole technique in 55 patients had a recurrence rate of 37 % (half required reoperation) and two meshes were removed due to infection [51]. Multiple studies have shown modified Sugarbaker method to have favorable outcomes, even in patients with high risk of hernia recurrence [53]. Recurrence rate range from 4 to 12 %, infection rates were low (4–4.5 %), and morbidity rates were low [53, 55]. A review of the literature reveals that laparoscopic modified Sugarbaker and keyhole techniques have recurrence rates of 9.2 versus 19.7 % (range 0–19 and 2.8–46 %, respectively) and mean wound infection was similar with both techniques (3.5 vs. 3.6 %) (Table 2) [47, 51–58]. Mesh was removed in four modified Sugarbaker and 11 laparoscopic keyhole procedures. Overall, modified Sugarbaker method appears to have lower recurrence rates and less mesh-related morbidity. Outcomes comparing biologic versus synthetic mesh in laparoscopic intraperitoneal repair have yet to be adequately studied. However, Ellis et al. retrospectively evaluated 20 patients who underwent open Sugarbaker technique using biologic mesh and report 9 % recurrence during a median follow-up of 18 months.

Table 2 Laparoscopic Sugarbaker versus keyhole technique

Study	Year	Mesh type	# Patients (*N*)	Recurrence % (*N*)	Wound infection % (*N*)	Mesh removed % (*N*)	Follow-up in months (range)
Laparoscopic Sugarbaker technique							
Hansson et al.	2013	ePTFE	61	6.6 % (4)	1.6 % (1)	1.6 % (1)	26 (n/a)
Asif et al.	2012	ePTFE	14	0	7.1 % (1)	0	7.2 (0-14)
Berger et al.	2007	ePTFE	41	19.5 % (8)	4.9 % (2)	4.9 % (2)	24 (3-72)
Mancini et al.	2007	ePTFE	25	4 % (1)	4 % (1)	4 % (1)	19 (2-38)
Mean % (*N*)			141	9.2 % (13)	3.5 % (5)	2.8 % (4)	
Laparoscopic keyhole technique							
Mizrahi et al.	2012	PP/ePTFE[a]	29	46.4 % (13)	3.4 % (1)	3.4 % (1)	28 (12-53)
Wara et al.	2011	PP/ePTFE[a]	72	2.8 % (2)	4.2 % (3)	5.6 % (4)	72 (6-132)
Hansson et al.	2009	ePTFE	55	36.4 % (20)	3.6 % (2)	3.6 % (2)	36 (12-72)
Craft et al.	2008	ePTFE	21	4.8 % (1)	4.8 % (1)	9.5 % (2)	14 (1-36)
Van Sprundel	2004	ePTFE	16	12.5 % (2)	0	12.5 % (2)	29 (5-52)
Mean % (*N*)			193	19.7 % (38)	3.6 % (7)	5.7 % (11)	

PP polypropylene mesh, *ePTFE* expanded polytetrafluoroethylene mesh

[a] PP facing parietal and *ePTFE* facing visceral side

Prophylactic mesh placement

Due to the high frequency of PH and difficulties encountered during recurrent repair, there has been growing interest in preventing PH by mesh reinforcement during the index operation when a stoma is fashioned. Two separate randomized controlled studies placed synthetic lightweight mesh in the sublay position [59, 60]. Incidence of PH was significantly lower (14.8, 13 %) in the study group than in the control group (40, 80 %) during long-term follow-up (29 and 65 months, ranging 13–83 months). A systematic review including seven studies with a total of 179 patients showed that mesh placement during the initial stoma operation resulted in 7.8 % patients with PH compared to 55 % in the control group [61]. There were no meshes removed, and mesh-related morbidity was low in all these studies. Placement of prophylactic mesh during the primary operation appears to be a safe procedure and decreases the risk of PH.

Conclusion

Parastomal hernias are nearly an inevitable consequence of stoma creation. Although the incidence of complicated PH appears to be uncommon, management of CPH is a clinical dilemma and the literature does not directly address management of CPH adequately. Different surgical techniques for the treatment of PH have been described, with variable and unsatisfying results.

The ideal repair should ensure an integral repair of the abdominal wall while preserving the functionality of these stomas. As is the case with other abdominal hernia wall repairs, each repair carries risk of future prolapse or hernia recurrence. The choice of surgical technique will depend on the characteristics of the hernia as well as the patient [46]. Moreover, it is not likely that one technique will be applicable to all patients with PH, as history, presentation and needs are so vastly heterogeneous. Therefore, an individualized approach should be used in choosing the appropriate method.

Suture repair alone is not recommended due to its substantial recurrence rate. Stoma relocation should be considered if the original stoma is incorrectly sited or no longer optimal. Despite the vast array of literature on PHR, the quality of the studies is low and drawing fixed conclusions about the preferred technique is very difficult. The results of open and laparoscopic techniques are comparable. Acceptable outcomes have been shown with fascial repair with mesh, and laparoscopic intraperitoneal mesh approach. The laparoscopic Sugarbaker technique can be performed quickly and is associated with low recurrence. There are emerging studies addressing the use of prophylactic mesh placement that are very compelling, and consideration should be given in patients with risk factors for hernia formation undergoing permanent stoma creation. We recommend open repair for large complex fascial defects rather than risk performing mesh-bridging operations, as a purely laparoscopic repair may not be feasible. From the studies reviewed, biologic mesh does not pose higher infection risk than synthetic mesh and yields acceptable outcomes in complicated hernias. This represents an important advantage in the presence of potentially contaminated and contaminated wounds. Larger studies with long-term follow-up are needed to assess safety and efficacy of various techniques.

Conflict of interest Dr. Stamos is a consultant for Ethicon, Olympus, Gore, NiTi/NovoGI and Adolor/GlaxoSmithKline. Covidien training support has been paid to the University of California, Irvine, for clinical immersion courses for laparoscopic colectomy. Dr. Pigazzi is a consultant for Intuitive Surgical, Cook, Ethicon, Covidien and Cubist. He has received consultancy fees and educational grants paid to the Department of Surgery, University of California at Irvine. Dr. Mills is a consultant for Ethicon Endosurgery. Dr. Carmichael has received educational grant from Ethicon paid to the Department of Surgery, University of California at Irvine. Dr. Hwang and Dr. Hanna have no disclosures.

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G. S. Hwang • M. H. Hanna • J. C. Carmichael • S. D. Mills • A. Pigazzi • M. J. Stamos
Department of Surgery, Irvine School of Medicine, University of California, Irvine, CA, USA

G. S. Hwang
Department of Surgery, Keck School of Medicine,
University of Southern California, Los Angeles, CA, USA

M. J. Stamos (Corresponding author)
Department of Surgery, Irvine School of Medicine,
University of California, 333 City Blvd. West Suite 850,
Orange, CA 92868, USA
e-mail: mstamos@uci.edu