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Prevention and Management of Ileal Conduit Parastomal Hernia*

Learning Objective: At the conclusion of this continuing medical education activity, the participant will be able to describe the risk factors, diagnosis, prevention and management of parastomal hernia in patients who have undergone cystectomy and ileal conduit urinary diversion.

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INTRODUCTION

Bladder cancer is the most common malignancy involving the urinary tract in the United States. The estimated numbers of new cases and deaths from bladder cancer in 2019 were 80,740 and 17,670, respectively, which represents 4.6% of all new cancers and 2.9% of all cancer deaths.[1] Radical cystectomy with urinary diversion is the gold standard treatment for muscle invasive bladder cancer as well as high risk non-invasive variants.[2] The 3 main types of urinary diversion are ileal conduit, orthotopic neobladder and continent cutaneous diversion, with the approach used dependent on patient characteristics and surgeon preferences. Ileal conduit is the simplest technique and has been the most commonly used form of urinary diversion for more than 50 years.[3] Complications following ileal conduit are common and may be mechanical (eg stoma problems, bowel obstruction, ureteral stricture) or metabolic. Stoma related complications are not uncommon and are classified as short-term (bleeding, necrosis) or long-term (stenosis, retraction, parastomal hernia).[4]

PSH, defined as protrusion of peritoneal content through the abdominal wall defect adjacent to the stoma,[5] may be associated with various symptoms and has a negative impact on quality of life. Management of PSH is challenging, with high recurrence rates following surgical treatment. Studies of PSH in urology are limited, although data are available in the general surgery literature (ie colostomy and ileostomy) that can be useful for patients with IC. In this Update we review different aspects of PSH following RC and IC, including epidemiology, risk factors and diagnosis, as well as different techniques of prevention and management.

EPIDEMIOLOGY AND RISK FACTORS

PSH is a common complication in patients with IC urinary diversion. **The incidence of PSH varies from 14% to 48% in different urology series, with a mean rate of 17.1% in the pooled analysis.[5-10]** This variation may be related to different factors including sample size, surgical techniques, diagnostic method (physical examination vs radiological evaluation), varied definition or criteria and duration of follow-up. The largest study reported was issued from the Mayo Clinic and included 1045 patients with conduit diversion.[9] In this series PSH was the most common stoma related complication, occurring in 14% of patients at a median of 2 years. In a study from the University of Southern California, which had a median follow-up of 57 months, the rate of PSH was as high as 23%.[8] Similarly in a retrospective review of the Indiana University cystectomy database the risks of PSH were 12% and 22%, respectively, at 1 and 2 years postoperatively.[6]

Patient related risk factors. PSH is associated with several patient related factors, including advanced age, obesity, poor nutrition, diabetes mellitus, smoking, chronic obstructive pulmonary disease, prolonged ileus, steroid use, wound infection, prior surgery and radiation. Few studies in the urology literature have addressed these risk factors. However, **female gender** (HR 2.25; 95% CI 1.58, 3.21; p <0.0001), **BMI** (HR 1.08; 95% CI 1.05, 1.12; p <0.0001) and **preoperative albumin level** (HR 0.43; 95% CI 0.25, 0.75; p <0.003) are significantly associated with risk of PSH.[7] In fact, the risk of PSH is more than fourfold greater in **obese patients** (BMI >40 kg/m^2) vs those with a normal BMI.[6] Furthermore, **prior exploratory laparotomy** is associated with an increased risk of PSH (HR 1.98, 95% CI 1.97–3.36; p=0.01). **In a systematic review of studies describing PSH following RC and IC age, race, smoking status, alcohol consumption, neoadjuvant radiation, chemotherapy, chronic obstructive pulmonary disease, steroid therapy and diabetes mellitus had no significant association with development of PSH.[10]** However, that review was limited to a few retrospective studies with heterogeneous patients and thus cannot provide a high level of evidence.

Surgery related risk factors. Surgical technique may influence the risk of PSH. Improper stoma placement (ie lateral to rectus sheath) has been proposed to increase the likelihood of PSH. **Nevertheless, a recent Cochrane review did not reveal any difference between lateral pararectal and transrectal stoma placement in terms of PSH development.[11] Current evidence also suggests that the type of stoma (ie Turnbull vs end stoma) would not affect the risk of PSH.[7,12]** In addition, some investigators evaluated the impact of IC fixation to the rectus fascia on PSH formation. In a retrospective study of 496 patients undergoing radical cystectomy and IC Pisters et al showed that **anterior fascial fixation of the IC** compared to no fascial fixation did not reduce the risk of PSH formation.[13] Liu et al also demonstrated that the use of **4 quadrant fascial fixation sutures** did not prevent PSH formation.[6] They highlighted the possible importance of intrinsic properties of abdominal wall fascia, including amount of type 1 collagen deposition, in the development of PSH. Other surgery related factors, including operative time, excessive blood loss and postoperative wound dehiscence, have also been reported to have no effect on development of PSH.[6,7]

CLINICAL PRESENTATION

The majority of PSH cases are asymptomatic and are diagnosed through radiological evaluation. Studies from the University of Southern California and Memorial Sloan Kettering Cancer Center have revealed rates of symptomatic PSH as high as 28% and 40%, respectively.[7,8] Patients who are symptomatic may present with parastomal pain, appliance difficulties and symptoms of intermittent obstruction or, rarely, bowel strangulation. In a large series of patients who underwent RC and IC the most common symptoms attributed to PSH were appliance issues (ie poor fit, leakage),[7] which may also lead to unpleasant odor, spoilage of clothes and skin complications. **Most PSH cases are diagnosed within the first 2 years postoperatively, with a median time to diagnosis of 11.5 to 28 months.[7-9]** Quality of life may also be affected in patients with PSH. In a study evaluating this issue patients with PSH with parastomal bulging reported significant impairment in quality of life regarding symptom load, worry and general sense of well-being.[14]

ABBREVIATIONS: BMI (body mass index), CT (computerized tomography), IC (ileal conduit), PSH (parastomal hernia), PTFE (polytetrafluorethylene), RC (radical cystectomy)

DIAGNOSIS

The diagnosis of PSH is primarily clinical and can usually be made by history and physical examination. Clinical examination is recommended with Valsalva maneuver performed with the patient in the supine and erect positions. The sensitivity and specificity of clinical examination for detection of PSH are reportedly as high as 94% and 100%, respectively.[15] In a retrospective study of 516 patients who underwent RC and IC Liu et al reported that 8.6% of PSH cases were diagnosed by physical examination only, 70.6% by physical examination plus CT and the remainder by CT only.[6]

Radiological evaluation increases the accuracy of diagnosis and may be performed in uncertain cases. Although there is no gold standard diagnostic method, CT has been the traditional imaging modality of choice to confirm the diagnosis or obtain better characterization of PSH. Imaging is routinely performed with the patient in the supine position, although the prone position may increase sensitivity. However, CT may fail to detect 7% of PSH cases, which may present only when the patient is in an upright position.[15,16]

Intrastomal 3-dimensional ultrasonography is a new imaging modality for investigation of PSH that is a promising alternative to CT. The main advantage of this novel technique is the possibility of performing the investigation during clinical examination and directly correlating the 3-dimensional ultrasonography findings with signs and symptoms. In addition, this approach does not expose the patient to radiation.[17,18] Näsvall et al reported a high sensitivity and specificity of this imaging technique to distinguish a bulge from a PSH when assessed by a dedicated radiologist.[18] Nevertheless, the current evidence has not yet confirmed use of ultrasonography as a routine imaging technique for the diagnosis of PSH.

CLASSIFICATION

Several classifications for PSH have been proposed, which are mainly based on clinical examination and CT (Appendix 1).[15,19-21] The value of these classifications lies in the assessment of risk of stoma complications, defining the indication for surgical intervention and uniform reporting between studies to allow comparability and synthesis of outcomes. However, use of these classifications has been limited in daily practice, and none has been validated to date. **Moreno-Matias et al categorized PSH into 3 different subtypes based on a clinicoradiological classification system (fig. 1).[22]** In this classification type Ia is a probable hernia (pre-hernia stage), while types Ib, II and III are considered true hernias. Using this classification system, Donahue et

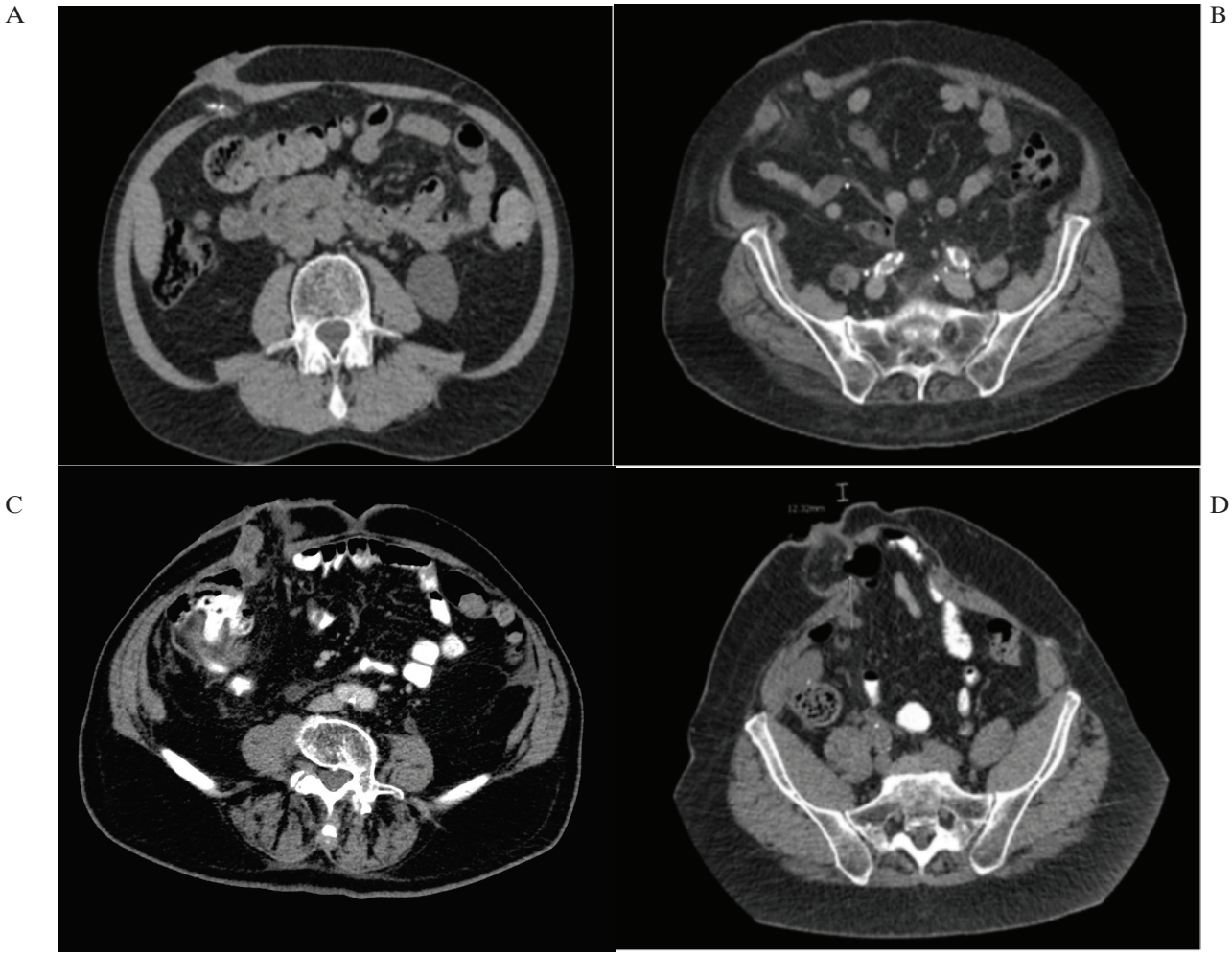

Figure 1. Moreno-Matias radiological classification of parastomal hernia. Type Ia (A) consists of hernial sac containing loop forming stoma, with sac diameter <5 cm. Type Ib (B) consists of hernial sac containing loop forming stoma, with sac diameter >5 cm. Type II (C) consists of hernial sac containing omentum. Type III (D) consists of hernial sac containing loop of bowel different from that forming stoma.

al noted types I, II and III in 4%, 66% and 30% of their PSH cases, respectively, at 2 years following RC and IC.[7]

NATURAL HISTORY

There is no prospective study regarding the natural history of PSH following RC and IC. In a retrospective study Donahue et al reported progression to a higher grade of PSH in 25% of patients.[7] In the study by Moreno-Matias et al 80% and 30% of types I and II PSH, respectively, eventually progressed to type 3 hernias during follow-up.[22]

FINANCIAL BURDEN

Mean wear time of a urostomy appliance (5 days) is decreased for patients with PSH.[23] Current estimates of monthly cost of usual ostomy supply in the United States range from $100 to $300, depending on insurance coverage and usage.[24] Frequent changing of appliances, more expensive custom fit appliances and other accessories required to form a better seal in patients with PSH can drive up the monthly cost of stoma care. Furthermore, parastomal urine leakage may cause skin complications, which can lead to an increase in health care costs.[24, 25]

PREVENTION

The best strategy for PSH prevention has not yet been defined. Different prospective trials have been published in the non-urological (ie general surgery) literature using various mesh devices with different anatomical positioning that showed reduced rates of PSH after mesh augmentation compared to the conventional technique.[19, 26-30] **A 2017 systematic review and meta-analysis of 8 randomized trials indicated that prophylactic placement of mesh at the time of ostomy (ie colostomy or ileostomy) construction significantly decreased the incidence of PSH (OR 0.24, 95% CI 0.10-0.58) without increasing postoperative complication rates.[31]** In addition, Pianka et al also demonstrated superiority of non-absorbable meshes and sublay mesh positioning in open surgery.[31] According to the results of these trials, the European Hernia Society guidelines recommend use of prophylactic synthetic non-absorbable mesh to reduce the PSH rate at the time of elective permanent end colostomy, although there is no recommendation for ileostomies or IC, or use of synthetic absorbable or biological meshes.[15] The cost-effectiveness of mesh prophylaxis in the aforementioned surgeries has been confirmed in multiple studies.[32, 33] Nevertheless, there is still concern regarding use of prophylactic mesh in daily practice due to uncertainty surrounding the most suitable surgical strategy, necessity of spending additional time at the end of a demanding operation and the possible side effects of implanting mesh in the operative field.[34] Future research is expected to further address these issues.

In the field of urology there is a lack of data regarding use of prophylactic mesh in patients undergoing RC and IC urinary diversion. However, the results of 3 ongoing trials are yet to be reported (Appendix 2).[35-37] The outcomes of these trials can help further our understanding of the role of prophylactic mesh in patients with IC.

For preventive mesh placement the University of Southern California technique uses mostly 8×12 cm FlexHD® Structural™ acellular human dermis in an intraperitoneal onlay fashion with either open or robotic surgery (fig. 2).[35] This type of mesh has been chosen due to its unique characteristics, including biocompatibility with anticipated integration and incorporation into abdominal wall as well as low morbidity rate, especially regarding surgical site infection. Different methods can be used, including a Carter-Thomason® suture passer, for circumferential fixation of the mesh to the intra-abdominal wall in a keyhole pattern. We use a Carter-Thomason needle in open and robotic surgeries, and affix the mesh in 6 to 8 places (4 corners and 2 to 4 at midpoint of each side) with 2-zero Vicryl® sutures. The center of the biologic mesh is precut with an almost 2 cm incision and the IC is pulled through it oriented in the proper direction. Turnbull vs rosebud stoma technique can be used to fashion the IC, and the stoma is fixed to the anterior abdominal fascia with interrupted absorbable sutures.

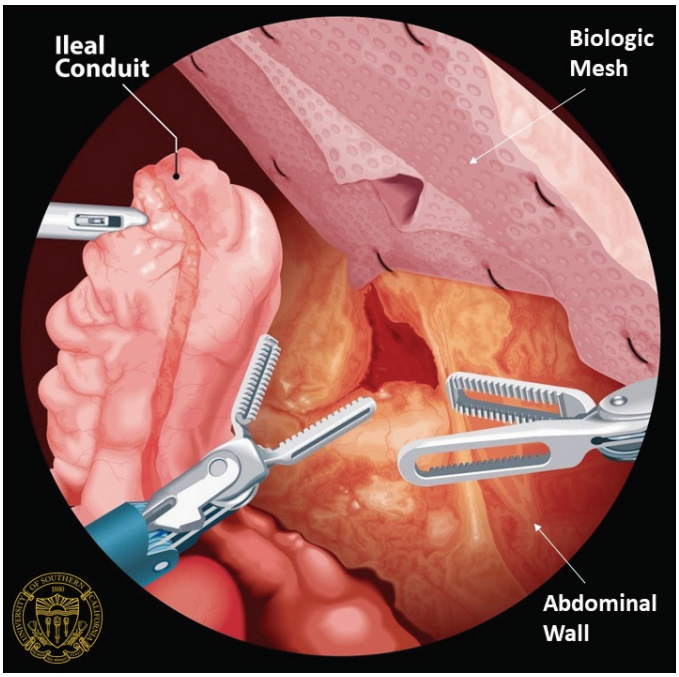

Figure 2. Robotic placement of prophylactic biologic mesh in ileal conduit.

MANAGEMENT

There is a lack of level 1 evidence regarding the comparative outcome of conservative management vs surgery for patients with a non-incarcerated PSH. **Nevertheless, the consensus is to proceed with non-operative management for patients with no or only mild symptoms that are not sufficiently bothersome to warrant repair.[15, 25]** Surgical repair is generally avoided due to its complexity and the propensity for PSH to recur. Risks associated with conservative management include bowel incarceration or strangulation and potential enlargement of the hernia (which may increase the difficulty and risks of subsequent surgery), increased incidence of perioperative complications following emergent surgery and effect on quality of life parameters that should be considered when making clinical decisions.[15] If a decision is made for non-operative management, the patient should be counseled on signs and symptoms of bowel obstruction and strangulation/infarction.

Non-operative management. **Patients without indications for surgery can be treated conservatively.** Use of skin protective sealants, a flexible appliance and a stoma or abdominal support belt can often improve appliance security.[25, 38] A stoma belt is

designed to provide stability around the stoma site to minimize bulging at the skin level. The main goal is not to reduce the hernia but to fix the appliance in a stable position and decrease leakage. While these belts are ideally custom-made for each patient, they may also be available for online purchase. Regular wound ostomy care nursing can be an effective strategy to decrease the rate of stoma appliance leakage and improve quality of life in these patients. Unfortunately most patients do not have access to ostomy care nursing or appropriate accessories such as paste, rings and adhesives. In a study of 743 patients with ostomies who reside in North America only 13% reported regular consultation with a wound ostomy care nurse and 32% stated that they had never visited a wound ostomy care nurse.[39]

Operative management. **Surgical treatment of PSH is limited mainly to patients with severe symptoms and complications due to high recurrence rates following hernia repair.** Although the general surgery literature describes operative repair in 11% to 70% of PSH cases,[40] less than 10% of patients with PSH following RC and IC have required surgery.[7-9] Donahue et al reported that 17% of patients with clinically evident hernias following IC were referred for surgical consultation and 9% underwent repair.[7]

Indications: Absolute indications for PSH repair include incarceration, strangulation, obstruction, parastomal fistula, perforation and stomal ischemia. Relative indications are history of incarceration, recurrent temporary symptoms of obstruction, difficulty in maintaining the collection device, inability to visually control and treat the stoma, hernia related pain, erosion of the surrounding skin, inability to accept the stoma aesthetically, narrow hernia gate resulting in difficulty in its reduction and other concomitant complications with indication for intervention (eg stenosis or prolapse). Relative contraindications to PSH repair are unresectable or metastatic cancer, serious comorbidity and uncontrolled infections including those of the urinary tract and skin near the stoma.[41, 42]

Methods: Different operative methods for PSH repair have been described mainly in the general surgery literature. These methods can be classified based on technique (fascial suture, mesh repair, stoma relocation) and approach (open, laparoscopic, robotic). In addition, when the mesh option is chosen, various materials (biologic, synthetic) can be used in different anatomical positions (onlay, inlay, sublay, intraperitoneal). Each method has had varying rates of success and recurrence. Clinical decision making should be based on local resources, patient preferences, surgical experience and specific patient conditions, including comorbidities, prior surgeries, intraperitoneal adhesions and size of the hernia.

Fascial suture repair is a simple technique with low morbidity but a high recurrence rate of around 70%.[43] Following a parastomal incision and reduction of the hernia sac, in this approach the fascial opening is narrowed with absorbable or non-absorbable sutures. **This technique is not recommended for elective PSH repair due to the high recurrence rates, but should be reserved for patients with small defects in whom there is a strong desire to avoid mesh or more extensive surgery.[15, 25]**

Repair with mesh is the preferred technique for surgical management of PSH due to lower recurrence rates. In a systematic review analyzing various techniques for repair of PSH the risk of recurrence was significantly higher for fascial suture repair compared to mesh repair (OR 8.9, 95% CI 5.2-15).[43] However, mesh repair is also associated with a recurrence rate of 6.9% to 17% as well as other rare complications including mesh infection, erosion causing perforation, adhesions and fistula formation. The overall mesh infection rate is 3%.[43, 44]

Relocating the stoma was a common approach in the past with a lower recurrence rate compared to simple fascial repair. Rubin et al reported that first-time PSH repair with stoma relocation was superior to simple fascial repair, with recurrence rates of 33% and 76%, respectively.[21] **Nevertheless, this technique has not generally been recommended in recent years because of the high rate of hernia at the original and new stoma sites as well as risk of operative morbidity.** The rate of hernia is as high as 52% at the original site, and recurrence rates range from 24% to 86% at the new site after primary stoma relocation with further increase after second relocation.[21, 40] In addition, moving the stoma to the other side is a complex surgery because it generally requires full mobilization of the entire conduit and possible distal ureters that are often densely adherent to the retroperitoneum or great vessels. Complication rates for this surgery are reportedly as high as 40% to 88%.[21, 45] If this option is chosen in selected patients, the stoma should be created on the opposite quadrant. Prophylactic mesh at the new site, in combination with a sublay mesh repair of the abdominal wall defect at the primary stoma site, may potentially decrease the recurrence rates.[40]

Various prosthetic and biologic types of mesh have been used for PSH repair. Polypropylene and expanded PTFE are the most often used prosthetic materials. **Polypropylene mesh is associated with a high rate of complications including development of dense intra-abdominal adhesions and mesh erosion into adjacent organs (ie bowel), and risk of fistula formation.** Hence, this type of mesh is generally not recommended for intraperitoneal use. The risk of infection is relatively low with this type of mesh. In fact, a recent study revealed favorable rates of infection with the use of lightweight polypropylene mesh for ventral hernia repair in a contaminated field.[46] The result of this study has challenged the long held belief that synthetic mesh is unsafe in contaminated fields. **PTFE is a soft, inert material that does not appear to adhere to bowel.[15, 25]** However, PTFE has a tendency to shrink, leading to higher rates of recurrence. PTFE is also more susceptible to infection than polypropylene mesh, although no differences in wound or mesh infections were found between these 2 prosthetic mesh types in a systematic review.[43]

Biologic absorbable meshes recently have gained interest as an alternative to traditional mesh types. The main advantage of biologic mesh is the resistance to infection.[25] Based on studies of other types of abdominal hernia (eg ventral hernia), if the risk of surgical site infection is high, the use of synthetic mesh is contraindicated and biologic mesh is recommended.[47] A systematic review including 4 retrospective studies using a collagen based biologic mesh for PSH repair indicated that biologic grafts have recurrence rates similar to synthetic meshes.[48] However, a recent study using cross-linked porcine dermal collagen biologic mesh with onlay technique showed a 90% recurrence rate with a median time to recurrence of 10 months.[49] In addition, biologic meshes are much more expensive than synthetic ones (Appendix 3) and may lead to higher rates of seroma formation.[50] **According to the available data, there is no evidence supporting superiority of biologic over synthetic meshes in PSH repair.** However, biologic meshes may be considered in patients who are at high risk for prosthetic

mesh associated complications or wound infection.

Composite meshes are composed of more than one material and were developed to mitigate the side effects of prosthetic/biologic meshes. They are made either in bilayer or temporary barrier coated forms.[51] The few studies available on the use of this type of mesh for PSH repair have indicated low recurrence rates (2% to 9%) using different laparoscopic and open techniques.[52-54]

Meshes can be anatomically placed in an onlay, inlay, sublay (preperitoneal) or intraperitoneal onlay position. The mesh is placed on the anterior rectus aponeurosis with the onlay technique, while the inlay technique involves cutting the mesh to the size of the abdominal wall defect and sutured to wound edges. In the sublay technique the mesh is placed dorsal to the rectus muscle anteriorly to the posterior rectus sheath. Finally, in the intraperitoneal onlay technique the mesh is placed intra-abdominally on the peritoneum (fig. 3). Mesh should extend 5 to 10 cm beyond the edge of the defect in all of these techniques.[40]

The inlay mesh technique has largely been abandoned because of high recurrence rates.[25] The onlay method is technically simple with the need for intra-abdominal dissection. Nevertheless, this approach is associated with a higher recurrence rate compared to the sublay technique (17.2% vs 6.9%).[43] The sublay position has the benefit that the mesh is enveloped in well vascularized tissue and also is not in direct contact with the abdominal organs. The intraperitoneal onlay mesh repair is performed with the keyhole or Sugarbaker technique and has the advantage of employment with both open and laparoscopic approaches (fig. 4). **Based on the current evidence, there is no consensus on the best anatomical positioning for mesh placement, although the sublay and intraperitoneal onlay are often used because of their more efficient biomechanical features and lower recurrence rates.**[15, 25, 40, 43]

PSH repair is traditionally done through an open surgical approach. Although the use of minimally invasive surgeries has increased significantly in the last 2 decades, open PSH repair is still the most common approach, with only about 10% of repairs being performed laparoscopically.[55, 56] **Laparoscopic PSH repair is associated with decreased perioperative morbidity and improved short-term outcomes.**[56-58] In a large cohort of patients undergoing PSH repair Halabi et al reported that laparoscopic repair was associated with shorter operative time and length of hospital stay (by 3.3 days), reduced risk of overall morbidity (OR 0.42) and decreased risk of surgical site infections (OR 0.35) compared to open repair.[56] This approach also has the advantages of greater mesh overlap and transabdominal fixation in case of repair with mesh while avoiding the creation of potential new hernia sites.[59] However, in a systematic review and meta-analysis by Hansson et al **open or laparoscopic repair using mesh had no significant difference in terms of recurrence rates.**[43] Furthermore, the odds of mesh infection and morbidity did not differ significantly between laparoscopic and open cases.

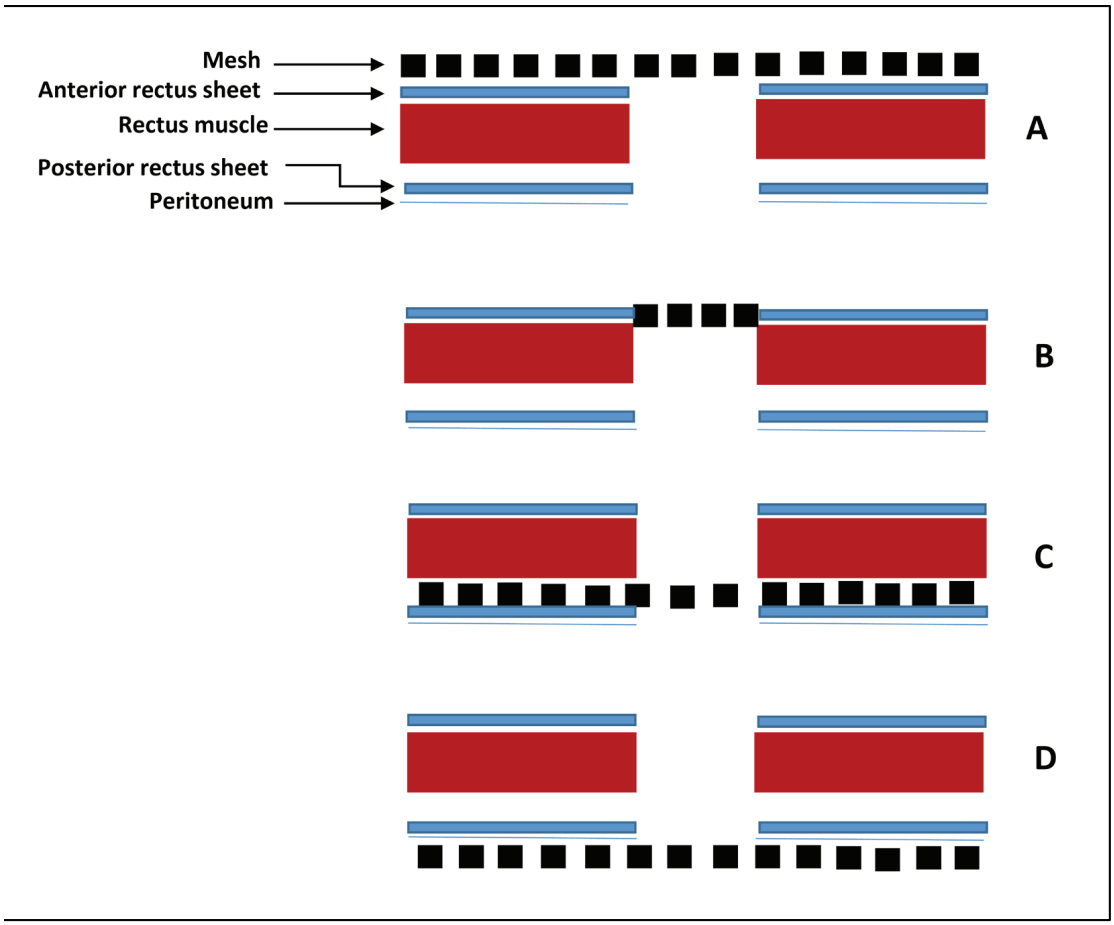

Figure 3. Schematic illustrations of anatomical positions of mesh placement in parastomal hernia repair: (*A*) onlay, (*B*) inlay, (*C*) sublay and (*D*) intraperitoneal onlay.

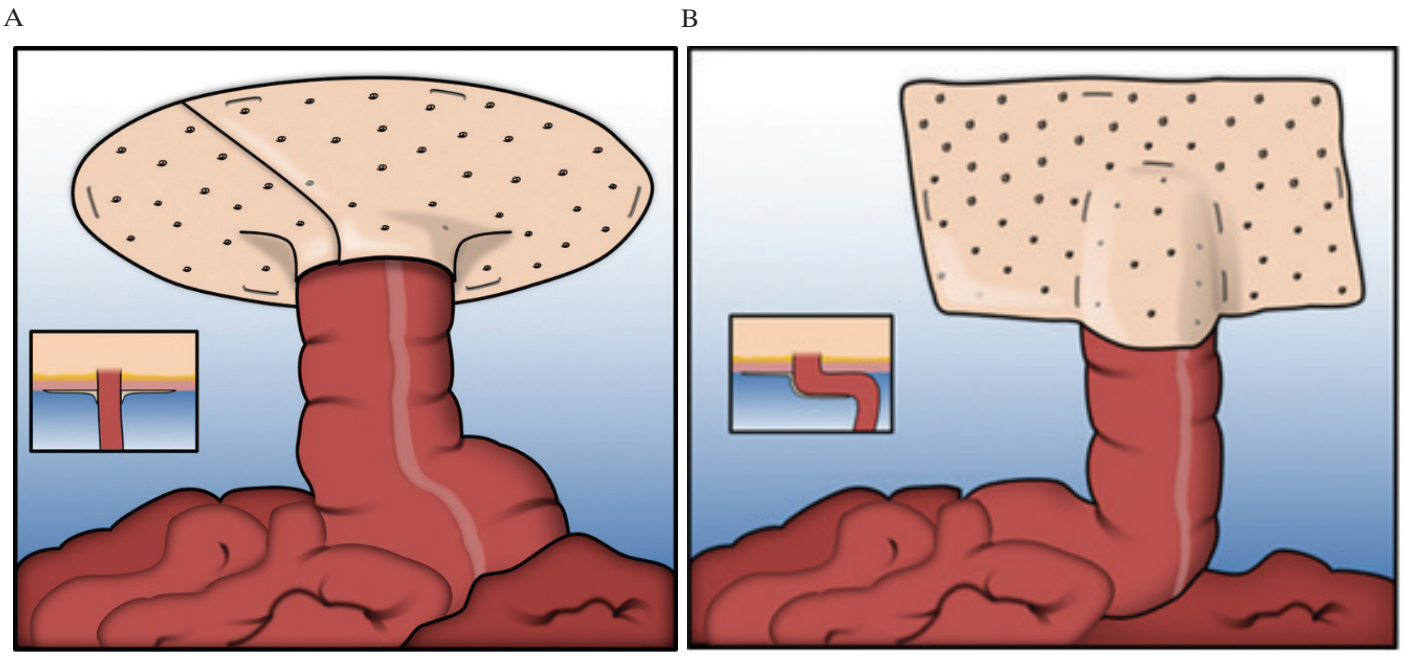

Figure 4. Keyhole (*A*) and Sugarbaker (*B*) techniques for intra-abdominal mesh placement.[64]

There is no evidence to determine which patient with PSH is the best candidate for the laparoscopic approach. Surgical experience, as well as the patient's condition, has an important role in this regard. Based on the experience with other types of abdominal wall hernias, the laparoscopic approach is best reserved for patients with smaller defects, absence of severe adhesions, history of prosthetic infection and lack of need for restoration of muscular reapproximation (eg elderly patients).[60]

Different techniques have been described for laparoscopic PSH repair. The **keyhole technique** involves placement of mesh with a central hole or a slit surrounding the bowel loop forming the stoma. In the **laparoscopic modified Sugarbaker technique** the mesh covers the bowel loop, which is laid in a side-to-side fashion on the abdominal wall (fig. 3). The **sandwich technique** is a combination of these 2 approaches and has the lowest recurrence rate (2.1%). It is noteworthy that **the laparoscopic Sugarbaker technique has been observed to have a significantly lower recurrence rate compared to the keyhole technique (OR 2.3, 95% CI 1.2–4.6, p=0.01)**.[43]

Robotic PSH repair is performed in a manner similar to the laparoscopic approach. Among the few reported case series on this approach LeBlanc noted no recurrence during 2 to 36 months of follow-up in 16 robot-assisted PSH repairs using mesh.[61] Mekhail et al also demonstrated the safety and feasibility of robotic PSH repair in a small case series of patients with PSH following RC and IC.[62] They used a keyhole technique with biologic mesh and reported minimal morbidity and good short-term outcomes. Further studies with larger sample size and longer follow-up are required to confirm the outcomes of the robotic approach.

RECURRENCE

PSH repair is associated with a wide range of recurrence rates due to variations in surgical technique, definition of PSH recurrence (ie radiographic, clinical), type of stoma, indications for intervention and length of follow-up. Surgical technique is probably the most important factor associated with PSH recurrence.[63] Few reports are available in the urology literature that include heterogeneous patients and procedures. Kouba et al reported a 50% recurrence rate following PSH repair in 6 patients with IC.[5] Five cases were done laparoscopically and 1 using an open approach, and in all cases the fascial defect repair was done with mesh using the same ostomy site. Liu et al also reported a 27% PSH recurrence rate following repair, with 57% of patients undergoing a second surgical repair.[6]

Limited studies are available on the feasibility and outcome of recurrent PSH repair. It is a challenging surgery, especially if mesh has been used in the original repair. If onlay or sublay mesh has been used previously, the next step could be repair using intraperitoneal mesh. Stoma relocation to the opposite side is another option that may have promising results.[63] Prophylactic mesh during creation of the new stoma may also be helpful in this setting.

FUTURE DIRECTION

Most of the data regarding PSH in urology are based on a few retrospective studies of non-homogeneous cohorts. Prospective studies are needed to provide a high level of evidence for the best method of prevention and treatment of PSH. **There are 2 ongoing trials in the United States on the use of prophylactic mesh in patients with ileal conduit (Appendix 2).** These trials will be closed in 2020 and their results will be reported in subsequent years. Moreover, novel techniques with new generation of mesh materials are expected to improve outcomes while decreasing morbidity. **Increased use of minimally invasive, including robotic, approaches in recent years will expectantly help to improve perioperative morbidity as well as surgical outcomes in patients undergoing PSH repair.**

DID YOU KNOW?

- PSH is a common complication in patients undergoing radical cystectomy and ileal conduit urinary diversion, with a mean rate of 17.1% (range 14%-48%).
- Female gender, obesity, low preoperative albumin and history of laparotomy are associated with increased risk of PSH.
- Most PSH cases are asymptomatic and found primarily during physical examination, although imaging (ie CT) increases the accuracy of diagnosis.
- There are no data regarding the efficacy of prophylactic mesh in patients with ileal conduit. The results of current ongoing trials are yet to be reported.
- Most parastomal hernias are managed conservatively, and surgical treatment is limited to patients with severe symptoms and/or hernia complications. Mesh repair with an open or minimally invasive approach is the preferred technique due to lower recurrence rates.

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Appendix 1. Different classifications of parastomal hernia

Devlin:[19] Type I: interstitial hernia Type II: subcutaneous hernia Type III: intrastomal hernia Type IV: peristomal hernia (stoma prolapse)	**Rubin et al**:[21] Type I: true parastomal hernia Ia: interstitial Ib: subcutaneous Type II: intrastomal hernia Type III: subcutaneous prolapse Type IV: pseudohernia (connected with flank insufficiency or denervation)
Gil and Szczepkowski:[20] Type I: isolated small parastomal hernia Type II: small parastomal hernia with coexisting midline incisional hernia (without any significant front abdominal wall deformity) Type III: isolated large parastomal hernia (with significant front abdominal wall deformity) Type IV: large parastomal hernia with coexisting midline incisional hernia (with significant front abdominal wall deformity)	**European Hernia Society**:[15] Type I: PSH ≤5 cm without cIH Type II: PSH ≤5 cm with cIH Type III: PSH >5 cm without cIH Type IV: PSH >5 cm with cIH

cIH=concomitant incisional hernia.

Appendix 2. Ongoing clinical trials using prophylactic mesh in patients with ileal conduit

Title	PI/Institute	Design	Type of mesh
Biologic Mesh in Preventing Hernia in Patients With Bladder Cancer Undergoing Radical Cystectomy With Ileal Conduit Diversion[35]	Hooman Djaladat/ University of Southern California	Open-label, randomized	Acellular cadaveric dermal matrix
A Study to Determine if Mesh Placement During Bladder Surgery Can Reduce the Chances of Developing a Hernia[36]	Bernard Bochner/ Memorial Sloan Kettering Cancer Center	Single-blind, randomized	Ultrapro®
Role of Mesh Stoma Reinforcement Technique (MSRT) in Prevention of Parastomal Hernia After Ileal Conduit Urinary Diversion[37]	Ahmed E. Mosbah/ Mansoura University	Single-blind, randomized	Polypropylene

Appendix 3. Costs of biologic and synthetic meshes used for parastomal hernia repair[48]

Material	Source	Cost per cm^2
AlloDerm®	Human dermis	$35.31
Permacol™	Porcine dermis	$18.97
Surgisis®	Porcine small intestinal submucosa	$20.00
Collamend®	Porcine dermis	$18.88
Peri-Guard®	Bovine pericardium	$3.91
Veritas®	Bovine pericardium	$22.02
Ultrapro	-	$5.28
Polypropylene/expanded PTFE	-	$3.65

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Study Questions Volume 39 Lesson 21

1. A 70-year-old man with a history of cystectomy and ileal conduit for a nonfunctional bladder 6 months prior and recurrent urinary tract infections is seen in follow-up. He denies pain, infection or difficulties with his appliance. On examination there is a parastomal defect with a non-tender bulge. The next step is
   a. continue routine follow-up
   b. intrastomal 3-dimensional ultrasound
   c. abdominal CT with Valsalva maneuver
   d. surgical repair of parastomal hernia

2. A 65-year-old woman with a history of radical cystectomy and ileal conduit has a parastomal hernia. Abdominal CT reveals a 3 cm fascial defect adjacent to the conduit, which contains omentum. According to the Moreno-Matias classification, the type of hernia is
   a. Ia
   b. Ib
   c. II
   d. III

3. A 70-year-old man has a symptomatic parastomal hernia following robotic radical cystectomy and ileal conduit. He also has a history of open bilateral inguinal hernia repair and laparoscopic cholecystectomy. His current BMI is 40. The best surgical approach for this patient is
   a. fascial suture repair
   b. hernia repair with biologic mesh placement
   c. hernia repair with prosthetic mesh placement
   d. stoma relocation with mesh placement at both primary and secondary sites

4. Compared to a laparoscopic parastomal hernia repair, an open approach is associated with
   a. increased operative time
   b. decreased length of hospital stay
   c. decreased perioperative morbidity
   d. increased recurrence rate

5. A 60-year-old morbidly obese woman with diabetes with a parastomal hernia following radical cystectomy and ileal conduit is scheduled for hernia repair with biologic mesh. The main advantage of biologic mesh compared to the prosthetic mesh is
   a. decreased risk of infection
   b. decreased recurrence rate
   c. decreased risk of seroma
   d. lower price

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