Review Article

Risk Factors for the Development of Parastomal Hernia: A Narrative Review

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Abstract

Parastomal hernia is one of the most common late complications after stoma formation, significantly decreasing patient's quality of life and negatively impacting body image and physical functioning. Progress has been made regarding the surgical technique of stoma creation in different categories of patients, but a better understanding of the risk factors is crucial in reducing the likeliness of parastomal hernia formation and in helping develop risk stratification strategies for pre-and post-operation management. However, currently there is limited consensus on the associated risk factors. Accordingly, for this narrative review, the authors conducted a literature review through three databases (PubMed, Web of Science, and Scopus) and categorized the identified risk factors into the following three categories: patient-, surgery-, and disease-related. Within these categories, the following 10 risk factors were identified and discussed: age, gender, waist circumference, type of ostomy, laparoscopic approach, aperture size >3 cm, stoma not passing through the middle of rectus abdominis muscle, BMI >25 kg/m^2, altered collagen metabolism, and diabetes.

Keywords: Colostomy, incisional hernia, parastomal hernia, risk factors, stoma

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Submitted: 18-May-2022 **Revised:** 13-Mar-2023 **Accepted:** 07-Jun-2023 **Published:** 15-Jul-2023

INTRODUCTION

Colostomies, enterostomies and ileal conduit stoma continue to be very important components of surgical practice. Among the frequently encountered complications, parastomal hernia (PH) is one of the most common late complications after stoma formation.[1] The reported prevalence of PH is between 30%–50%, with a wide variation due to differences in follow-up period, lack of a consistent definition, and the use of a clinical diagnosis without a CT-scan evaluation.[1-3] Accordingly, the incidence of PH has varied across studies: 36% in the 1-year follow up after surgery,[2] 37.8% using CT-scan to define PH,[1] and an increase from 52% to 78% at 15 months of follow-up using a clinical examination along with a CT-scan evaluation.[3]

A proposed definition of PH is an incisional hernia, in which one or more loops of the intestine protrude through the wall defect, causing the skin in the vicinity of the stoma to bulge.[4-6] Several risk factors, patient, disease, and surgery-related, have been proposed or demonstrated as being involved in the occurrence of PH.[6-8] PH is not only related to a significant decrease in patient's quality of life, body image, and physical functioning,[9,10] but also highly related to other future complications such as abdominal/

Access this article online

Quick Response Code:

Website: https://journals.lww.com/sjmm

DOI: 10.4103/sjmms.sjmms_235_22

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How to cite this article: Manole TE, Daniel I, Alexandra B, Dan PN, Andronic O. Risk factors for the development of parastomal hernia: A narrative review. Saudi J Med Med Sci 2023;11:187-92.

back pain, bowel obstruction, or peristomal skin disorders, representing a high economic burden for health-care facilities.[11,12]

Progress has been made regarding the surgical technique of stoma creation in different categories of patients, but a better understanding of the risk factors is crucial for reducing the prevalence of PH and in helping develop risk stratification strategies for pre-and post-operation management. However, currently there is limited consensus on the associated risk factors. Accordingly, the aim of this paper is to review and determine the risk factors mostly associated with the development of PH following colostomies, which in turn could potentially lead to studies in the future for minimizing their involvement.

A literature review was conducted using PubMed, Web of Science, and Scopus using the following search formula: risk factors AND parastomal hernia OR peristomal hernia. Only studies that were published in English, had full text available, and were published within the past 15 years were included; the final search was carried out in May 2022. In addition, gray literature was searched for relevant manuscripts. Finally, all relevant articles (N = 33) were then included in the preparation of this narrative review.

DEFINITION AND CLASSIFICATIONS

To improve the ability to compare different studies, a generally accepted definition of PH must be used. There is a lack of consistency when it comes to defining PH and different classifications in literature were developed in the attempt to facilitate uniform reporting of the studies concerning the topic. The current classifications take different aspects into consideration: physical examination, intraoperative findings, and radiological criteria.

In 2014, the European Hernia Society (EHS) proposed a classification for PHs considering two components on radiological examination, namely, the size of the PH defect and the presence of a concomitant incisional hernia (IH), which is defined as any protrusion at the site of the surgical scar. This resulted in the following four subcategories for guiding therapeutic approach:[13]

- Type I: PH defect ≤5 cm without IH
- Type II: PH defect ≤5 cm with IH
- Type III: PH defect >5 cm without IH
- Type IV: PH defect >5 cm with IH

A multicenter cross-sectional study from 2014 demonstrated that the presence of PH represents a risk factor for IH. Patients with PH were found to have a seven times higher risk of developing an IH compared with patients without PH. Moreover, the increased prevalence of IH observed during the follow-up period of this group having abdominoperineal resection or Hartmann's procedure, had been attributed to the presence of PH, opening a new perspective for future research. It should be noted that while the EHS classification system has been utilized to provide an accurate examination of the incision scar and of hernia itself, when present,[14] it has not been clinically validated.

Another classification considers the findings of CT scan, which is an excellent tool for the early identification of subclinical PH and for a consistent follow-up of reoccurrences.[15] The Moreno-Matias (MM) Classification of PH divide PH as follows:

- Type 0: Normal, peritoneum follows the wall of the bowel forming the stoma with no formation of a sac.
- Type I: The hernia sac containing the bowel forming the stoma (in Type Ia, the diameter of the sac is <5 cm, while in Type Ib, the diameter of the sac >5 cm).
- Type II: The omentum is within the hernia sac, together with the bowel forming the stoma.
- Type III: Comprising an intestinal loop (other than that forming the stoma).

Only Types Ib, II, and III are considered true PHs. Although CT scan classification is reproductible and positively impacts the detection of PH, another paper suggests that this should be used together with a careful clinical examination to provide the best results for each patient and to better estimate the prevalence of PH.[16]

Interestingly, a very recent study retrospectively analyzed 705 postoperative CT scans from 154 patients with permanent stoma creation following colorectal resection to determine the use of EHS and MM in predicting the need for PH surgical repair at the time of diagnosis.[1] This study found that only the EHS classification showed a certain degree of predictive value between the type of PH and the need for surgical repair, wherein type III PH was associated with a lower incidence of surgical repair compared with type I PH. These results could be explained by considering the indications for surgery depending on the type of PH. Further, this study could represent a starting point for future debates on whether the radiological classification of PH could play a role in surgical planning.[17]

RISK FACTORS

The etiology of PH is not well understood. For a long time, the risk factors for IH and PH were considered

to be similar; however, this view has evolved based on several recent studies demonstrating differences in risk factors, and thus, management. Considering that temporary or permanent colostomy creation are life-changing procedures. PH as a late stoma complication only adds up to the impairment in the quality of life of these patients, and thus needs to be adequately addressed through a comprehensive understanding of the risk factors involved in its development.

Three categories of risk factors can be considered: patient-, surgery- and disease-related [Table 1]. In the patient-related category, the following risk factors have been identified in several studies: old age, gender, and waist circumference.[1,2,4,6,18-21] The surgery-related category risk factors include the type of ostomy, laparoscopic approach, the site of specimen extraction, aperture size, transperitoneal route of stoma creation, and a stoma that did not pass through the middle of the rectus abdominal muscle.[2-6,12,18,19,21-24] Finally, disease-related risk factors include BMI ≥25 kg/m^2, malignancy leading to ostomy surgery, diabetes mellitus, ulcerative colitis, chronic obstructive pulmonary disease, and collagen III alterations.[1,2,4,5,18,20,22-26] Other risk factors taken in consideration in some of the studies were malnutrition, diverticulitis, increase in intraabdominal pressure, and prior diagnosis of hernia. In the future, a risk stratification system that corroborates all these risk factors to provide an individual risk score for each patient could be beneficial in both pre- and postoperative management.

PATIENT-RELATED RISK FACTORS

Age

Age has been identified as an independent risk factor of PH occurrence in eight studies included in this review, wherein, mostly, being aged 60–70 years has been reported as a significant risk factor for PH.[1,2,4,6,19-21,27] This is likely because with age, the strength of the abdominal muscles tends to decrease, resulting in the abdominal wall becoming incapable of providing the needed support for a stoma creation.

In 2011, a large-scale study with a 10.5-year follow-up, found that being aged >60 at the time of diagnosis was an independent risk factor for PH.[21] Similarly, in a recent study where stoma creation was done after colorectal surgery in patients with ulcerative colitis, older age was found to significantly increase the risk of PH formation.[20] However, it should be noted that both these were retrospective studies. Nonetheless, in a register-based prospective study from Denmark, which included data of 5019 patients who underwent ileostomy or colostomy and were followed-up for 400 days, age was found to significantly increase the risk of PH, corroborating the findings of other studies. Interestingly, this study found that the prevalence of PH formation within the follow-up period was 36.2%.[2] In fact, a small-scale prospective study has found that the risk of developing PH increased by 4% for every year added to the patient age.[19] Based on this, future studies should study age-related comorbidities as risk factors for PH formation.

Table 1: Risk factors for parastomal hernia development

Patient-related	Surgery-related	Disease-related
Age	Type of ostomy	BMI >25 (kg/m^2)/obesity
Gender	Laparoscopic versus open approach	Diabetes
Waist circumference	Aperture size >3 cm	Collagen III
	Rectus abdominis muscle	

BMI – Body mass index

Gender

There are discrepancies in findings in terms of which gender is associated with higher risk of developing PH. While retrospective studies have reported female gender was associated with increased risk of PH formation,[1,6,18] the prospective large-scale study from Denmark found male gender was an independent risk factor.[2] Future debates might emerge on the topic, therefore, using more solid instruments with statistical power are needed to elucidate the differences.

Waist circumference

A study found that waist circumference of >100 cm increased the risk of developing PH by 75% and this was an independent risk factor in the development of PH after permanent colostomy, suggesting the potential benefit these patients could take from prophylactic mesh placement during the primary surgery. Similar findings were noted in a cross-sectional study that included 756 respondents.[4] However, additional studies are required to substantiate these findings.

SURGERY-RELATED RISK FACTORS

Type of ostomy

The correlation between the type of ostomy such as ileostomy, colostomy, or urostomy and the increased incidence of PH formation has been widely studied. Patients who have had performed a colostomy are at greater risk of developing a PH compared with those having an ileostomy or urostomy. In a cross-sectional study, Temple *et al*.[4] concluded that the risk of developing PH was highest after colostomies, followed by ileostomy and urostomy. Moreover, the presence of a larger colostomy size was highly associated with the presence of PH, but

this correlation was not seen with other types of stomas. However, the main limitation of this study is defining PH based on case reports. Another paper published in 2010 by Nastro *et al*.,[22] analyzed the complications and risk factors associated with PH in a large sample of 1216 patients, of which 647 underwent a colostomy, and concluded that formation of an end colostomy after surgery for malignancy was a dominant risk factor, along with respiratory co-morbidity and diabetes. These results are in line with two more publications cited in literature,[2,21] further supporting the theory that colostomy, especially end colostomy, is the main risk factor for developing PH in terms of the type of colostomy performed.[19,28,29]

Laparoscopic versus open approach

The Laparoscopic approach is generally considered to have more benefits for the patients when it comes to esthetic outcomes, rate of postoperative infections, and faster recovery. However, in terms of stoma, laparoscopy was demonstrated as an important risk factor for potentially developing a PH. In a prospective study conducted by Funahashi *et al*.,[5] which evaluated 80 patients, 27.5% developed PH during a follow-up of approximately 953 days. Regarding the risk factors thought to be associated with the formation of PH, their findings matched the ones of Western countries, demonstrating that the laparoscopy approach can significantly increase the incidence of PH. Moreover, transperitoneal route of stoma creation is another risk factor for PH development. This study comes in line with other papers published that confirmed the involvement of laparoscopic approach in PH occurrence.[2,19,30] It has been stated that PH occurs in 18% of the cases after using a laparoscopic method compared with only 2% after open procedures.[30] In this regard, it is recommended to not use the same site for specimen extraction rather than through a separate incision in the attempt to lower the risk of PH if laparoscopic approach is used.[30]

Another study that studied if single site laparoscopic approach compared with standard laparoscopic approach led to an increased risk of hernia development found no correlation between PH formation and different types of laparoscopic approaches.[31]

Although the laparoscopic approach increases the incidence of PH if used for the creation of the stoma, studies have shown a decrease in recurrence rate with the modified Sugarbaker technique in an attempt to correct an already formed PH, with no major postoperative complications, but the recommendation for this procedure is not precise.[32,33] Another study identified laparoscopic approach as being the only independent risk factor associated with the misplacement of the stoma.[12]

Aperture size

Both preoperative and postoperative CT scans provide adequate body metric characterization. In a recent study, which included patients who had undergone permanent colostomy and were followed-up for 1 year, the benefits of performing CT scans after stoma surgery were highlighted, most importantly for measuring the size of the ostomy created in the abdominal wall. The study found that an aperture size >34 mm was an independent risk factor for PH occurrence.[23] Similar findings have previously been found, wherein a wall defect <30-mm diameter results in a better outcome.[6,18,24] In another prospective study, where aperture size was an independent predictor of PH in the multivariate analysis, it was found that every increase in 1 mm of the stoma diameter increases the risk of PH formation by 10%.[19]

Rectus abdominis muscle

Two very recent retrospective studies have found that a stoma not passing through the middle of the rectus abdominis muscle is an independent risk factor for PH formation.[12,24] Rectus abdominis muscle was defined as the distance from the later edge to the medial edge of this muscle, separating this distance into three equal parts. The center third of this division is represented by the middle of the rectus abdominis muscle. CT scan was used in both studies not only to confirm the presence of PH, but also to identify its relationship with rectus abdominis muscle. The findings of these studies indicate the requirement for further studies to consolidate these findings.

DISEASE-RELATED RISK FACTORS

Body mass index ≥25 kg/m²

Based on the currently available data, a BMI of >25 kg/m² has been identified as one of the main risk factors associated with PH development.[1,5,20,24-26] Obesity induces a higher intraabdominal pressure, resulting in a low containment capacity of the abdominal cavity. Unsurprisingly, a recent study that included 6329 patients with a permanent stoma showed that in the multivariate analysis, a BMI >30 kg/m² was the only independent risk factor for PH formation.[26] Accordingly, before stoma creation operation in obese patients, other risk factors should be minimized, such as aperture diameter or locating the stoma through the rectus abdominis muscle, so as to minimize the possibility of PH development. For obese patients, randomized controlled trials can be conducted to determine if the use of mesh during colostomies and controlling perioperative bodyweight could minimize their risk of PH.

Diabetes

In a retrospective study, Nastro *et al*.[22] found diabetes to be one of the risk factors for PH, in addition to respiratory co-morbidities and the formation of an end colostomy. More recently, LaChapelle *et al*.,[20] in their retrospective cohort analysis of 423 colorectal surgery patients who underwent a subtotal colectomy for ulcerative colitis, found that those with diabetes were at increased risk of developing PH. However, currently, there is limited data to suggest a strong association between diabetes and the development of PH.

Collagen III

Types I and III are the main types of collagens in the derma. Collagen type I is stable and responsible for wound healing in the later stages of the wound-healing processes. On the other hand, collagen type III is mostly found in the early stages of wound healing. The Type I: III collagen ratio is used to qualify the collagen content in tissue samples and altered collagen metabolism is determined through decrease in this ratio. This is substantiated by findings from a recent study, wherein collagen type III and procollagen III levels were found to likely be involved in PH development.[18] However, other regulatory factors of collagen III synthesis must be analyzed.

CONCLUSIONS

PH is a significant complication after stoma formation. This review describes the risk factors in three categories as patient-related (aged >60 years), surgery-related (end colostomy, laparoscopic approach, aperture size >3cm, and a stoma not passing through the middle of rectus abdominis muscle) and disease-related (BMI >25kg/m^2 and altered collagen metabolism). In addition, waist circumference, gender, and diabetes have also been indicated as risk factors for PH occurrence; however, the evidence around these factors is not adequate, and thus requires future research to investigate the association.

Data availability statement

Data sharing is not applicable for this article, as no new data were created or analyzed.

Peer review

This article was peer-reviewed by two independent and anonymous reviewers.

Author Contributions

Conceptualization & Design: T.E.M., I.D., O.A., and P.N.D.; Literature search: T.E.M., O.A., B.A., and P.N.D.; Data acquisition & Analysis: T.E.M., I.D., B.A., P.N.D., and O.A.; Writing – original draft preparation: T.E.M., O.A., I.D., and P.N.D.; Writing – review and editing: T.E.M., I.D., B.A., P.N.D., and O.A.

All authors have read and agreed to the published version of the manuscript.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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