Original article

Evaluating risk factors for development of a parastomal hernia: a retrospective matched case-control study

ABSTRACT

Aim Identify risk factors most likely to contribute to parastomal hernia development.

Methods Retrospective matched case-control study using retrospective case note reviews. One public and one private South Australian hospital. Ostomates who underwent stoma formation surgery between 2018 and 2021, and did ('cases', n=50) or did not ('controls', n=50) develop parastomal hernia were matched by ostomy type. Potential parastomal hernia risk factors were identified from the literature and expert opinion to build a case note review tool. Case notes were selected by surgical date from 2018. Analyses were conducted in which univariable logistic regression investigated relationships between potential risk factors and parastomal hernia development. Exploratory subgroup analyses investigated whether relationships between risk factors and development of parastomal hernia differed according to ostomy type.

Results Patient characteristics were summarised descriptively and by hospital. Statistically significant evidence was found of links between development of parastomal hernia and higher BMI (OR for 5 kg/m2 increase: 1.74; 95% CI: 1.19, 2.76), post-operative infection (OR 2.68; 95% CI: 1.04, 7.33), multiple abdominal surgeries (OR 4.21; 95% CI: 1.18, 19.90), time since surgery (OR >30 months: 0.003; 95% CI: 0.0004, 0.02), and aperture size (OR for 1mm increase: 1.12; 95% CI: 1.02,1.24). Sufficient evidence was not found of expected relationships with factors such as smoking, chemotherapy and/or pelvic radiotherapy, lifestyle and activity factors.

Conclusions This study contributes to furthering the understanding of the relationships between known risk factors to inform stomal therapy nurses' practice in the prevention of a parastomal hernia.

High body mass index, postoperative infection, multiple surgeries, wide diameter of the stoma, and time since surgery of less than 30 months increased the risk of parastomal hernia, other factors did not reach significance probably due to use of an underpowered sample.

Opportunities to repeat this study would further strengthen the necessary evidence of the most important risk factors.

Keywords stomas, parastomal hernia, risk factors, stomal therapy nurses, retrospective matched case-control study

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BACKGROUND

Several conditions may lead to the formation of an intestinal stoma, including bowel/rectal and bladder cancer and inflammatory bowel disease. A stoma is a surgically created opening on the abdomen allowing stool or urine to leave the body via a colostomy, urostomy, or ileostomy. Estimated ostomy numbers vary worldwide. Recent numbers in the United States are more than 725,000;[1] European numbers are estimated at around 700,000;[2] and Australian numbers are approximately 50,000.[3] A parastomal hernia, when the intestines press outward through an abdominal wall defect in the vicinity of the stoma, is one of the most common complications experienced by people (Ostomates) who have had stoma formation surgery.[4] While estimated rates of parastomal hernia development vary, many estimates suggest around 50% of people with a stoma will develop a potentially preventable parastomal hernia.[4] Parastomal hernias are often painful and disruptive, impairing an Ostomate's quality of life.[5,6,7]

A systematic review by Zelga et al,[8] identified multiple risk factors that may contribute to developing a parastomal hernia including: body mass index (BMI); tobacco or alcohol misuse; presence of comorbid conditions (such as diabetes mellitus, coronary heart disease, hypertension, and chronic obstructive pulmonary disease). Several surgery-related factors were also identified including type of stoma (e.g. in the small or the large intestine, loop versus end stoma, surgeon's expertise), position of the stoma on the abdomen and the setting in which the ostomy was created (emergency vs elective). Another factor identified in the literature is malnutrition causing poor healing of the stoma or wound.[9] Finally, some research suggests parastomal herniation is more likely to occur in women than men.[10]

The purpose of this article is, firstly, to report the results on the most likely risk factors that would contribute to the development of a parastomal hernia to refine current parastomal hernia risk assessment tools; and secondly, to document the process of undertaking a retrospective matched case-control study. It is hoped that this will inform replication by future researchers to strengthen the available evidence and advance the understanding of the risks for developing a parastomal hernia. STROBE guidelines for reporting observational studies provided direction on reporting.[11]

METHODS

Research Design

A retrospective matched case-control study by way of case note review was undertaken to identify risk factors that appear to have strongest association with development of parastomal hernia after surgery.

Setting

The case note review was conducted at two sites: one major metropolitan public hospital and one smaller private metropolitan hospital in South Australia where stoma surgery is undertaken. Experienced stomal therapy nurses are employed at both hospitals working closely with colorectal surgeons to provide support to Ostomates.

Participants

The retrospective case note review consisted of two participant groups of Ostomates who had stoma formation surgery between 2018–2021. Group 1 were 'cases': a selection of case notes of some, not all, Ostomates who developed a parastomal hernia within this time frame (after original surgery) (*n*=50). The second group were controls: a selection of case notes of Ostomates who did not develop a parastomal hernia between 2018–2021 (after original surgery) (*n*=50), and they were proportionally matched according to type of ostomy. The identification and reporting of parastomal hernias were informally diagnosed by stomal therapy nurses or by confirmed computed tomography scans following medical review for suspected parastomal hernia. Selection of case notes was sequential, starting with the earliest surgeries from 2018. An equal number of case and control notes was to be selected from each of the two hospitals, with the intention that each hospital provide 25 case and 25 control case notes. However, this was not able to be achieved due to availability of case notes on each site. Therefore, 99 case notes were analysed: 50 from the public hospital (25 cases and 25 controls), and 49 from the private hospital (23 case and 26 control).

To ensure appropriate representation of ostomy type at each of the two hospitals (with different ostomy profiles), approximate observed proportions between 2018 and 2021 were purposively, or specifically, sampled. At the public hospital the proportion was 56% Ileostomy/40% Colostomy/4% Urostomy, while at the private hospital the proportion was 36% Ileostomy/36% Colostomy/28% Urostomy which corresponds with the percentage of ostomy surgery type at each respective hospital. To achieve these proportions, this meant (for example) ignoring notes from one ostomy type if the requisite quota for that type had already been met (See Figure 1).

Review tool and data sources

The case note review tool was developed through identifying key risk factors for parastomal hernias from the literature, the Association of Stoma Care Nurses, United Kingdom Risk Assessment Tool,[12] two previous Australian studies of stomal therapy nurses' perceptions[13] and the lived experiences of Ostomates.[14] The multidisciplinary nature of the research team was critical in the development and appraisal of the review tool to ensure input of relevant academic and clinical experience including physiotherapy, stomal therapy, and psychology, as well as a robust understanding of the evidence base (from biostatisticians). To ensure inter-user reliability and consistency in data collection, the final review tool was piloted by four members of the research team, who held positions in each hospital, until 100% agreement was reached on the items within the review tool. Four case notes each from the case and control groups were piloted. These case notes were not

included in the final review. Assessing activity levels proved difficult when piloting the tool. However, the decision to include the metabolic equivalent of task (frequently referred to as METs)[15] made this more feasible. This tool was often used by anaesthetists and was therefore recorded in the patients' preoperative anaesthetic assessment. Other minor changes were made to the review tools' wording and items to improve clarity and relevance.

Data collection and Statistical methods

Using patient case note numbers (unit records), case notes for review were selected through sequential selection from a list from each hospital. The case note review tool was manually completed for each case note by the four researchers from the two hospitals involved, as both hospitals still used hardcopy case notes.

Data from the review forms were imported from Excel into R v4 (R Foundation for Statistical Computing) for cleaning and subsequent analysis, according to a pre-specified analysis plan. Patient characteristics were summarised descriptively both overall and by study centre. Univariable relationships between pre-specified potential risk factors and development of a parastomal hernia were analysed using logistic regression. For binary risk factors, estimates were reported as odds ratios (OR) and 95% confidence intervals (CI) for 'yes' vs 'no'; for nominal or ordinal risk factors estimates were reported as OR and 95% CI for each subsequent level versus a reference level; and for continuous risk factors, estimates were reported as OR and 95% CI for a stipulated increase. All models were adjusted for type of ostomy (variable used for matching cases and controls), and some models were additionally adjusted for year of surgery. Exploratory subgroup analysis was also carried out to investigate whether relationships between risk factors and development of parastomal hernia differed according to type of ostomy. An interaction term between ostomy type and risk factor was included in the model, and separate estimates of risk (as OR) were obtained for each ostomy type.

Ethics

This project received approval from both the public and private hospitals Human Research Ethics Committees: Central Adelaide Local Health Network Ref 16705: St Andrews Hospital Number 138: University of Adelaide H-2020-231. The research team

Counts necessary to achieve totals for cases and controls at Public Hospital

Public Hospital 1 Case Note Number:_____

1. Type of Ostomy (Tick one only): [ ]Ileostomy [ ]Colostomy [ ]Urostomy
2. Development of a parastomal hernia (PSH)?: [ ]Yes [ ]No

Current count of ostomy type and development of PSH

	Ileostomy	Colostomy	Urostomy
PSH [Yes]=Cases	___(Out of 14)	___(Out of 10)	___(Out of 1)
PSH [No]= Controls	___(Out of 14)	___(Out of 10)	___(Out of 1)

Counts necessary to achieve totals for cases and controls at Private Hospital

Private Hospital 1 Case Note Number:_____

3. Type of Ostomy (Tick one only): [ ]Ileostomy [ ]Colostomy [ ]Urostomy
4. Development of a parastomal hernia (PSH)?: [ ]Yes [ ]No

Current count of ostomy type and development of PSH

	Ileostomy	Colostomy	Urostomy
PSH [Yes]=Cases	___(Out of 9)	___(Out of 9)	___(Out of 7)
PSH [No]= Controls	___(Out of 9)	___(Out of 9)	___(Out of 7)

Figure 1. Format for determining sampling for each hospital based on Ostomy type and presence of parastomal hernia.

sought waiver of patient consent from each Ethics Committee, which was approved based on the assurance of anonymity and confidentiality by not reporting identifiable information about individuals. Strict processes of access and storage of case notes were followed according to each hospital's policy during data collection.

RESULTS

Process and Descriptive Statistics

The approach for the matched case-control study was necessarily pragmatic, given that the number of case notes reviewed was limited by time available to the researchers and ability to access case notes within the hospital. As neither hospital had electronic records, original hard copy case notes were accessed. This process was very time consuming. Table 1 reports characteristics of included participants, by case/control status and overall. The numbers for cases (parastomal hernia) and controls (no parastomal hernia) are not precisely equal for each ostomy type. Patient characteristics differed slightly between cases and controls, with cases being slightly older (median age 70.37 years compared to 66.11 years for controls), more likely to be male (64.6% of cases compared to 52.9% of controls) and having a higher mean weight (87.5 kg compared to 75.2kg for controls). The rate of follow up from stomal therapy nurses was 100% in both groups, and the proportion of patients receiving parastomal hernia-specific education prior to development of a hernia was similar in cases (39.6%) and controls (39.2%).

Patient characteristics were similar between the two study centres (See Table 1).

Potential risk factors

Table 2 reports results of univariable analyses of all risk factors. For most factors there was no evidence of an association with risk of developing parastomal hernia; however, there was evidence of an increased risk of parastomal hernia with higher BMI (OR for a 5 kg/m^2 increase in BMI 1.74, 95% CI 1.19 to 2.76), and for increased aperture size (OR for 1mm increase

Table 1. Characteristics of participants by case/control status and overall.

Characteristic	Parastomal hernia (Case) n=48	No parastomal hernia (Control) n=51	Overall n=99
Type of ostomy: N(%)			
Colostomy	19 (39.58)	19 (37.25)	38 (38.38)
Ileostomy	21 (43.75)	24 (47.06)	45 (45.45)
Urostomy	8 (16.67)	8 (15.69)	16 (16.16)
Study centre: N(%)			
Public hospital	25 (52.08)	25 (49.02)	50 (50.51)
Private hospital	23 (47.92)	26 (50.98)	49 (49.49)
Age at surgery (years): Median (IQR)	70.37 (61.49, 77.03)	66.11 (55.13, 74.50)	68.27 (59.08, 75.65)
Gender: N(%)			
Male	31 (64.58)	27 (52.94)	58 (58.59)
Female	17 (35.42)	23 (45.10)	40 (40.40)
Missing	0 (0.00)	1 (1.96)	1 (1.01)
Year of surgery: N(%)			
2018	26 (54.17)	27 (52.94)	53 (53.54)
2019	18 (37.50)	18 (35.29)	36 (36.36)
2020	0 (0.00)	5 (9.80)	5 (5.05)
2021	4 (8.33)	1 (1.96)	5 (5.05)
Follow up from stomal therapy nurses: N(%)	48 (100.00)	51 (100.00)	99 (100.00)
Time to stomal therapy nurses follow up (days): Median (IQR)	30.50 (22.75, 48.75)	22.50 (20.00, 30.25)	27.00 (20.75, 42.00)
Parastomal hernia-specific education: N(%)	32 (66.67)	20 (39.22)	52 (52.53)
Parastomal hernia-specific education before parastomal hernia: N(%)*	19 (39.58)	20 (39.22)	39 (39.39)
Time to parastomal hernia education (days): Median (IQR)	89.00 (27.50, 154.25)	23.00 (8.00, 69.00)	56.00 (10.00, 136.00)
Height (cm): Mean (SD)	170.37 (8.74)	170.13 (10.20)	170.25 (9.46)
Weight (kg): Mean (SD)	87.52 (22.85)	75.20 (20.42)	81.17 (22.39)

in aperture size 1.12, 95% CI 1.02 to 1.24). The aperture size was identified from the patients' case notes at first STN review post operatively (approx. day 1–3). The risk of parastomal hernia also decreased significantly at >30 months after surgery, with an odds ratio of 0.003 (95% CI: 0.0004 to 0.02). For other factors, there was some evidence that multiple abdominal surgery and post-operative infection increased the risk of parastomal hernia; however, due to relatively small numbers, the confidence intervals for the estimated odds ratios were too wide to be meaningful. Similarly, there was some evidence that higher levels of activity reduce the risk of parastomal hernia, with a statistically significant decrease in odds for those whose activity level was 'vigorous' compared to 'light'. However, there were only small numbers of participants with this level of activity, limiting statistical power.

In some cases, potential risk factors could not be analysed due to small numbers; for example, only one participant had ascites and only two experienced abdominal aortic aneurysms. Stoma placed out of the rectus muscle had no recorded instances. Siting within the rectus sheath could not be ascertained from medical notes for the majority of participants since it was not clearly documented either before or after surgery. While the proportion of Ostomates using support garments was considerably higher in Ostomates without a parastomal hernia evidence of this relationship was not statistically significant. This may have been due to a large proportion of missing data, especially in the control group, decreasing the power to detect the nature of the relationship.

Subgroup analysis by ostomy type

Subgroup analysis did not reveal any evidence of differences between type of ostomy in the relationship between potential risk factors and development of parastomal hernia. It is prudent to be mindful, however, that this does not mean that no differences exist, as in many cases, the numbers were too small when broken down by ostomy type for analysis to be sensible.

DISCUSSION

The purpose of this study was to identify risk factors that appear to have strongest association with development of a parastomal hernia. It is anticipated that the results will help to refine current risk assessment tools and provide other clinicians and researchers working with Ostomates with a protocol to replicate and gather further evidence regarding parastomal hernia risk.

Completing the case note review

The process of the case note review is outlined in the methods section; however, some additional issues should be highlighted given the invitation to replicate. The review found that many patients had a long history of medical care and so it was not unusual to have a number (three to six)

Table 2. Results of univariable analyses of all risk factors.

Risk factor	Parastomal hernia n=48 N (%)	No parastomal hernia n=51 N (%)	Odds ratio (95% CI)	p value
Patient factors				
BMI (kg/m^2)[a,d]	29.00 (25.89, 32.20)	26.17 (21.48, 28.72)	1.74 (1.19, 2.76)	0.009
Manual occupation[b]	11/45 (24.44)	10/49 (20.41)	1.28 (0.47, 3.50)	0.623
Young children[b]	5/47 (10.64)	6/50 (12.00)	0.87 (0.23, 3.16)	0.832
Activity level[a,f]: Light	20/48 (41.67)	11/50 (22.00)	(ref)	0.074*
- Moderate	26/48 (54.17)	31/50 (62.00)	0.53 (0.20, 1.37)	0.192
- Vigorous	2/48 (4.17)	8/50 (16.00)	0.12 (0.02, 0.79)	0.027
Smoking history[b,f]: Nonsmoker	18/48 (37.50)	13/50 (26.00)	(ref)	0.474*
- Previous smoker	19/48 (39.58)	24/50 (48.00)	0.57 (0.22, 1.45)	0.239
- Current smoker	11/48 (22.92)	13/50 (26.00)	0.62 (0.21, 1.84)	0.389
Support garment[a,f]: Yes	9/33 (27.27)	9/19 (47.37)	(ref)	0.963*
- Sometimes	2/33 (6.06)	1/19 (5.26)	1.38 (0.06, 30.54)	0.839
- No	22/33 (66.67)	9/19 (47.37)	1.18 (0.28, 4.96)	0.822
Surgery details				
Emergency[b]	16/48 (33.33)	13/51 (25.49)	1.61 (0.57, 4.71)	0.370
Sited[b]	33/48 (68.75)	42/51 (82.35)	0.42 (0.15, 1.17)	0.102
Post-op infection[b]	16/48 (33.33)	8/51 (15.69)	2.68 (1.04, 7.33)	0.046
Multiple abdominal[b]	10/48 (20.83)	3/51 (5.88)	4.21 (1.18, 19.90)	0.039
Malnutrition[b]	17/37 (45.95)	26/43 (60.47)	0.56 (0.22, 1.40)	0.221
Robotic/laparascopic[b]	9/46 (19.57)	17/51 (33.33)	0.49 (0.19, 1.23)	0.135

Risk factor	Parastomal hernia n=48 N (%)	No parastomal hernia n=51 N (%)	Odds ratio (95% CI)	p value
>30 months since surgery[b]	2/47 (4.26)	47/51 (92.16)	0.003 (0.0004, 0.02)	<0.001
Stoma details				
Out of rectus muscle[b,c]	0/7 (0.00)	0/3 (0.00)	–	
Trephine[b,g]	3/39 (7.69)	3/38 (7.89)	0.96 (0.17, 5.55)	0.963
Aperture (mm)[b]	38.00 (35.00, 40.00)	35.00 (32.00, 40.00)	1.12 (1.02, 1.24)	0.021
Aperture >35mm[b]	29/48 (60.42)	22/50 (44.00)	2.17 (0.92, 5.28)	0.080
Transverse colostomy[c,h]	0/19 (0.00)	0/19 (0.00)	–	
Indication for stoma surgery				
Malignancy[b]	28/48 (58.33)	30/51 (58.82)	0.98 (0.42, 2.29)	0.954
Diverticular[b]	12/47 (25.53)	11/50 (22.00)	1.23 (0.45, 3.33)	0.687
Comorbidities				
Previous hernia[b]	12/48 (25.00)	9/50 (18.00)	1.55 (0.58, 4.27)	0.385
Previous abdominal surgery[b]	20/47 (42.55)	21/50 (42.00)	1.04 (0.46, 2.36)	0.917
Abdominal aortic aneurysm[c]	1/47 (2.13)	1/50 (2.00)	–	
Connective tissue disorder[b]	2/48 (4.17)	2/51 (3.92)	1.04 (0.12, 8.98)	0.973
Diabetes[b]	12/47 (25.53)	9/50 (18.00)	1.58 (0.58, 4.44)	0.371
Other[b]	25/33 (75.76)	22/36 (61.11)	2.06 (0.73, 6.15)	0.178
Medication				
Steroids[a]	8/44 (18.18)	11/49 (22.45)	0.78 (0.26, 2.25)	0.647
Chemo within 1 year[a]	13/47 (27.66)	13/50 (26.00)	1.28 (0.49, 3.41)	0.619
Pelvic radiotherapy[b]	5/47 (10.64)	8/51 (15.69)	0.62 (0.17, 2.03)	0.437
Raised intra-abdominal pressure				
Respiratory disease[b]	19/46 (41.30)	14/51 (27.45)	1.84 (0.78, 4.43)	0.168
Chronic cough[b]	4/40 (10.00)	3/48 (6.25)	1.66 (0.34, 8.92)	0.528
Ascites[b]	1/46 (2.17)	0/51 (0.00)	–	
Acute/chronic constipation[b,i]	8/23 (34.78)	9/26 (34.62)	1.02 (0.31, 3.36)	0.972

[a] Adjusted for ostomy type and year of surgery

[b] Adjusted for ostomy type

[c] No analysis performed due to insufficient numbers of events

[d] Continuous variable; descriptives are median (IQR) and estimate is OR for a 5 kg/m^2 increase

[e] Continuous variable; descriptives are median (IQR) and estimate is OR for a 1mm increase

[f] Categorical/ordinal variable; estimates are odds ratios for each level versus the reference level and asterisked p value is for a test of overall equality of odds between categories

[g] Includes ileostomy and colostomy patients only

[h] Includes colostomy patients only

[i] Includes colostomy and urostomy patients only

case note files reviewed for each patient which had not been factored into the allocation of time per patient review. Quality of information available within the patient case notes varied; while the reviewers were able to ascertain more precise information regarding body mass index and aperture size than anticipated, information regarding siting of stomas was not well documented. Additionally, documentation regarding discussion with patients on parastomal hernia prevention and support garment use was often only provided when patients had a parastomal hernia, leading to ascertainment bias; the reported results regarding support garment use are therefore possibly not a true reflection of the relationship with parastomal hernia.

The nature of the recording of two risk factors was enhanced during the review process. Following the UK risk assessment tool,[12] obesity (BMI greater than 30) and stoma aperture size greater than 35mm had been added. However, documentation in the case notes allowed for the recording of these as

continuous variables. Specifically, case notes included specific aperture size at first STN review post operative review, as well as height and weight of patients which allowed the reviewers to calculate specific body mass index. This is a strength of the study, as reporting aperture and body mass index as continuous variables allowed for higher statistical power and for specific odds ratios to be calculated, providing a more nuanced understanding of the relationship between body mass index and aperture size and parastomal hernia.

BMI

Results of this case note review indicate that patients with higher BMI or larger stoma aperture were more likely to develop a parastomal hernia. In particular, for every 5 kg/m^2 increase in BMI, the chances of parastomal hernia increased 74%. This is a particularly important finding as the study's population is known to have higher than average Body Mass Index, especially at the public hospital located in a lower socioeconomic area. A link between socioeconomic status and obesity has been established.[16]

Surgery related factors

Some evidence was also found regarding increase in parastomal hernia risk for patients with multiple abdominal surgeries and post-operative infection, however small numbers of patients with these risk factors affected the statistical power to determine risk. While previous literature,[4,10,18,19,20,21] suggests increased parastomal hernia risk from some surgery-related factors (rectus muscle, trephine stoma; transverse colostomy) and ascites,[22] these potential risk factors could not be examined due to insufficient data (i.e., the number of case notes with these features recorded was not high enough to calculate an odds ratio with sufficient power). Further, for every 1mm in increased aperture, the risk of hernia increased by 12%. This is consistent with previous literature reporting that for every millimetre increase in aperture size, the risk of parastomal hernia increased 10%.[8] Additionally, a parastomal hernia is most likely to develop in the first 30 months post-surgery.

Smoking

Interestingly, while previous literature has suggested smoking to be a risk factor for parastomal hernia,[12] no evidence of a relationship between smoking and parastomal hernia was found in this study. This was surprising given the tendency of smokers to cough, increasing intra-abdominal pressure and leading to abdominal straining.[22] Overall, tobacco smokers are known to have poorer post-surgical outcomes, due to reduced oxygen and nutrient flow throughout the body, delaying healing.[24] There is some suggestion that nicotine use may inhibit cell repair, however this has not been a focus of research within the context of parastomal hernia.[17]

Chemotherapy and radiotherapy

No evidence was found of a link between chemotherapy and radiotherapy within a year of surgery, and parastomal hernia development due to a weakening of muscles due to treatment. However, previous studies[26] have shown a link. It is possible no effect was found in the recent study due to small sample size, and, therefore, this should be investigated further.

Overall, the significant findings of this study are in keeping with much of the previous literature,[8,17,20,22] which reassures its relevance in the Australian setting and motivates the need for clarification on other potentially important factors that potentially require further study with more case notes.

LIMITATIONS

Consideration should be given to this study's limitations. Firstly, while the pragmatic design was necessary given the clinical context of the research (busy metropolitan hospitals with non-digitised case notes), this did leave the study underpowered to detect potential risk for some factors, particularly co-morbidities and additional treatments, such as chemotherapy or radiotherapy. Future research could include prospective data collection of a powered sample from a multi-centric study with long follow-up of the risk factors for parastomal hernia.

Additionally, each hospital had its own protocols for documentation, assessment, and action. For example, one hospital has a pathway which directs staff to contact the diet aid or dietitian to assess a patient if their Body Mass Index is low, had lost significant weight unintentionally, or had poor appetite, while the other hospital employed a dietitian who undertook a comprehensive assessment, including routine blood tests e.g., iron, magnesium levels, regardless of BMI. Such differences in protocols may have affected the data.

The assessment of the heavy lifting risk factor was problematic as very little data was recorded in case notes, and any available notes were often ambiguous. This is not particularly surprising due to the subjective nature of the question. However, this meant occupational and recreational activities that required heavy lifting could not be adequately assessed as a risk factor.

Practices had changed over time at each of the hospitals. For example, in the case notes of one hospital, cases before 2021 generally made little reference to parastomal hernia education, however after 2021 this was consistently documented which again could impact the quality of the data collected.

Finally, reporting of the measurement of the stoma was undertaken from a pragmatic point of view as there is no consensus about when to measure the stoma post-operatively to determine the risk of parastomal hernia formation. It is understood that the stoma will change in size and shape post-operatively and generally be at a consistent size at 6 to 8 weeks. When a patient develops a parastomal hernia the stoma may change in size and shape.[25] It was observed in the clinical setting at both hospital sites that patients were occasionally developing a parastomal hernia at or before 6 weeks post-operatively. Therefore, the decision was made to measure at the first review post-surgery for consistency. Hence the larger number of stomas over 35mm. The best time to measure an aperture with respect to understanding this as a risk factor is an area for future research.

While the matched case-control design of this study increases the chances of representative data, the issues outlined above mean the findings may not be generalisable more broadly to people with a stoma.

CONCLUSION

This study was the first of its kind in Australia to synthesise previous findings relating to parastomal hernia risk and to conduct a retrospective case note review to refine these risk factors. As parastomal hernias often impair an Ostomate's quality of life,[5] it is important to continue to understand the potential risk factors to better inform preventative management. By outlining the process of this study our hope is that it may guide future studies by clinicians and researchers in other health settings to enhance the necessary evidence of important risk factors.

High body mass index, postoperative infection, multiple surgeries, wide diameter of the stoma and time since surgery less than 30 months increased the risk of parastomal hernia, other factors did not reach significance probably due to use of an underpowered sample.

The research team found many issues of missing information, particularly related to patient factors, such as lifting and other lifestyle factors. It is recommended that tools to record activity (such as the metabolic equivalent of task[15]), and for lifting (the Dictionary of Occupational Title[23]) which are used in other settings and could be incorporated into stomal therapy nurses assessment process.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

ETHICAL STATEMENT

Central Adelaide Local Health Network Human Research Ethics Committee H-2020-231: St Andrews Hospital Number 138 and University of Adelaide Human Research Ethics Committee Ref. 16705.

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