The incidence of incisional hernias following ileostomy reversal in colorectal cancer patients treated with anterior resection

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ABSTRACT

INTRODUCTION The aim of this study was to identify the rate of incisional hernia formation following ileostomy reversal in patients who underwent anterior resection for colorectal cancer. In addition, we aimed to ascertain risk factors for the development of reversal-site incisional hernias and to record the characteristics of the resultant hernias.

MATERIALS AND METHODS Using a prospectively compiled database of colorectal cancer patients who were treated with anterior resection, we identified individuals who had undergone both ileostomy formation and subsequent reversal of their ileostomies from January 2005 to December 2014. Medical records were reviewed to record descriptive patient data about risk factors for hernia formation, operative details and any subsequent operations. Computed tomography reports were reviewed to identify the number, site and characteristics of incisional hernias.

RESULTS A total of 121 patients were included in this study; 14.9% ($n = 18$) developed an incisional hernia at the ileostomy reversal site; 17.4% ($n = 21$) at a non-ileostomy site and 6.6% ($n = 8$) developed both. The reversal-site hernias were smaller both in width and length compared with the non-ileostomy-site hernias. Risk factors for the development of reversal-site incisional hernias were higher body mass index (BMI), lower age, open surgery, longer reversal time and a history of previous hernias. We did not detect a difference in the size of the incisional hernias that developed in patients with these specific risk factors.

CONCLUSIONS Incisional hernias are a significant complication of ileostomy reversal. Further evaluation of the use of prophylactic mesh to reduce the incidence of incisional hernias may be worthwhile.

KEYWORDS

Ileostomy – Rectal Cancer – Incisional Hernia – Computed Tomography – Incidence

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Introduction

Temporary diverting ileostomies (TDIs) are commonly formed by surgeons after anterior resection of mid- and low-rectal cancers to protect the distal colo-anal anastomosis and to reduce the incidence of postoperative ileus and bowel obstruction.¹ Despite being an effective preventative measure, the use of TDIs is associated with multiple stoma-related complications.² One such complication is the development of incisional hernias at the ileostomy reversal site, which can occur in up to 48% of cases.^{3,4} Incisional hernias are problematic for patients because they can cause pain, lead to strangulation and may require operative repair.⁵ In addition to considerable morbidity for the patient, the significant financial burden is worth consideration.

Risk factors for ileostomy site incisional hernia formation are not currently well understood. A better understanding of these specific predictive variables could allow surgeons to

better prepare for these reversal cases. Brook et al.⁶ propose that patient factors such as BMI and patient comorbidity can predict the development of incisional hernia formation following ileostomy reversal. On the other hand, De Keersmaecker et al.,⁷ did not identify any risk factors for incisional hernia development. These studies were implemented in centres where the majority of resections are carried out using open surgical approach. This contrasts with our centre, where 88.4% were done laparoscopically.

The primary objective of this study was to investigate the rate of incisional hernia following ileostomy reversal. Secondly, we aimed to identify further risk factors for incisional hernia development, including assessing whether a history of any concomitant hernias, such as parastomal or inguinal hernias, may be predictive of stoma-site incisional hernia formation. Thirdly, we aimed to ascertain whether patients grouped according to specific risk factors develop incisional hernias with different characteristics.⁸

Methods

A prospectively compiled institutional database was used to identify rectal cancer patients who were treated with anterior resection, TDI and subsequent ileostomy reversal between January 2005 and December 2014. Preoperative data about patient age, smoking status, BMI, previous surgical history, cancer stage and therapy regime were recorded from medical records and computerised clinical systems. Details regarding surgical methods and postoperative complications, including the development of hernias, were noted.

Subsequently, computed tomography (CT) was reviewed to assess the rate of development of postoperative incisional hernias in this cohort of patients. At our institution, all cancer patients who undergo anterior resection receive CT in the first 12 months and at 2 years post-surgery; all scans are reported by experienced radiologists. The CT images of patients with reported incisional hernias were re-analysed to assess dimensions and to categorise them according to the European Hernia Society (EHS) classification.⁸ This classification system was put forward by Muysoms et al. in 2009 to address the lack of consensus in the reporting of incisional hernias.⁸ This system categorises incisional hernias based on their location in grid-like abdominal-wall domains, as well as recording the length and width and recurrence of hernias.⁸ Only patients with at least one post-reversal CT scan were included in our study.

The data was tabulated and analysed to identify risk factors for the development of incisional hernias. The primary outcome was the diagnosis of incisional hernia at the ileostomy reversal site. We used the definition of an incisional hernia adopted by the EHS: 'Any abdominal wall gap with or without a bulge in the area of a post-operative scar perceptible or palpable by clinical examination or imaging', which was proposed by Korenkov et al. in 2001.⁹

Results

Patient details

The cancer database identified 339 patients who underwent anterior resection between January 2005 and December 2014, of which 218 were excluded. The reasons for exclusion were: no stoma formed (93); no reversal of ileostomy (47); no CT scans on the system (29); colostomy formed (27); notes not available (18); diverticular disease (3); duplicate record (1). The baseline descriptive data for the remaining 121 patients are shown in Table 1. Of note, 88.4% of the anterior resections were carried out laparoscopically ($n = 107$); the remaining 11.6% by open surgery. One of the patients was found to have two separate rectal tumours in the pathological specimen; we included both TNM cancer staging results of this patient in our analysis.

Outcomes

A total of 333 CT scans were carried out for the assessed cohort of patients (mean 2.8 scans/patient) with a mean CT imaging follow-up period of 2.2 years and a clinical follow-

Table 1 Descriptive baseline data for the 121 patients included in the final analysis

Characteristics	Patient data			
	Mean	%	SD	n/N
Age at day of operation (years)	65.3		9.4	
Weight (kg)	76.7		16.4	
Body mass index (kg/m ²)	26.5		4.5	
Male sex		63.6		77/121
Smoker		11.6		14/121
Diabetes mellitus		6.6		8/121
Chronic obstructive pulmonary disease		1.6		2/121
History of hernia:		18.2		22/121
Previous inguinal hernia		9.9		12/121
Previous parastomal hernia		5.8		7/121
Previous incisional hernia		1.7		2/121
Previous anterior wall hernia		0.8		1/121
Tumour staging by pathology of resection:				
T0		2.5		3/122
T1		10.7		13/122
T2		27.9		34/122
T3		49.2		60/122
T4		9.8		12/122
Nodal involvement:				
N0		71.3		87/122
N1		18.9		24/122
N2		9		11/122
Metastatic disease:				
M0		71.3		87/122
Mx		27.9		33/122
M1		0.8		1/122
Preoperative radiotherapy:		23.1		28/121
Long course		21.5		26/121
Short course		1.7		2/121
Preoperative chemotherapy		0.8		1/121
Adjuvant radiotherapy		0.8		1/121
Adjuvant chemotherapy		24		28/121
Type of surgical access:				
Laparoscopy		88.4		107/121
Open		11.6		14/121
Anastomotic leak		7.4		9/121
Wound infection		2.5		3/121

Table 2 Analysis of the incidence and characteristics of the incisional hernias that developed following ileostomy reversal of 121 patients

Outcome	Patient data			
	Mean	%	SD	n/N
Site				
Ileostomy:		14.9		18/121
Length (cm; <i>n</i> = 18)	3.3		± 1.3	
Width (cm; <i>n</i> = 18)	2.7		± 1.4	
EHS classification:				
W1		83.3		15/18
W2		16.7		3/18
W3		0		0/18
Non-ileostomy:		17.4		21/121
Length (cm; <i>n</i> = 21)	4.8		± 3.2	
Width (cm; <i>n</i> = 21)	4.6		± 2.6	
EHS classification:				
W1		47.6		10/21
W2		47.6		10/21
W3		4.8		1/21
Ileostomy site or non-ileostomy site incisional hernias at any site		25.6		31/121
Ileostomy-site recognition:				
Clinical		88.9		16/18
Radiological		94.4		17/18
Symptomatic		88.9		16/18
Repairs		72.2		13/18
EHS, European Hernia Society				

up period of 3.7 years. The range of radiological follow-up was 1–115 months, with 13 patients having a radiological follow-up period of less than 1 year; the range of clinical follow-up was 1–123 months, with four patients having a clinical follow-up period of less than 1 year.

Of the 121 patients considered, 18 patients (14.9%) developed reversal-site incisional hernias (Table 2); the median period for the postoperative development of reversal-site incisional hernias was 9.5 months (95% confidence interval, CI, 7.0–12.7 months).

Twenty-one patients (17.4%) developed non-reversal-site abdominal incisional hernias; the median period for development was 20 months (95% CI 16.3–25.1 months). These 21 hernias were all localised in the medial aspect of the abdominal wall; 81% were umbilical or para-umbilical (*n* = 17/21), with the remaining 19% (4/21) affecting a larger proportion of the anterior abdominal wall. Eight individuals developed incisional hernias at both the reversal site and in

the abdominal wall (6.6%). Approximately 75% of patients who developed an incisional hernia subsequently underwent repair.

The reversal site incisional hernias had shorter mean vertical lengths compared with those that developed at other sites in the anterior abdominal wall (3.3 cm ± standard deviation, SD, 1.1 vs 4.8 cm ± SD 3.3; Student *t* test; *P* = 0.0835); in addition, their widths were also significantly shorter (2.7 cm ± SD 1.3 vs 4.6 cm ± SD 2.6; Student *t* test; *P* = 0.0094).

Risk factors

For our cohort of patients, individuals with an incisional hernia were more likely to have a higher BMI (mean 29.1 kg/m²; SD 5.03 vs 26 kg/m²; SD 4.305; Student *t* test, *P* = 0.0053), a lower age (mean 60 years; SD 13.46 vs 68.3 years; SD 7.88, Student *t* test, *P* = 0.0004), an open resection (27.8% vs 8.7%, Fisher's exact test; *P* = 0.0352), a history of previous hernia (38.9% vs 14.6%, Fisher's exact test; *P* = 0.0215) and a longer time to ileostomy reversal (mean 10.9 months; SD 12.8 vs 4.7 months; SD 3.93, Student *t* test, *P* ≤ 0.0001; Table 3). The other listed variables in Table 2 were not statistically different in the two outcome groups.

Patients with a history of previous hernias had a reduced hernia-free survival (Fig 1). A Cox regression model showed that a unit increase of BMI (hazard ratio 1.16, 95% CI 1.06–1.26, *P* = 0.0026), younger age (hazard ratio 1.08, 95% CI 1.04–1.12, *P* = 0.0004), open resection (hazard ratio 3.0, 95% CI 1.91–4.15, *P* = 0.049), longer time to ileostomy reversal (hazard ratio 1.07, 95% CI 0.72–1.43, *P* = 0.00015) and previous history (hazard ratio 3.59, 95% CI 2.6–4.5, *P* = 0.0087) are associated with developing an incisional hernia at the ileostomy reversal site (Table 4). A secondary multivariate model using both age and BMI together did not significantly affect the observed association. A history of previous hernia, a higher BMI (> 30 kg/m²), a longer reversal interval (> 12 months), open resection and a lower age (< 65 years) did not significantly increase the likelihood of developing a larger incisional hernia (Fisher's exact test, W1 vs W2/W3/W4; *n* = 18, *P* = 1.0, *P* = 1.0, *P* = 1.0, *P* = 0.6, *P* = 1.0, respectively).

Discussion

For our cohort of patients, the rate of reversal-site incisional hernias was 14.9% at a median postoperative period of 9.5 months. Previous authors have suggested that the rate of incisional hernia formation is between 0% and 48% of patients, although these studies were limited by the grouping of ileostomies and colostomies at the analysis stage.^{3,4,10} More recently, Brook et al.⁶ and De Keersmaecker et al.⁷ focused specifically on ileostomy reversals and identified ileostomy-reversal incisional hernia rates of 13.5% and 11.6%, respectively.

In our analysis, the rate of non-ileostomy-site incisional hernias was 17.4% over a median postoperative period of 20 months. At our department, ileostomy wounds and extracutaneous sites are both closed using the 'mass-closure' technique with number-1 monofilament synthetic absorbable polydioxanone sutures, impregnated with antibiotics; a continuous 3-0 Monocryl® Suture (Ethicon) is used for skin closure.

Table 3 Patient and surgical factors in the development of incisional hernia

Variable	Incisional hernia		P value
	Yes (n = 18)	No (n = 103)	
Age (years) ^a	60 (SD ± 13.46)	68.3 (SD ± 7.89)	0.0004
Smoking % (n) ^a	11.1 (2)	11.7 (12)	1
BMI (kg/m ²) ^a	29.1 (SD ± 5.03)	26.0 (SD ± 4.31)	0.0053
Diabetes mellitus ^b	5.6 (1)	6.8 (7)	1
Male sex % (n)	55.6 (10)	65.0 (67)	0.42
ASA grade ^a	1.8 (SD ± 0.55)	1.8 (SD ± 0.68)	0.914
Previous hernia % (n) ^b	38.9 % (7)	14.6 (16/104)	0.0215
Time to reversal (months) ^a	10.9 (SD ± 12.8)	4.7 (SD ± 3.93)	< 0.0001
Preoperative radiotherapy % (n) ^b	11.1 (2)	25.2 (26)	0.239
Adjuvant chemotherapy % (n) ^b	38.9 (7)	20.4 (21)	0.126
Laparoscopic resection % (n) ^b	72.2 (13)	91.3 (94)	0.0352
Open resection % (n) ^b	27.8 (5)	8.7 (9)	0.0352
CT follow-up (months) ^a	24.1 (SD ± 24.91)	26.7 (SD ± 20.78)	0.6287
Clinical follow-up (months) ^a	44.8 (SD ± 22.9)	46.7 (SD ± 25.7)	0.74
Wound infection % (n) ^b	11.1 (2)	1 (1)	0.0576
Anastomotic Leak % (n) ^b	16.7 (3)	5.8 (6)	0.1307

^a Unpaired two-tailed Student *t* test performed for continuous variables^b Two-tailed Fisher's exact test performed for categorical variables

Navaratnam et al. recorded a lower incisional hernia rate of 8% and suggested that standardisation of specimen extraction can reduce the incidence of IHs following specimen extraction.¹¹

Risk factors

Five risk factors were found to be significant in the development of ileostomy-site hernias, namely, high BMI, lower age group, longer reversal time, open resection and a previous history of hernia. Two of these five risk factors (higher BMI and open resection) correlate well with previous larger studies evaluating the risk factors for incisional hernia formation following abdominal surgery.^{12,15} A higher BMI has also been shown to be a risk factor for incisional hernia development following ileostomy reversal recently by Brook et al.,⁶ who also identified a high preoperative blood pressure to be statistically linked to a higher incisional hernia rate.

Only a few retrospective cohort studies have investigated having a previous history of hernias as an independent risk factor for incisional hernia development; these found a positive but not a statistically significant association. Schreinemacher et al.¹⁰ reported an odds ratio of 1.51 (*P* = 0.52), while De Keersmaecker et al.⁷ showed a higher incidence of previous hernia repairs among patients with an incisional hernia (17.6% vs 10.3%, *P* = 0.41).⁷ If this association is true, it may point towards different hernia types having similar pathophysiology.

A longer ileostomy reversal time was also found to be a risk factor for incisional hernia formation in our study. Several previous ileostomy studies with radiological incisional hernia diagnosis have investigated this factor;¹⁴ Brook et al.,⁶ Schreinemacher et al.¹⁰ and Cingi et al.¹⁵ did not find a statistically significant association between closure time and rate of incisional hernia formation. The finding of lower age being a risk factor for development of an incisional hernia contrasts with larger previous hernia studies, which report an older age to be a risk factor for incisional hernia formation.¹³ Incorporating other risk factors such as BMI and longer ileostomy reversal time into our model, did not attenuate the observed association between lower age and incisional hernia development. A possible explanation for this finding is that our study did not include patients who underwent ileostomy reversals for pathological reasons such as inflammatory bowel disease, diverticulosis and inflammatory fistulae and only included a very select group of patients with rectal cancer, for whom this trend may apply.

In addition to previous findings, it was our aim to evaluate whether specific risk factors affect the characteristics of incisional hernias, such as the size of the hernia. The risk factors identified by this study, including previous hernia, open resection, lower age, longer reversal time and higher BMI were not statistically associated with larger hernias. Moreover, previous studies were carried out in institutions where the majority of anterior resections are carried out via open

Fig 1 Kaplan–Meier curve showing time to develop incisional hernia in patients with no previous hernia (blue line) and in those with a history of hernia (black line)

Variable	Coefficient	Hazard ratio	Confidence interval	P value
Body mass index	0.15	1.16	0.10	0.0026
Age	−0.074	0.93	0.04	0.00035
Female sex	0.33	1.39	0.92	0.49
Previous hernia	1.279	3.59	0.95	0.0087
Time to reversal (months)	0.068	1.07	0.35	0.00015
Preoperative chemotherapy	−0.79	0.45	1.47	0.29
Laparoscopy	−1.12	0.33	1.12	0.049
Adjuvant chemotherapy	0.91	2.47	0.96	0.064

surgery, whereas the majority (approximately 90%) of the patients underwent anterior resections via laparoscopy.

To date, only a few studies have investigated the option of using prophylactic mesh for the prevention of incisional hernias at ileostomy-reversal sites and in the short term have found them to be feasible and safe.^{16–18} There are currently two randomised controlled trials in progress (Reinforcement of Closure of Stoma Site and Prophylaxis of Ileostomy Closure Site Hernia by Placing Mesh) currently investigating this topic.¹⁹ Owing to the unknown longer-term risks of using prophylactic mesh, it may be an option to consider using prophylactic mesh only in patients with risk factors for the development of incisional hernias, such as high BMI, open resection and with a history of hernias.

Bias

The interpretation of our results is affected by a number of significant limitations. Our study is a retrospective study, which included only a select group of patients, namely colorectal cancer patients who developed an incisional hernia. A further potential source of inaccuracy was the fact that the CT scans were assessed by different experienced radiologists from our department, with a minimum of 5 years of experience, who were on duty at the time of the scan reporting. In our study, having only one reporter per scan precluded an interobserver variability analysis. Furthermore, the fact the radiologists were primarily looking for cancer recurrence may also have resulted in an underestimation of incisional hernia formation rate. An additional limitation of the study is that 4 of the 121 patients had a clinical follow-up period of less than 1 year and 13 patients had a radiological follow-up of less than 1 year; this means that our calculated rate of incisional hernia formation could be an underestimate, because for these patients an incisional hernia may have developed at a later point, following inclusion in the study.

Conclusions

Approximately 15% of rectal cancer patients treated with anterior resection, TDI and subsequent ileostomy reversal develop incisional hernias at the ileostomy reversal site. We found that both patient factors, such as a high BMI, lower age, a previous history of hernias, and surgical factors such as having open surgery are risk factors for their development. These risk factors were not found to be associated with larger incisional hernias as defined in the EHS classification.

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