Incisional hernia after cystectomy: incidence, risk factors and anthropometric predisposition

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Introduction: Postoperative incisional hernias (PIH) are an established complication of abdominal surgery with rates after radical cystectomy (RC) poorly defined. The objective of this analysis is to compare rates and risk factors of PIH after open (ORC) and roboticassisted (RARC) cystectomy at a tertiary-care referral center.

Materials and methods: We performed a retrospective review of patients undergoing ORC and RARC from 2000-2015 with pre and postoperative cross-sectional imaging available. Images were evaluated for anthropometric measurements and presence of postoperative radiographic PIH (RPIH). Patient demographics, type of urinary diversion and postoperative hernia repair (PHR) were also assessed.

Results: Of the patients that met inclusion criteria (n = 469), the incidence of RPIH and PHR were 14.3% and 9.0%, respectively. Between ORC and RARC, analysis revealed no statistically significant differences in rates of RPIH (13.6% versus 20.3%, p = 0.152) or PHR (8.2% versus 12.5%, p = 0.214). Body mass index was associated with a slightly increased likelihood of RPIH on univariate analysis alone (OR 1.08, p = 0.008). Ileal conduit was associated with a decreased likelihood of RPIH (OR 0.42, p = 0.034) and PHR (OR 0.36, p = 0.023). Supraumbilical rectus diastasis width (RDW) was an independent predictor of both RPIH (OR 1.52, p = 0.023) and PHR $(OR \ 1.43, p = 0.039)$ on multivariate analysis.

Conclusions: Patients undergoing RC are at significant risk of RPIH and PHR regardless of surgical approach. Anthropomorphic factors and urinary diversion type appear to be associated with PIH risk. Further research is needed to understand how risks of PIH can be reduced in patients undergoing cystectomy.

Key Words: cystectomy, robotics, postoperative hernia, urinary diversion, anthropometry

Introduction

Despite representing only 4.5% of all new cancer diagnoses in the United States, bladder cancer remains the most costly malignancy to treat on a per-patient

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basis.1 Radical cystectomy (RC) continues to have significant morbidity with high reported complication rates (> 60%) contributing to these costs.²⁻⁴ Elderly and/or frail patients and those receiving neoadjuvant chemotherapy (NAC) are especially at risk.^{5,6} Efforts to minimize the morbidity burden of RC have focused on enhanced recovery pathways and the use of minimallyinvasive surgical techniques.7,8

Postoperative incisional hernias (PIH) are an established complication of abdominal surgery with a significant impact on quality of life outcomes.

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Incidence and risk factors of incisional hernias following cystectomy are poorly defined in the current urologic literature. Additionally, the impact of robot-assisted techniques on PIH rates is unclear, as only a handful of studies have compared traditional open to robotic cystectomy outcomes.¹⁰⁻¹³

We sought to assess whether robotics has delivered on the promise of lowering morbidity burden in the postoperative hernia domain by comparing rates of PIH after robotic assisted radical cystectomy (RARC) and open radical cystectomy (ORC) at a tertiary care referral center. We assessed how demographic and anthropometric factors predict help PIH in these cohorts and examined the impact of urinary diversion selection on PIH rates.

Materials and methods

After institutional review board approval, we performed a retrospective review of our prospectively maintained institutional cystectomy database. Patients who underwent ORC between 2000-2015 and RARC between 2007-2015 were identified and included for analysis if

they had documented follow up greater than 1 year and if both preoperative and postoperative crosssectional imaging was available for review. A patient was determined to have a PIH if they had radiographic evidence of PIH on postoperative imaging without any hernia demonstrated on preoperative imaging (RPIH). The record was also reviewed for evidence of postoperative incisional hernia repair (PHR), and instances were indexed. All ORC cases were performed via an infraumbilical midline incision. RARC with extracorporeal ileal conduit or Indiana pouch urinary diversion utilized a periumbilical incision. Meanwhile, RARC with extracorporeal neobladder urinary diversion utilized either a periumbilical incision or a lower midline incision, similar to that of ORC. The extracorporeal approach to urinary diversion was performed in all RARC patients. Patient demographics and urinary diversion type were also indexed. Preoperative imaging was used to obtain patient anthropometric measurements. Skin-to-fascia depth (SFD) and rectus diastasis width (RDW) were obtained for analysis by two reviewers and confirmed by a third, senior reviewer.

	PHR present	PHR absent	p value	RPIH present	RPIH absent	p value
Age (y)	64.9	67.7	0.108	65.3	67.8	0.088
BMI (kg/m ²)	28.3	28.1	0.874	30.8	27.8	0.006
Supraumbilical RDW (cm)	4.23	3.44	0.018	4.15	3.43	0.018
Infraumbilical RDW (cm)	3.04	2.27	0.027	2.79	2.30	0.130
Supraumbilical SFD (cm)	3.25	2.37	0.021	2.84	2.39	0.071
Infraumbilical SFD (cm)	2.51	2.79	0.338	3.14	2.70	0.073
Gender						
Female	8	122	ref	17	109	ref
Male	34	302	0.210	50	276	0.662
Approach						
RARC	11	77	ref	15	59	ref
Open	31	350	0.214	52	329	0.152
Diversion						
Continent	8	33	ref	11	30	ref
Ileal conduit	34	386	0.023	55	355	0.034

TABLE 1. Demographics, anthropometrics and surgical characteristics of patients undergoing radical cystectomy

PHR = postoperative hernia repair; RPIH = radiographic postoperative incisional hernia; BMI = body mass index; RDW = rectus diastasis width; SFD = skin-to-fascia depth; RARC = robotic-assisted radical cystectomy

Statistical analysis was performed using IBM® SPSS Statistics 24.0. Student's T-test and Pearson's chi square were used to compare demographic variables and univariate and multivariate logistic regression were employed to assess likelihood of outcomes. RPIH was the primary outcome and PHR was the secondary outcome evaluated. Factors analyzed included surgical approach (ORC/RARC), gender and urinary diversion status. Covariates included SFD, RDW, BMI and age. Significance is described at p < 0.05 with a 95% confidence interval.

Results

The overall incidence of RPIH in our cohort was 14.3% (n = 67) and the overall incidence of PHR was 9.0% (n = 42). On univariate analysis, presence of RPIH was a significant predictor of likelihood of undergoing PHR (OR 2.53, CI 1.19-5.36; p = 0.030). Full patient characteristics can be found in Table 1. Table 2 and Table 3 report the results of the univariate and multivariate analyses for RPIH and PHR, respectively.

Surgical approach: ORC versus RARC

Of the 469 patients that were identified who met inclusion criteria, 88 were treated with RARC and 381

were treated with ORC. Of the patients who underwent RARC and ORC, 20.3% (n = 15) and 13.6% (n = 52) developed a RPIH within 1 year, respectively. 12.5% (n = 11) of RARC and 8.2% (n = 31) of ORC patients had documented hernia repairs during follow up. There were no statistical differences in rates of RPIH (p = 0.152) or PHR (p = 0.214) based on surgical approach.

Patient demographic factors

Age (p = 0.869) and gender (p = 0.541) did not correlate with RPIH or PHR on univariate or multivariate analysis. Body mass index (BMI) was associated with a slightly increased risk of RPIH on univariate analysis alone (OR 1.08, CI 1.02-1.12; p = 0.008).

Urinary diversion: ileal conduit versus continent diversion

Ileal conduit was utilized in 92.3% (n = 349) and 85.5% (n = 71) of ORC and RARC patients, respectively. Ileal conduit was associated with a decreased likelihood of RPIH (OR 0.42, CI 0.20-0.89; p = 0.034) and PHR (OR 0.36, CI 0.16-0.85; p = 0.023) on univariate analysis, but failed to reach significance on multivariate analysis.

Anthropometric factors

Supraumbilical RDW was associated both with RPIH

		Univariate			Ν		
	RPIH present (%)	OR	CI	p value	OR	CI	p value
Age	1	1.02	0.99-1.05	0.089	1.00	0.95-1.05	0.940
Body mass index		1.08	1.02-1.12	0.008	1.05	0.96-1.15	0.240
Gender							
Female	13.5%	ref			ref		
Male	15.3%	1.16	0.64-2.10	0.662	1.40	0.48-4.14	0.540
Approach							
RARC	20.3%	ref			ref		
Open	13.6%	0.62	0.33-1.18	0.152	0.49	0.18-1.31	0.155
Diversion							
Continent	26.8%	ref			ref		
Ileal conduit	13.4%	0.42	0.20-0.89	0.034	0.59	0.16-2.23	0.435
Supraumbilical RDW		1.25	1.03-1.52	0.021	1.52	1.05-2.13	0.023
Infraumbilical RDW		1.14	0.96-1.35	0.140	0.73	0.49-1.10	0.136
Supraumbilical SFD		1.08	0.94-1.23	0.266	1.05	0.87-1.27	0.606
Infraumbilical SFD		1.10	0.94-1.30	0.227	0.90	0.61-1.33	0.606
RPIH = radiographic posto	perative incisional	hernia [.] RA	RC = robotic-ass	sisted radical cv	stectomv [.] R	DW = rectus dia	stasis width

TABLE 2. Univariate and multivariate analysis of the primary outcome: radiographic postoperative incisional hernia

RPIH = radiographic postoperative incisional hernia; RARC = robotic-assisted radical cystectomy; RDW = rectus diastasis width; SFD = skin-to-fascia depth

		Univariate			Multivariate			
	Hernia repaired (%)	OR	CI	p value	OR	CI	p value	
Age		1.02	0.99-1.05	0.104	1.02	0.97-1.07	0.558	
Body mass index		1.00	0.95-1.05	0.870	1.03	0.95-1.13	0.4860	
Gender								
Female	6.2%		ref		ref			
Male	10.1%	1.72	0.77-3.82	0.210	2.33	0.71-7.64	0.162	
Approach								
RARC	12.5%		ref		ref			
Open	8.2%	0.62	0.30-1.29	0.214	0.94	0.34-2.62	0.901	
Diversion								
Continent	24.2%		ref		ref			
Ileal conduit	8.1%	0.36	0.16-0.85	0.023	0.30	0.95-12.50	0.600	
Supraumbilical RDW		1.27	1.03-1.54	0.021	1.43	1.02-2.00	0.039	
Infraumbilical RDW		1.19	1.01-1.41	0.037	1.18	0.85-1.64	0.320	
Supraumbilical SFD		1.15	0.97-1.35	0.099	2.17	1.12-4.17	0.021	
Infraumbilical SFD		1.17	0.82-1.66	0.384	2.54	1.17-5.56	0.019	
RARC = robotic-assisted ra	adical cystectomy;	RDW = re	ctus diastasis w	idth; SFD = ski	n-to-fascia	depth		

TABLE 3.	Univariate and	multivariate	analysis of	the secondary	v outcome:	posto	perative	hernia r	epair
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(OR 1.25, CI 1.03-1.52; p = 0.021) and PHR (OR 1.27, CI 1.03-1.54; p = 0.021) on univariate analysis, and an independent predictor of both RPIH (OR 1.52, CI 1.05-2.13; p = 0.023) and PHR (OR 1.43, CI 1.02-2.00; p = 0.039) on multivariate analysis. The relationship was such that odds of RPIH increased by 40.9% and odds of PHR increased by 35.2% for every centimeter increase of supraumbilical RDW. Infraumbilical RDW and both supraumbilical and infraumbilical SFD had no statistically significant relationship to RPIH on univariate or multivariate analysis (all p > 0.05). However, infraumbilical RDW was associated with increased likelihood of PHR on univariate analysis (OR 1.19, CI 1.01-1.41; p = 0.037). Also, supraumbilical SFD (OR 2.17, CI 1.12-4.17; p = 0.021) and infraumbilical SFD (OR 2.54, CI 1.17-5.56; p = 0.019) were associated with increased likelihood of PHR on multivariate analysis.

Discussion

First described in the literature by Menon et al in 2013, RARC has become an accepted surgical approach in appropriately selected patients.⁹ Our retrospective analysis demonstrates statistically comparable radiographic postoperative incisional hernia rates in patients who underwent robotic and open approaches to radical cystectomy at our tertiary care cancer center with an overall radiographic incisional hernia incidence of 14.3% and a hernia repair rate of 9.0%.

These results dovetail with reports of other outcome metrics when ORC and RARC are compared. A retrospective cohort analysis utilizing the National Cancer Database demonstrated equivalent surgical margin status between open and robotic approaches, with RARC reporting a higher lymph node (LN) yield.¹⁰ Similarly, a Surveillance, Epidemiology and End-Results (SEER) database analysis found that RARC offered equivalent perioperative and short-tointermediate term OS and CSS and offered a greater LN yield with shorter length of stay (LOS).¹¹

More recently, prospective randomized trials comparing open and robotic cystectomy approach have been reported. A single-institution trial from Memorial Sloan Kettering demonstrated equivalent perioperative outcomes and postoperative QoL.¹² Bochner et al reported that RARC had lower operative blood loss, but increased operative time with similar overall complication rates.¹² The open approach, on this analysis, was reported to be marginally more cost effective.¹² A multi-institutional clinical trial spearheaded by investigators from the University of Miami substantiated these findings with data supporting that the robotic approach decreases blood loss and LOS, with equivalent perioperative morbidity and oncologic outcomes.¹³ Thus, although some concerns have been made regarding RARC's potential inferiority with regard to local control, both administrative and randomized trials data support the fact that robotic and open approaches appear to be clinically similar.¹⁴

Previously published data examining incisional hernias following cystectomy have been inconsistent. A retrospective single center cohort review of patients treated with RARC with 10 year follow up reported a 1% and 4% re-operation rate for incisional and parastomal hernias, respectively, but a relationship with diversion approach was not noted.¹⁵ Conversely, Torrey et al demonstrated a 5.9% incidence of incisional hernia repair in the first 30 days postoperatively, with an additional 8.8% incidence of incisional hernia repair after the 90 day mark, specifically in patients receiving continent Indiana Pouch diversion.¹⁶ Use of continent diversion (ie. Indiana pouch or orthotopic neobladder) in our cohort was associated with an increased risk of both RPIH and PHR on univariate, but not multivariate analysis. It has been postulated that the increased abdominal pressure that must be generated to void via valsalva with a neobladder may predispose to hernia formation.¹⁷ Furthermore, it has been suggested that the stomal incision site of the ileal conduit itself may transmit tension away from the primary incision site and therefore decrease risk of hernias.17

A retrospective review of 104 patients undergoing robotic urologic surgery with both pre and postoperative cross-sectional imaging discovered four times as many occult radiographic hernias compared to clinically evident hernias.¹⁸ To date, there remains significant variability in the method of postoperative hernia reporting. In this report, although only 16.4% of patients with radiographically evident incisional hernias moved forward with repair, patients with RPIH were 2.53 times more likely to undergo repair. There are potential reasons for the discordance between RPIH presence and rates of repair, including a wide spectrum of clinical or bothersome symptomatology, and significant heterogeneity in which patients elect to have repair. Considering this, the objective diagnosis of RPIH allows for more consistency in the reporting of this complication.

The University of Southern California experience with ORC and ileal conduit (n = 670), had an 18.7% rate of PIH at a median follow up of 57 months, with approximately 1/3 of these patients undergoing repair.¹⁷ Reasons for this higher rate of patients moving to repair are unclear, but may relate to patient mix and institutional preferences. The USC group in a multivariate analysis reported that significant risk factors for development of PIH included age > 80 (HR 2.238), male gender (HR 2.272), BMI > 30 kg/m^2 (HR 2.115), and utilization of orthotopic diversion (HR 3.906), while infraumbilical incision length was protective compared to incisions extending supraumbilically (HR 0.616).

There have been no studies to date directly comparing hernia rates and rates of repair between ORC and RARC. Our data suggests overall equivalent hernia outcomes between the two modalities. This study is the first reported in the literature to utilize radiographic anthropometric measurements for risk-stratification of PIH development in cystectomy patients. As a surrogate for BMI, SFD has been proposed to be an easily quantifiable metric of the depth of the adipose tissue layer. Indeed, a greater SFD likely results in a more technically challenging fascial closure.¹⁹ In the current study, increasing supraumbilical and infraumbilical SFD were associated with increased likelihood of undergoing PHR on multivariate analysis, but demonstrated no relationship with RPIH. Conversely, increasing BMI was associated with an increased likelihood of RPIH on univariate analysis, but demonstrated no relationship with PHR.

RDW is an objective measure of the extent of rectus diastasis, a condition that is reflective of weak abdominal wall musculature and correlated with both fascial laxity and reduced core strength dynamics.¹⁹ It has been hypothesized that increased RDW may be indicative of weakened connective tissue that is more likely to separate or fail under tension after closure.¹⁹ As such, it is an established metric of abdominal wall integrity.^{19,21} Reports demonstrate conflicting data regarding significance of RDW in predicting future hernias.^{20,21} Nevertheless, in the current study supraumbilical RDW was associated with an increased likelihood of both RPIH development and undergoing PHR on both univariate and multivariate analysis. Infraumbilical RDW demonstrated a relationship only with PHR and only on univariate analysis. Considering that supraumbilical RDW demonstrated a strong and consistent associated with RPIH and PHR, this metric deserves further investigation.

Our study has several limitations including inherent patient selection biases, retrospective design, intermediate-term follow up, and a limited sample size. Performed at a tertiary care referral center, this study may lack generalizability. Additionally, other risk factors that may predispose patients to poor wound healing, such as nutritional status and perioperative chemotherapy, were not evaluated in this study. Furthermore, technical factors of fascial closure, including type of suture utilized (monofilament vs. braided; permanent vs. absorbable) and suturing method (continuous vs interrupted) were not evaluated in the current analysis and may confound results. Nevertheless, this study affords a unique perspective and contributes to the ongoing debate regarding the value of robotics in the bladder cancer space.

Conclusion

Patients undergoing RC are at significant risk of RPIH regardless of surgical approach. The presence of radiographic PIH may be predictive of need for future hernia repair, but further research is necessary to confirm. Anthropomorphic factors and urinary diversion type appear to be associated with PIH risk. These data have the potential to be used during the informed consent process prior to extirpative bladder surgery. Regardless of approach, further research is needed to understand how risks of PIH can be reduced in patients undergoing cystectomy.

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