Factors associated with intraoperative conversion during robotic sacrocolpopexy

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ABSTRACT

Objective: To evaluate for potential predictors of intraoperative conversion from robotic sacrocolpopexy (RSC) to open abdominal sacrocolpopexy.

Patients and Methods: We identified 83 consecutive patients from 2002-2012 with symptomatic high-grade post-hysterectomy vaginal vault prolapse that underwent RSC. Multiple clinical variables including patient age, comorbidities (body-mass index [BMI], hypertension, diabetes mellitus, tobacco use), prior intra-abdominal surgery and year of surgery were evaluated for potential association with conversion.

Results: Overall, 14/83 cases (17%) required conversion to an open sacrocolpopexy. Patients requiring conversion were found to have a significantly higher BMI compared to those who did not (median $30.2kg/m^2$ versus $25.8kg/m^2$; p=0.003). Other medical and surgical factors evaluated were similar between the cohorts. When stratified by increasing BMI, conversion remained associated with an increased BMI. That is, conversion occurred in 3.8% (1/26) of patients with BMI ≤ 25 kg/m^2, 14.7% (5/34) with BMI 25-29.9 kg/m^2 and 34.7% (8/23) with BMI ≥ 30 kg/m^2 (p=0.004). When evaluated as a continuous variable, BMI was also associated with a significantly increased risk of conversion to an open procedure (OR 1.18, p=0.004).

Conclusions: Higher BMI was the only clinical factor associated with a significantly increased risk of intra-operative conversion during robotic sacrocolpopexy. Recognition of this may aid in pre-operative counseling and surgical patient selection.

INTRODUCTION

Abdominal sacrocolpopexy is considered the "gold standard" in the repair of symptomatic high grade vaginal vault prolapse, secondary to high success rates and durable long-term results (1, 2). Recently, multiple series have shown similar excellent long-term outcomes in patients managed with a robotic approach to sacrocolpopexy (3-5). However, while replicating the anatomic principles of the open sacrocolpopexy and potentially decreasing length of hospitalization and blood loss, one issue unique to a minimally invasive approach (whether laparoscopic or robotic) to sacrocolpopexy is that of the potential for requiring conversion to an abdominal sacrocolpopexy (4, 6).

Prior series on RSC have demonstrated a conversion rate ranging from 0 to 11% (3, 6-8). Furthermore, in other surgeries performed with robotic assistance, multiple potential risk factors for conversion such as surgeon experience (9), technical difficulty/failure to progress/ injury to adjacent organs (9, 10), patient risk factors (prior abdominal surgery, obesity, etc.)

(9-11) and equipment malfunction (12) have been proposed. However, there is a paucity of data regarding potential predictors of conversion specifically for RSC. Notably, compared to other robotic pelvic surgeries, RSC presents unique technical challenges such as dissecting in the retroperitoneal fat and potential for hemorrhage from presacral veins. Thus, recognizing specific factors associated with conversion during RSC may aid in patient selection as well as pre-operative patient counseling.

Therefore, in a large cohort of RSC patients we sought to evaluate for clinical predictors of intraoperative conversion from RSC to an open procedure.

PATIENTS AND METHODS

Following Institutional Review Board approval, 83 consecutive patients undergoing RSC at our institution between 2002 and 2012 were identified. RSC was performed for patients with high-grade (Baden Walker-Grade 3 to 4 or Pelvic Organ Prolapse Quantification-Stage 3 to 4) symptomatic post-hysterectomy vaginal vault prolapse.

All patients were treated by a single surgeon via our previously reported technique for RSC (3, 13). Briefly, we utilize the da Vinci-S® system (Intuitive Surgical, Sunnyvale CA, USA) and set up our operative approach with a periumbilical trocar, two standard laparoscopic ports for retraction, and two robotic ports. The sacral promontory is exposed with the use of retraction suture placed through the sigmoid mesentery. The bladder is then dissected from the anterior vaginal wall. The posterior peritoneal reflection is incised and a polypropylene Y-graft is sutured to the sacrum and vagina. Following fixation to the sacral promontory we place the posterior vaginal sutures and then the anterior sutures. The posterior peritoneum is then closed to retroperitonealize the graft.

Clinical variables recorded for evaluation included age, body mass index (BMI), pertinent medical comorbidities (hypertension, diabetes and tobacco use), operative time, estimated blood loss, concurrent procedures performed and post-operative complications.

BMI (weight in kilograms divided by height in meters squared) was examined using the National Institutes of Health definitions of normal weight (BMI <25 kg/m²), overweight (BMI 25-29.9 kg/m²), and obese (BMI ≥30 kg/m²). Because of limited patient numbers, patients with mild obesity (BMI ≥30 and <35 kg/m², n=15) were combined here for analysis with patients that were moderately (BMI ≥35 and <40 kg/m², n=6) and severely (BMI ≥40 kg/m², n=2) obese.

The Wilcoxon rank sum test was used to examine the association between BMI, post-operative recovery and conversion to open surgery. Statistical analyses were performed using the SAS software package (SAS Institute, Cary, NC). All statistical tests were two-sided, with a p-value <0.05 considered statistically significant.

RESULTS

We identified 83 females with a median age of 67 years (IQR 59, 74) that were treated by RSC for high grade, symptomatic vaginal vault prolapse from 2002 to 2012. Of these, 14 patients (17%) required conversion to an open sacrocolpopexy. Reasons for conversion included inability to dissect the anterior vaginal wall from bladder secondary to scarring in 5 cases (35.7%), dense abdominal adhesions preventing laparoscopic access in 5 cases (35.7%), and failure to progress during presacral dissection in the remaining 4 cases (28.5%). Overall, the median OR time was 165 minutes, with a median length of hospital stay of 1.6 days (IQR 1,2). Not surprisingly, cases requiring conversion were significantly longer in duration than those that did not convert (median 195 versus 160 minutes; p=0.002) and had a longer post-operative length of hospitalization (median 1 versus 3 days; p<0.0001).

Clinicopathologic demographics for patients undergoing RSC, stratified by whether conversion was required, are shown in Table-1. As can be seen, the cohorts were similar with regard to age at the time of surgery, year of surgery, as well as pertinent medical and surgical comorbidities; aside from BMI. That is, those requiring conversion had a significantly higher BMI compared to those where RSC was completed (median 30.2 kg/m² versus 25.8 kg/m²; p=0.003). Of note, the median BMI for all patients treated was 26.4 kg/m²

Table 1 - Clinical and demographic information for patient undergoing robotic sacrocolpopexy stratified by requirement for intraoperative conversion.

	No Conversion (N=69)	Conversion (N=14)	p value
Age at surgery, years, median (IQR)	67 (57, 74)	66.5 (63, 72)	0.91
Year of surgery			0.38
2002-2005	31 (44.5%)	1 (3.1%)	
2006-2009	23 (33%)	9 (64.3%)	
2010-2012	15 (21.7%)	4 (28.6%)	
Diabetes mellitus	3 (4.3%)	0 (0.0%)	0.64
Hypertension	29 (42.0%)	6 (42.9%)	0.95
Route of hysterectomy (n=72)			0.38
Vaginal	27 (45.8%)	4 (30.8%)	
Abdominal	32 (54.2%)	9 (69.2%)	
Prior abdominal surgery			0.35
Infraumbilical	31 (75.6%)	9 (75%)	
Supraumbilical	2 (4.9%)	0 (0%)	
Both	8 (19.5%)	3 (25%)	
Prior transvaginal prolapse repair	28 (40.6%)	7 (50%)	0.52
Tobacco use	2 (2.9%)	1 (7.1%)	1.00
Body mass index, kg/m^2, median (IQR)	25.8 (24.1, 29.7)	30.2 (27.9, 35.7)	0.003
Concurrent procedure performed	54 (78.3%)	12 (85.7%)	0.71
Operative time, min, median (IQR)	160 (135, 180)	195 (173, 242)	0.002
Postoperative hospitalization, days, median (IQR)	1 (1, 1)	3 (2, 4)	<0.0001

(IQR 24.3,30.4) and 28% (23/83) had a BMI ≥30 kg/m^2. Notably, in regard to the year of surgery, on further evaluation, there was a linear trend for years of surgery among conversions; however, on univariate logistic model it was not significant (p=0.06). Additionally, patients in the first 3 years of the series (2002-2005) had a significantly lower BMI, compared to the remainder of the patients (25.5 kg/m^2 versus 28.2 kg/m^2, p=0.03).

We next evaluated the impact of BMI on the surgical procedure by stratifying patients by BMI class (≤25 kg/m^2, 25-29.9 kg/m^2, or ≥30 kg/m^2) (Table-2). Here we found that among subca-tegories, an increasing BMI was associated with a significantly increased risk of conversion. That is, conversion occurred in 3.8% (1/26) of patients with a BMI ≤25 kg/m^2, 14.7% (5/34) with a BMI 25-29.9 kg/m^2 and 34.7% (8/23) with a BMI ≥30 kg/m^2 (p=0.004). Notably, both patients with a BMI >40 kg/m^2 required intraoperative conversion. Furthermore, when evaluated as a continuous variable, BMI remained a significant predictor of conversion to an open procedure (OR 1.18, p=0.004). Interestingly, no significant difference in operative time (p=0.06) or intra-operative blood loss (p=0.52) was identified with increasing BMI.

Table 2 - Outcomes of patients undergoing robotic sacrocolpopexy stratified by body-mass index.

	Normal Weight (BMI<25) (N=26)	Overweight (BMI 25-30) (N=34)	Obese (BMI >30) (N=23)	p value
Age at surgery (years), Median (IQR)	70.5 (59, 74)	69 (58, 73)	65 (59, 74)	0.70
Operative time (min), Median (IQR)	155 (130, 173)	167.5 (150, 195)	180(135, 235)	0.06
Hospital Stay (days), Median (IQR)	1 (1, 1)	1 (1, 2)	1 (1, 2)	0.18
Estimated blood loss (cc), Median (IQR)	50 (25, 100)	50 (25, 100)	50 (25, 100)	0.52
Intraoperative conversion	1 (3.8%)	5 (14.7%)	8 (34.8%)	0.004

DISCUSSION

We found, in a large cohort of patients treated by RSC for symptomatic high-grade vaginal vault prolapse, that only obesity (BMI >25 kg/m^2) was associated with a significantly increased risk of intra-operative conversion from RSC to an abdominal sacrocolpopexy. Furthermore, the risk associated with conversion rose with increasing BMI values. To our knowledge this represents the first report evaluating such risk factors for conversion during RSC.

With regard to conversion from a minimally invasive approach to sacrocolpopexy, previous series on laparoscopic and robotic sacrocolpopexy have demonstrated conversion rates between 0-11% (3, 6-8). Our overall conversion rate (16.9%) is somewhat higher, which may be secondary to early adoption of the technique (3) and broad patient inclusion (median BMI 26.4 kg/m^2, range 18.2-47.3 kg/m^2). This occurred as we have attempted to further application of RSC, while acknowledging that conversion may be necessary when discussing management options with patients pre-operatively.

In other laparoscopic and robotic surgeries, multiple risk factors for conversion have been proposed. For instance, when evaluating patients undergoing laparoscopic colectomy, Chew et al. noted an increased conversion rate with increased patient age at the time of surgery, obesity and more advanced pathologic stage (11). Other potential factors such as surgeon experience (9), technical difficulty/failure to progress (9, 10), injury to adjacent organs (9, 10), prior abdominal surgery (9, 14) and device malfunction (12) have been reported. Our analysis extends these previous series with specific application to RSC. In our series BMI was the only identified predictor of conversion and roughly one-third of the conversions were due to difficulty with the presacral dissection specifically. Notably, this dissection is unique to sacrocolpopexy and can be significantly more technically difficult when a large volume of presacral retroperitoneal adiposity is encountered. This may explain why conversely, some studies on other robotic female pelvic surgeries (for instance, hysterectomy) have reported no association between BMI and conversion (15-17). Furthermore, in our series, year of surgery (a marker for surgeon experience over time), route of hysterectomy, prior prolapse repair and prior abdominal surgery were not associated with conversion. Notably, there was a trend toward increased conversion among patients with prior abdominal versus transvaginal hysterectomy, and the absence of statistical significance may be secondary to the limited number of conversions. Additionally, no device malfunctions requiring conversion were encountered. Recognizing specific challenges of the RSC and identification of potential risk factors for conversion is needed to assist with accurate pre-operative counseling and appropriate patient selection.

One potential area of future study is in pre--operative weight loss and pelvic organ prolapse surgery. It has previously been shown that obesity is associated with an increased risk of pelvic organ prolapse progression over time (18, 19). Interestingly, several reports demonstrate no difference in surgical success rate in obese versus normal weight patients (18, 20). That being said, Bradley et al. reported a higher serious adverse events rate among obese patients (22.4% versus 36.5%; p=0.02) (18). Notably, in the bariatric literature, enhanced post--recovery has been noted in patients with a 5-10% weight reduction preoperatively (21). Thus, in addition to overall health benefits from weigh reduction, highlighting the importance pre-operative weight loss to patients may be beneficial regarding successful completion of RSC and helping to avoid peri--operative complications.

Limitations of our study should be noted including its retrospective, non-randomized design. As such, it is subject to bias from patient selection and alterations in technique over time. Additionally, as expertise with the procedure developed over the timeframe of the study, the complexity of cases including patient BMI increased. This likely contributed to the higher conversion rate reported in the later years of the study. Furthermore, given the retrospective nature of this study, there is potential for additional confounding variables/missing data (such as indication for hysterectomy and in some cases route of hysterectomy) which could not be accounted for. Likewise, many of the conversions were not directly related to issues other than obesity (for instance intra-abdominal adhesions), suggesting that while no other factor was associated with conversion on univariate analysis, the risk of conversion may be multifactorial. However, given the sample size in our series, some differences in the cohorts may not be detected. Additionally, our results represent those of a tertiary care center with a relatively high-volume RSC practice, and thus may not be able to be extrapolated to all surgical practices. Thus, external validation from other centers is needed.

CONCLUSIONS

A higher BMI was the only clinical factor associated with a significantly increased risk for intra-operative conversion during robotic sacrocolpopexy. While external validations of these results are needed, recognition of this may aid in pre-operative counseling and in surgical patient selection.

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CONFLICT OF INTEREST

None declared.

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