

Impact of Previous Abdominal Surgery on Robot-Assisted Radical Cystectomy

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ABSTRACT

Objective: We analyzed the effect of previous abdominal surgery (PAS) on consecutive patients who underwent robot-assisted radical cystectomy (RARC).

Materials and Methods: From 2005 to 2008, 73 patients at a single institution underwent RARC with bilateral extended pelvic lymph node dissection and urinary diversion. Lysis of adhesions was performed robotically and laparoscopically. Records were reviewed to assess the impact of PAS on operative outcomes and complications up to 3 months after surgery.

Results: Of the 73 patients, 37 (51%) had undergone PAS. Of these 37, 6 (16%) had PAS above the umbilicus, and 31 (84%) had surgery either above and below or strictly below the umbilicus. Patients with PAS were significantly older than those without ($P < 0.01$). No statistically significant difference was seen with respect to blood loss, transfusion requirement, operative time, lysis of adhesion time, length of ICU stay, overall hospital stay, or the need for reoperation between patients with PAS and those without PAS. The overall postoperative complication rate was higher in the group with PAS ($P = 0.04$). Lymph node yield was higher in patients without PAS ($P < 0.01$). Patients with PAS below the umbilicus had a significantly longer hospital stay than patients with surgery strictly above the umbilicus had ($P = 0.01$). Whether individuals had previously undergone single or multiple surgeries had no significance.

Conclusion: Robot-assisted radical cystectomy in patients with a history of previous surgery may carry a higher risk for postoperative complications. However, previous operations do not appear to affect the likelihood of a

safely completed robotic operation. Patients should be counseled about their risk of obstacles after surgery.

Key Words: Cystectomy, Robot-assisted radical cystectomy, Abdominal surgery.

INTRODUCTION

Previous abdominal surgery (PAS) frequently results in adhesions that potentially complicate subsequent minimally invasive surgical attempts. Adhesions can form in up to 95% of abdominal surgeries.¹ The possible pitfalls associated with operating in a poorly defined field must be weighed against the potential benefits of minimally invasive surgery.

In colorectal surgery, the safety of laparoscopy in patients with PAS has been well described.² Several studies have also documented feasibility of laparoscopic renal surgery in the previously operated abdomen. However, the effect of abdominal adhesions on urologic pelvic surgery, in particular robot-assisted surgery, has not been extensively studied.

Robot-assisted radical cystectomy (RARC) is now more commonly performed as a minimally invasive surgical option for patients with locally advanced bladder cancer. Previous abdominal surgeries and adhesions are commonly found in the elderly patient population with bladder cancer. In a recent assessment of the safety of urologic robot-assisted pelvic surgery, Nazemi et al³ examined a cohort of diverse operations. However, only a small minority of the patients in this study underwent cystectomy. To our knowledge, a focused study of the impact of PAS on RARC has not been pursued. We examined the effect of PAS on operative and postoperative outcomes in patients undergoing RARC and extracorporeal urinary diversion.

MATERIALS AND METHODS

The quality assurance database records of 73 consecutive RARCs performed at Roswell Park Cancer Institute between October 2005 and January 2008 were retrospec-

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tively reviewed. The robotic da Vinci Surgical System (Intuitive Surgical, Sunnyvale, CA) was used in all operations. No patient was denied RARC based solely on a history of PAS. The study was conducted in accordance with institutional review board guidelines.

In all cases, the Veress needle was used to gain access to the peritoneum. Adhesiolysis was performed robotically when possible, reserving a laparoscopic approach for instances in which the extent of the adhesions hindered the initial docking of the robot. Extended bilateral pelvic lymph node dissections were performed robotically. All bowel surgery was performed extracorporeally. In cases where an orthotopic neobladder was used, the robot was redocked to perform the neobladder-urethral anastomosis. Further technical aspects of the surgery are discussed in other literature.⁴

PAS was defined as any type of open or laparoscopic surgery known to cause abdominal or pelvic adhesions, excluding all cardiothoracic, rectal, or endoscopic urologic procedures. We assessed the impact of PAS on operative time, lysis of adhesion time, estimated blood loss, intraoperative transfusion and transfusion rate, hospital stay, intensive care unit (ICU) stay, reoperation rate, intraoperative complications, and postoperative complications up to 3 months after surgery. All complications were considered significant and tabulated. Minor complications were defined as those requiring only basic medical treatment or observation and major complications as those that required a return to surgery, or resulted in substantial morbidity or considerable threat to life.

For comparison, patients were divided into several groups. Group 1 consisted of all patients with PAS, and Group 2 included patients without PAS. Group 1 patients were further divided into subgroups: Group 3 consisted of patients with PAS above the umbilicus; Group 4 of patients with surgery below the umbilicus, regardless of whether they also had PAS above the umbilicus; Group 5 consisted of patients with a single PAS; Group 6 consisted of patients with multiple PAS. Because adhesions typically form at the site of surgery, operations above the umbilicus were expected to form adhesions differently than operations below the umbilicus. The surgical field of RARC lies solely below the umbilicus making lower abdominal and pelvic adhesions those of interest. Therefore as a comparison, operations above and below the umbilicus were grouped with those solely below the umbilicus.

Statistical Analysis

Statistical analyses for categorical variables were performed using Fisher's exact test, while continuous variables were analyzed using the Wilcoxon nonparametric test with exact P-values obtained using Monte-Carlo estimates. Statistical analysis was performed using Statistical Analysis Software (SAS) version 9.1.3. A nominal significance level of 0.05 was used. Power calculations indicated this study to have an estimated 80% power to detect an effect size of at least 1.29 units between the 2 groups.

To analyze the intraoperative and postoperative categorical outcomes, a logistic regression model was used, while a linear regression model was used to analyze continuous outcomes. The covariates considered were age, sex (M, F), body mass index (BMI), American Society of Anesthesiologists (ASA) Score,¹⁻⁴ and previous history of surgery (0, =1, >1). The initial model consisted of all the main effects and 2-way interactions between previous surgery and the remaining covariates. The final model was obtained using backward elimination of the interactions using the criteria of P-value <0.05.

RESULTS

Of the 73 patients who underwent RARC, 37 (51%) (Group 1) had PAS, while the other 36 had no history of prior surgery (49%) (Group 2). A comparison of patients with and without PAS is made in **Table 1**. Patients with PAS were significantly older than patients without PAS (P<0.01). Sex, BMI, and ASA scores were similar. Patients in Group 1 had adhesions requiring takedown 86% of the time. There was no significant stage difference or difference in diversion type between the 2 groups. Previous operations carried a slightly increased risk of positive margins, but this did not reach statistical significance (P=0.11). Number of lymph nodes harvested during the lymph node dissection was higher in patients without previous surgery (22 vs 16, P<0.01).

With respect to operative outcome, there was no statistically significant difference between Groups 1 and 2 in estimated blood loss, transfusion requirement, operative time, lysis of adhesion time, length of ICU stay, intraoperative complications, overall hospital stay, or the need for reoperation. The rate of postoperative complications per patient was higher in the PAS group (P=0.04) (**Table 1**).

Of the 37 patients with PAS, 6 (16%) had surgery above the umbilicus only (Group 3), and 31 (84%) had surgery either strictly below, or both above and below the umbilicus (Group 4). Patients in Group 4 had a signif-

Table 1.
Comparison of Patients With or Without Previous Abdominal Surgery

| | Previous Abdominal Surgery | | Δ P Value |
|------------------------------------|----------------------------|--------------------------|------------------|
| | Yes (Group 1) (n = 37) | No (Group 2) (n = 36) | |
| Total operating time* (min) | 382 (141) | 373 (111) | 0.99 |
| Lysis of adhesion time (min) | 25 (47.6) | 11 (13.5) | 0.10 |
| Estimated blood loss (mL) | 576 (388) | 570 (576) | 0.49 |
| Intraoperative transfusion (units) | 0.62 (1.3) | 0.28 (0.85) | 0.25 |
| Hospital stay (days) | 10 (10) | 9 (5.8) | 0.71 |
| ICU stay (days) | 1.4 (2.3) | 0.8 (1.3) | 0.33 |
| Total complications | 0.81 (1.2) | 0.33 (0.59) | 0.04 |
| Lymph nodes removed | 16.48 (9.19) | 22.29 (9.95) | <0.01 |
| No. of patients with reoperation† | 5 (13.5) | 4 (11.1) | 1.00 |
| Positive margins | 6 (16.22) | 1 (2.78) | 0.11 |
| Pathologic stage | | | 0.12 |
| ≤T1 | 6 (16.22) | 14 (38.89) | |
| T2 | 8 (21.62) | 5 (13.89) | |
| T3 | 14 (37.84) | 13 (36.11) | |
| T4 | 9 (24.32) | 4 (11.11) | |
| Diversion type | | | 0.67 |
| Continent | 4 (10.81) | 2 (5.56) | |
| Conduit | 33 (89.19) | 34 (94.44) | |
| Age | 71 (8.8) | 64 (12.5) | <0.01 |
| Body mass index | 27 (4.8) | 28 (6.2) | 0.26 |
| Sex | | | 0.56 |
| Male | 28 (75.7) | 30 (83.3) | |
| Female | 9 (24.3) | 6 (16.7) | |
| ASA score | | | 0.12 |
| 3 | 14 (37.8) | 7 (19.4) | |
| 2 | 23 (62.2) | 29 (80.6) | |

*Values for continuous variables are given as mean (SD).

†Values for categorical variables are given as frequency (percent).

icantly longer hospital stay (11 vs. 6 days) ($P=0.01$) compared with patients in Group 3, whereas no difference was shown in any of the other parameters (**Table 2**). Twenty patients (54%) had a single prior surgery (Group 5) compared with 17 patients (46%) with multiple prior abdominal procedures (Group 6). A history of more than one PAS carried no differential statistical significance (**Table 3**).

Our patients had a diverse history of PAS (**Table 4**) below the umbilicus, including ventral hernia repair, abdominal aortic aneurysm repair, retroperitoneal lymph node dissection, radical prostatectomy, bowel resection, hysterectomy, and appendectomy. The majority of PAS above the umbilicus was performed on the gallbladder, spleen, or kidney. Wound complications, urinary tract infections, small bowel obstruction, and postoperative ileus were the

Table 2.
Comparison of Patients With Previous Surgery Below or Above the Umbilicus

| | Above the Umbilicus (n = 6) | Below the Umbilicus (n = 31) | ΔP Value |
|------------------------------------|--------------------------------|---------------------------------|----------|
| *Total operating time (min) | 345 (83) | 389 (150) | 0.61 |
| Lysis of adhesion Time (min) | 10 (8.8) | 28 (51.8) | 0.36 |
| Estimated blood loss (mL) | 596 (461) | 572 (381) | 1.00 |
| Intraoperative Transfusion (units) | 0.33 (0.82) | 0.68 (1.40) | 0.85 |
| Total Complications | 0.50 (1.22) | 0.87 (1.15) | 0.20 |
| Hospital Stay (days) | 6 (1.5) | 11 (10.5) | 0.01 |
| ICU Stay (days) | 0.3 (0.5) | 1.6 (2.5) | 0.09 |
| †No. of patients with Reoperation | 1 (16.7) | 4 (12.9) | 1.00 |
| Age | 71 (9.2) | 71 (8.5) | 0.81 |
| Body mass index | 27 (4.9) | 27 (4.7) | 0.94 |
| Sex | | | 0.70 |
| Male | 16 (80.0) | 12 (70.6) | |
| Female | 4 (20.0) | 5 (29.4) | |
| ASA Score | | | 0.74 |
| 3 | 7 (35.0) | 7 (41.2) | |
| 2 | 13 (65.0) | 10 (58.8) | |

*Values for continuous variables are given as mean (SD).

†Values for categorical variables are given as frequency (percent).

Table 3.
Comparison of Patients With Single or Multiple Previous Abdominal Surgeries

| | Previous Abdominal Surgeries = 1 (n = 20) | Previous Abdominal Surgeries > (n = 17) | Δ[β]P Value |
|------------------------------------|---|---|-------------|
| *Total operating time (min) | 374 (107) | 392 (176) | 0.89 |
| Lysis of adhesion time (min) | 15 (15.4) | 38 (68.3) | 0.61 |
| Estimated blood loss (mL) | 585 (378) | 565 (411) | 0.70 |
| Intraoperative transfusion (units) | 0.30 (0.73) | 1.00 (1.73) | 0.25 |
| Total complications | 0.95 (1.39) | 0.65 (0.79) | 0.89 |
| Hospital Stay (days) | 11 (11.6) | 9 (7.6) | 0.64 |
| ICU Stay (days) | 1.6 (2.4) | 1.2 (2.3) | 0.65 |
| †No. of patients with reoperation | 3 (15.0) | 2 (11.7) | 1.00 |

*Values for continuous variables are given as: mean (sd).

†Values for categorical variables are given as: frequency (column percent).

complications most commonly seen (**Table 5**). The majority of complications were considered minor and managed medically.

No access-related complications occurred. Two patients

(2.7%) required conversion to open cystectomy; these were in patients with no PAS and unrelated to adhesions. One patient was unable to tolerate Trendelenburg positioning due to compromised pulmonary function, the

Table 4.
Distribution of Previous Surgeries

| Operation | Frequency |
|----------------------------------|-----------|
| Hernia repair (ventral/inguinal) | 26.5% |
| Cholecystectomy | 22.4% |
| Appendectomy | 18.4% |
| Hysterectomy | 8.2% |
| Splenectomy | 6.1% |
| Nephrectomy | 4.1% |
| Abdominal aortic aneurysm repair | 4.1% |
| Radical prostatectomy | 2.0% |
| RPLND | 2.0% |
| Others | 6.1% |

Table 5.
Distribution of Complications

| Minor | Frequency |
|--------------------------------|-----------|
| Wound breakdown/infection | 13% |
| Small bowel obstruction | 13% |
| Ileus | 10% |
| Urinary tract infection | 10% |
| Parietal complications | 5% |
| C. difficile colitis | 5% |
| Pouchitis | 3% |
| Major | |
| Sepsis | 10% |
| Dysrhythmia | 8% |
| Cardiopulmonary decompensation | 8% |
| Hemorrhage | 5% |
| DVT | 5% |
| Fistula | 3% |
| Renal failure | 3% |
| Bowel injury | 3% |

other had a tumor invading the rectum that was not amenable to robotic resection. There were no intraoperative mortalities in our series, but 2 overall mortalities occurred. One patient without PAS died from complications related to postoperative small bowel obstruction and another from complications secondary to alcoholic cardiomyopathy. The overall mortality rate was 2.7%.

One bowel injury occurred during robotic lysis of adhesions in a patient with PAS. This injury was repaired

primarily with no sequelae during the diversion creation. No injuries to major vasculature occurred; however, 2 episodes of postoperative hemorrhage required a return to the operating room. In both instances, small veins at the site of extended lymph node dissection were identified and controlled. One of these patients had a history of an appendectomy, and the other had no history of PAS.

DISCUSSION

Intraabdominal adhesions are frequently encountered after PAS. To safely and efficiently proceed with the intended operation, the surgical plan must include handling abdominal adhesions in those patients at risk. In this comparison of patients with and without prior surgery, most operative and postoperative parameters showed no significant difference. However, an increased frequency of total complications was appreciated in the patients with PAS, with further discussion to follow. Lymph nodes retrieved were fewer in the patients with PAS. Previous surgery in the lower abdomen was associated with a longer hospital stay. Nonetheless, whether previous surgery was above or below the umbilicus or involved multiple surgeries did not generally affect outcomes.

The average age of patients undergoing cystectomy is generally greater than 65. These elderly patients are more likely to have undergone PAS and more likely in turn to have adhesions compared with a younger patient population. In concordance, patients in this study with PAS were significantly older, 71 vs 64, which is in correlation with other studies.^{5,6}

In this analysis, operative time, blood loss, conversion rate, reoperation rate, and other parameters were not adversely affected by PAS. The complication rate was increased, but this may be attributable to the selection of a more elderly cohort. Several authors have previously determined age to be a significant risk factor for complications after cystectomy.^{7,8} Regardless, this stresses the importance of carefully selecting patients for operation and diligence in operative and postoperative care, as they may have less of a physiologic reserve.

While many colorectal surgeons feel comfortable performing laparoscopic surgery in previously operated fields, controversy still abounds. Law et al⁹ felt that prior surgery did not affect operative or postoperative outcomes, and conversion rate was not increased. On the other hand, Franko et al¹⁰ found rates of conversion, inadvertent enterotomy, postoperative ileus, and reoperation to be higher in patients with prior abdominal surgery.

Debate of this topic has continued in the urologic literature. Mita et al¹¹ found no significant association between prior abdominal surgery and outcomes for urologic retroperitoneal surgery. In a retrospective series, Seifman et al⁵ reported that upper retroperitoneal laparoscopic procedures performed in previously operated abdomens had higher operative and major complication rates. Parsons et al⁶ found hospital stay, perioperative blood transfusion, and operative time to be increased in renal surgery patients with prior surgery. Other outcomes, including complications, showed no significant differences. Pautler et al¹² reviewed operative videotape and determined that risk factors for the presence of adhesions were not a contraindication to transperitoneal laparoscopic urologic surgery. Unfortunately, these surveys have limited applicability to pelvic surgery.

Along these lines, recent urologic literature has only examined a handful of pelvic cases and notably few RARCs. Stolzenburg et al¹³ examined several cohorts of patients undergoing endoscopic extraperitoneal radical prostatectomy by dividing previous surgeries into upper and lower abdomen, pelvic and inguinal compartments. No significant difference in operative time, margin status, or complications was noted. Columbo et al¹⁴ found a 48% complication rate in 31 laparoscopic radical cystectomy patients in a laparoscopic series of 1867 patients. Laparoscopic radical cystectomy was an independent risk factor for perioperative complications. Nazemi et al³ concluded that robotic urologic surgery in patients with PAS was safe, but their outcomes were not stratified for the 8 patients undergoing RARC.

While sharing many technical nuances with laparoscopic surgery, robotic surgery may be even more affected by restrictions placed by intraabdominal adhesions. These adhesions can make entry into the abdomen more difficult, affect the visualization and exposure of anatomy, make dissection more challenging, and lead to injury to other organs due to a decrease in tactile feedback.

The da Vinci robot uses approximately 4 ports with additional laparoscopic ports as needed. The insertion of these multiple ports becomes more complex as the surgical field is obliterated. While there were no access-related complications in this study, the potential for injury exists. Pautler et al¹² reported one access-related complication in 82 patients. This group proceeded to change to the Hasson technique for peritoneal access. Seifman et al⁵ reported 5 access-related complications in 190 patients, with injuries both in the standard laparoscopic and hand-assisted groups. In the gynecologic literature, Lécuru¹⁵ described

the technique and safety of initial blind access. Those patients with PAS had higher rates of incidents or complications compared with those without prior surgery. Audibert et al¹⁶ determined the rate of umbilical adhesions to be significantly higher in women with previous laparotomy. Thus, they recommended preliminary inspection with a microlaparoscope through the left upper quadrant and insertion of the umbilical trocar under direct vision. Vilos et al¹⁷ similarly recommended left upper quadrant access in those with suspected periumbilical adhesions, hernia, or after 3 failed umbilical insufflation attempts. For preventing injuries, Borzellino et al¹⁸ and others have advocated the use of ultrasound for detection of abdominal adhesions in laparoscopic surgery. While many instruments and techniques have been used to attempt to decrease access-related injuries, there is no consensus regarding a superior choice.

Upon entering the peritoneal space, the adhesions often require takedown to accurately identify anatomical landmarks and progress with the dissection. Poorly placed ports may preclude efficient completion of the robot-assisted portion of the case. Maneuvering around adhesions as part of a difficult dissection may lead to visceral or vascular injury. When access is allowed, our robot was docked early so that the 3-dimensional vision and dexterous robotic arms could facilitate lysis of adhesions. Adhesion takedown often adds anesthetic time to the surgery, thus placing the patient at additional risk. In the present series, the increase in operating time in patients with prior surgery was not statistically significant (25 min vs 11 min). One bowel injury occurred during adhesiolysis that was repaired primarily without incident.

In performing robotic-assisted extended pelvic lymph node dissection, the delicate and exacting dissection may also be hindered by the presence of adhesions. Overall, with careful and meticulous dissection, the extended lymph node dissection may still be carried out safely and reliably.¹⁹ Although the lymph node dissection technique was standardized across all patients, mean lymph nodes removed were greater in the patients without previous abdominal surgery. This may be attributable to unintentional trepidation at the borders of dissection in cases of significant dense adhesions.

Recent literature^{20,21} suggests that RARC may be associated with decreased blood loss, a shorter hospital stay, and a more modest narcotic requirement at the cost of longer operative time. In a recent series of RARC by Pruthi et al,²² the complication rate was 30%. A comparative analysis by Wang et al²³ compared 21 open cystectomies

with 33 RARCs. The complication rates were similar between the open and robotic groups (24% vs 21%, respectively). Oncologic outcomes were also similar. Positive margin rates and stage differences were not statistically different between patients with and without PAS. In our series, there were complications in 28 of 73 patients for an overall complication rate of 38% within 3 months after surgery, which is comparable to RARC series as well as open cystectomy series.²⁴ Only 1 out of 6 patients in the subgroup of patients with surgery completely above the umbilicus experienced a major complication (late fistula), and no significant prolonged hospitalizations secondary to ileus or small bowel obstruction were appreciated. This may explain the shorter hospital stays seen in this subgroup. Also several very prolonged hospitalizations (>30 days) in the below umbilicus subgroup affected the mean hospital stay as outliers.

Although we are maintaining a prospective database, the current study was limited by its retrospective nature and relatively small number of patients. Larger series with at least 3 months of follow-up will be needed to fully assess the consequences of previous surgery. Other potential causes for adhesions, such as radiation therapy and inflammatory disorders, were not considered in this analysis.

CONCLUSION

In patients with prior abdominal surgery, RARC remains a feasible alternative. Postoperative complication rates were higher in patients with a history of previous surgery, although those with previous surgery were also older. Discretion should be taken for patients who are elderly and have had prior abdominal surgery, because their postoperative complication rate is higher. Patients should be carefully screened and counseled about their risk of obstacles after surgery.

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