Prevention and Management of Complications During Robotic-assisted Laparoscopic Radical Prostatectomy Following Comprehensive Planning: A Large Series Involving a Single Surgeon

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Abstract. *Aim: To report a series of 1,000 patients treated by a single surgeon using robotic-assisted laparoscopic radical prostatectomy (RALP) and to show how to prevent and manage complications of the procedure. Patients and Methods: Complication rates were prospectively assessed in a series of 1,000 consecutive patients who underwent RALP (group I, cases 1-200; IIa, 201-400; IIb, 401-600; IIIa, 601-800; and IIIb, 801-1000). Preoperative evaluation focused on patients' history of gout, use of drugs that can influence clotting time, and cardiopulmonary problems. Magnetic resonance imaging (MRI) was routinely performed. Operative difficulty was assessed based on the following variables: neoadjuvant hormonal therapy (NHT), obesity [body mass index (BMI) >30 kg/m^2], prostate volume >70 g, presence of a large median lobe with intravesical protrusion >1 cm, previous transurethral resection of the prostate, previous pelvic surgery, previous extended pelvic lymph node dissection (EPLND), and salvage robotic radical prostatectomy (SRP). Results: Operative difficulty tended to increase significantly with greater age, higher American Society of Anesthesiologists' anesthetic/surgical risk class scores, increased BMI, and more advanced clinical stage. The number of cases with NHT, obesity, previous pelvic surgery, EPLND, and SRP significantly increased from early to later groups of patients. Conversely, significantly less blood loss occurred in later groups of patients (group I, 179 ml to 97 ml in group IIIb; p<0.001). The need for blood transfusions gradually reduced from 3.5% to 0.5% in groups I and IIIb, respectively (p=0.022). The total complication rate was 6.4% (64/1,000; surgical/medical=5%/1.4%). Complication rates decreased significantly: 12%, 6%, 6%, 4%, and 4% in groups I, IIa, IIb, IIIa, and IIIb, respectively (p=0.003). The most common complications were blood transfusion and bowel problems (11/1,000=1.1%). Conclusion: Assessed in terms of groups of 200 cases, the surgeon's learning curve for RALP showed significantly fewer complications even as the operative difficulty of cases increased. The keys to preventing complications were meticulous preoperative evaluation of patients, MRI planning, and a dedicated robotic team for performing RALP. Early diagnosis and management of complications are paramount in patients who present any deviation from the normal postoperative course and clinical care pathway.*

Pentafecta is a new standard for reporting outcomes following robotic-assisted laparoscopic radical prostatectomy (RALP) (1, 2). First and foremost, surgeons must lower the complication rates of RALP as they gain experience. Previously, we reported results from an initial 200 cases of RALP and concluded that an individual surgeon must perform 150 RALP procedures in order to achieve significant decreases in complications (3). Coelho *et al*. reported a single-surgeon series that involved 2,500 cases of RALP and in which the complication rate decreased from 9.3% in cases 1-300 to 3.3% in cases 2,101-2,400 (4). Martin *et al*. addressed the 10 criteria for quality reporting of complications, including the method

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of accruing data; duration of follow-up; definitions of complications; outpatient information; mortality rates and causes of death; morbidity rates and total complications; procedure-specific complications; severity grading system; length of stay; and risk factors in the analysis (5). Patel *et al*. reviewed published articles and found only 2 series that met 9 of these criteria and 2 series that met all 10 criteria (3, 6-8). The Clavien grading system was adopted in the majority of the RALP studies identified by Patel *et al*., and the overall complication rate ranged from 6.1% to 26% (8).

Minimizing morbidities and complications is the ultimate goal of RALP. However, not every surgeon has high-volume experience with RALP. The aim of this study was to identify steps in comprehensive planning to reduce complications as the surgeon's experience grew, even as the ratio of the difficult cases among the total case load increased.

Patients and Methods

Preoperative variables. Between December 2005 and June 2015 at Taichung Veterans General Hospital 1000 consecutive patients with prostate cancer underwent RALP performed by a single surgeon (Y.-C. O.). After the protocol was approval by our Institutional Review Board (IRB number: CE 15215B), the prospective data we collected. Patients were divided into five groups: Group I, patients 1-200; group IIa, patients 201-400; group IIb, patients 401-600; group IIIa, patients 601-800; and group IIIb, patients 801-1000). We recorded patients' preoperative clinical characteristics, including age, American Society of Anesthesiologists anesthetic/surgical risks class (ASA), body mass index (BMI), prostate-specific antigen (PSA) levels (high PSA >50 ng/ml), biopsy Gleason score, clinical stage, and D'Amico risk classification.

Comprehensive planning and operative difficulty. Following a new diagnosis of prostate cancer, patients and their families were invited to attend group education sessions that lasted about 1.5 h. The education course was moderated by one of the authors (Y.-C. O.) every 2 weeks and included epidemiology, staging, guidelines for management, advantages and disadvantages of different kinds of treatment options, a follow-up schedule, and question and answer (Q&A). Each session typically included 10-15 patients and 20-30 family members.

Preoperative patient assessment involved taking a complete history, identifying comorbidities, and evaluation, including previous abdominal surgical history and use of concomitant drugs (particularly anti-coagulation and antiplatelet drugs), supplemental drugs, or herbs. The medical history included hypertension, diabetes, and gouty arthritis that required continuous medication. Cardiovascular and respiratory conditions were assessed by chest x-ray, electrocardiogram (ECG), and 2-D ECG. Anesthesiologists provided preoperative anesthetic consultation. Preoperative 1.5-Tesla multiparametric endorectal coil magnetic resonance imaging (MRI) was performed before 2011, and a 3.0-Tesla magnet with a slice thickness <3.0 mm was used for MRI after 2011. MRI evaluation included tumor status (tumor location, staging, tumor extracapsular apical or posterolateral extension, bladder neck or Denovillier fascia, seminal vesicle invasion, and lymph node metastasis), depiction of pelvic and prostate anatomic information (for example, narrow pelvis, deep or large prostate, intravesical protrusion, and apical configuration), and a check for abnormalities (for example, prostate abscess, large seminal vesicle cyst, and urinary bladder lesion). This information helped the surgeon who performed RALP in terms of preserving the neurovascular bundle and also helped refine operative details (9). At our hospital, a combined conference of urologists and radiologists took place every Monday. A multidisciplinary conference that included urologists, radiologists, medical oncologists, radiation oncologists, and pathologists was held every Tuesday. We learned that these conferences improved the interpretation of MRIs, helped hone surgical techniques, and improved outcomes.

Operative difficulty was assessed on the basis of patients' receipt of neoadjuvant hormonal therapy (NHT), obesity (BMI >30 kg/m^2), prostate volume >70 g, presence of a large median lobe with an intravesical protrusion >1 cm, previous transurethral resection of the prostate (TURP), previous pelvic surgery, receipt of extended pelvic lymph node dissection (EPLND), and receipt of salvage robotic radical prostatectomy (SRP). NHT was defined as receiving androgen-deprivation therapy with luteinizing hormone-releasing hormone agonists for at least 3 months. Pelvic surgery was defined as rectal or bladder surgery, not including inguinal hernia surgery. The template for EPLND included the pre-prostate fat pad, bilateral obturator nodes, exterior iliac nodes, hypogastric nodes with or without presacral and common iliac nodes at least 14 nodes and mean 18 nodes in our series (10-12).

Surgical techniques, operative factors, and complications. Our RALP technique was previously described (3, 13, 14). A dedicated robotic team performed RALP. Under general anesthesia, the patient was placed in a supine position, legs separated and flexed, and arms tucked to the sides of the beanbag positioning device; shoulder pads with surgical tape could be used to secure the patient. The patient was placed in a steep Trendelenburg position at about 25˚-30˚. With the patient in this position, intraoperative procedures were used to cut, cauterize, and clip under direct vision without compromising the vessels, nerves, and adjacent organs.

Operative parameters were analyzed, including the surgeon's console time, the patient's estimated blood loss (EBL), and the transfusion rate. Any complications were recorded according to the Clavien grading system (15). The clinical care pathway was as follows: Patients were allowed to ambulate on the first postoperative day (POD 1). Patients could begin to drink water and then eat a regular diet on POD 1-2. Removal of the drainage tube was carried out on POD 1-3. Patients were allowed to go home on POD 2-5 and then returned to our Outpatient Department for removal of the Foley catheter on POD 7-14 (3). If any deviation from the normal postoperative course and clinical care pathway occurred, we performed computed tomography of the abdomen to check for any intra-abdominal complications. All patients were followed-up at our outpatient Department, and the complication rate was evaluated within 6 months.

All data are expressed as the mean±standard deviation. SPSS 20.0 for Windows (IBM, Chicago, IL, USA) was used for biostatistical calculations. Statistical analysis was performed using one-way ANOVA and chi-square tests as appropriate. A *p*-value of less than 0.05 was considered statistically significant.

Results

Table I presents preoperative clinical characteristics of 1000 cases who underwent RALP. We found statistically significant differences associated with older age, higher ASA

score, larger BMI, and more advanced clinical stage in every 200-case interval from group I to group IIIb.

Table II shows the operative difficulty among the 1000 RALP cases. The number of cases of NHT, obese patients (BMI >30 kg/m^2), previous pelvic surgery, and performance of EPLND or SRP significantly increased from group I to IIIb.

Table III shows operative parameters and complications in the 1000 cases who underwent RALP. The console time and blood loss significantly decreased from group I to group IIIb (175.45±53.76 min *vs*. 111.36±23.91 min for console time; 179.05±178.92 ml *vs*. 97.51±86.39 ml for blood loss; both $p<0.001$). Blood transfusions significantly decreased from 3.5% in group I to 0.5% in group IIIb ($p=0.022$), and the perioperative complication rate was significantly reduced from 12% in group I to 4% in groups IIIa and IIIb ($p=0.003$).

In Table IV presents details of complications in the 1000 RALP cases according to the Clavien classification. In total, 64 patients (6.4%) had 72 events: one patient had three events, six patients had two events, and the other patients with perioperative complications had one event each.

The number of surgical complications was 50 (5%), and the number of medical complications was 14 (1.4%). The most common complications were blood transfusions (1.1%, 11/1000) and bowel problems (1.1%, 11/1000). Bowel problems occurred in 11 cases (Clavien grades I-VI) and included intestinal tear with intraoperative repair (1), rectal injury with intraoperative repair without sequelae (1), and prolonged ileus (5) with conservative treatment. Postoperatively, four patients underwent another surgery. One developed an incarcerated inguinal hernia that required laparoscopic hernioplasty on POD 7; one developed an intestinal obstruction that required laparoscopic lysis of an adhesion on POD 9; and two patients with bowel injury underwent transient colostomy and later colostomy closure (15). The second-tier common complications included gouty arthritis attack (0.6%, 6/1000), urine leakage (0.6%, 6/1000), and Clavien grade I-III wound problem (0.6%, 6/1000). Patients required surgical intervention in 12 cases with Clavien III and two with Clavien IV complications (Table IV).

Discussion

This study analyzed the complication rates following RALP based on an analysis of 1,000 surgeries performed by a single surgeon and following perioperative evaluation and a defined clinical pathway. It revealed an overall complication rate of 6.4% and showed that complications were reduced from 12% to 4% after the surgeon and team gained experience, even among cases in whom the operative difficulty was increased. Major complications were reduced from 2.5% in the first 200 patients to 0.5% in the last 200 patients.

No studies on the relationship of complications and the operative difficulty of RALP have been performed to date. Patients in our cohort had a mean PSA level of 19.27 ng/ml and were at clinical stage >T3 (10.8%). After gaining more experience, the surgeon can treat more challenging and difficult cases. The Pasadena Consensus panel identified a subgroup of patients who should be treated only by an 'experienced surgeon', including obese patients (BMI >30 kg/m^2), those with a large prostate volume (>70 g), patients with a large median lobe, cases with a previous TURP, high-risk patients requiring EPLND, and those who had had previous pelvic surgery (16). Only very experienced surgeons should perform SRP after radiation, cryotherapy, and high-intensity focused ultrasound (17). We modified the criteria for difficult cases by including the presence of a large median lobe of the prostate with an intravesical lobe protruding >1 cm. Patients with a protruding medial lobe >1 cm had significantly more base surgical margin positivity than patients with a <1-cm protruding medial lobe (35.9% *vs*. 20.1%, $p=0.012$) (18). In our experience, cases with NHT had more adhesion around the periprostatic tissue plane. NHT significantly increased the operative time required for RALP (254 min *vs*. 209 min, $p=0.019$) compared with the time required for patients without NHT (19).

We expanded the indication of RALP for more complicated cases after we gained experience. After the first 200 cases of RALP, we performed surgery in more difficult cases; for example 8% of later cases had undergone previous TURP, which had caused more rectal injury and major complications, compared with no previous TURP in earlier patients (16). Clavien IV major complications of bowel problems occurred in the first 200 cases, for example, unrecognized sigmoid colonic injury and recto-urethral fistula (3). After the team learned during the first 200 cases of RALP, no more rectal injuries occurred. After the team had gained experience, the outcomes among patients who had undergone previous TURP, had a large median lobe >1 cm, had undergone previous pelvic surgery, and had SRP were not statistically different from those of patients who had not had these intervention. The ratio of patients with NHT, BMI >30 kg/m^2, or prostate volume >70 g compared to other patients in the group were significantly increased in each 200-case interval (Table IV). The question is do challenging cases incur more complications? From our data, we believe that safe RALP, even among cases that present greater operative difficulty, depends on comprehensive preoperative planning performed by a dedicated robotic team and proper postoperative care.

Coelho *et al*. reviewed the complication rates following RALP in a high-volume center and reported complication rates from 4.4% to 22%, and major complication rates from 0.6% to 8.5% (4). They reported a single-surgeon series that involved 2500 cases of RALP, and the complication rate was 5.08%; complications decreased from 9.3% in cases 1-300 to 3.3% in cases 2101-2400 (4). Liss *et al*. reported an overall complication rate of 10.8% (108 out of 1000) among RALP cases (20). The overall complication rate was reduced

Table I. *Comparison of preoperative clinical characteristics of 1,000 cases who underwent robotic-assisted laparoscopic radical prostatectomy.*

Clinical data	Group I (Cases 1-200)	Group IIa (Cases 201-400)	Group IIb (Cases 401-600)	Group IIIa (Cases 601-800)	Group IIIb (Cases 801-1000)	*p*-Value	*p*-Value for trend	All cases
Age (years)	64.93±6.81	64.94±7.55	66.09±7.63	67.28±8.17	66.28±7.89	0.009	0.003	65.90±7.66
ASA I/II/III	32 (16.0%)/ 148 (74.0%)/ 20 (10.0%)	26 (13.0%)/ 157 (78.5%)/ 17 (8.5%)	25 (12.6%)/ 154 (77.8%)/ 19 (9.6%)	8 (4.0%)/ 161 (80.5%)/ 31 (15.5%)	7 (3.5%)/ 173 (86.5%)/ 20 (10.0%)	<0.001	<0.001	98 (9.8%)/ 793 (79.3%)/ 107 (10.7%)
BMI kg/m^2	24.59±15.63	24.69±3.18	24.60±2.66	24.90±2.96	25.24±3.36	0.161	0.025	24.80±3.02
PSA (ng/ml)	17.87±18.24	17.40±16.24	18.15±37.37	18.64±24.96	24.34±40.67	0.108	0.399	19.27±29.24
PSA >50 ng/ml	14 (7.0%)	10 (5.0%)	12 (6.0%)	11 (5.5%)	19 (9.6%)	0.365	0.337	66 (6.6)
Gleason score	6.58±1.04	6.88±1.07	6.75±1.11	6.85±1.06	6.87±1.12	0.024	0.133	6.78±1.08
Clinical stage								
T1	78 (39.0%)	50 (25.0%)	78 (39.0%)	67 (33.5%)	68 (34.0%)	<0.001	<0.001	341 (34.1%)
T2	110 (55.0%)	130 (65.0%)	98 (49.0%)	113 (56.5%)	100 (50.0%)			551 (55.1%)
T3-4	12 (6.0%)	20 (10.0%)	24 (12.0%)	16 (8.0%)	23 (11.5%)			95 (9.5%)
N1or M1	0 (0%)	0 0 (%)	0 (0%)	4 (2.0%)	9 (4.5%)			13 (1.3%)
Risk								
Low	42 (21.0%)	32 (16.0%)	63 (31.5%)	41 (20.5%)	46 (23.0%)	0.031	0.827	224 (22.4%)
Intermediate	66 (33.0%)	63 (31.5%)	59 (29.5%)	59 (29.5%)	57 (28.5%)			304 (30.4%)
High	92 (46.0%)	105 (52.5%)	78 (39.0%)	100 (50.0%)	97 (48.5%)			472 (47.2%)

BMI, Body mass index; ASA, American Society of Anesthesiologists anesthetic/surgical risks class.

Table II. *Comparison of operative difficulty in 1,000 cases of robotic-assisted laparoscopic radical prostatectomy.*

Clinical data (Cases 1-200)	Group I (Cases 201-400)	Group IIa (Cases 401-600)	Group IIb (Cases 601-800)	Group IIIa (Cases 801-1000)	Group IIIb	*p*-Value	*p*-Value for trend	All cases
Neoadjuvant hormonal therapy	5 (2.5%)	8 (4.0%)	15 (7.5%)	20 (10.0%)	24 (12.0%)	0.001	<0.001	72 (7.2%)
Obese patients (BMI >30 kg/m^2)	7 (3.5%)	8 (4.0%)	9 (4.5%)	11 (5.5%)	24 (12.0%)	0.002	0.001	59 (5.9%)
Prostate volume >70 g	23 (11.5%)	14 (7.0%)	16 (8.0%)	22 (11.0%)	30 (15.0%)	0.074	0.136	105 (10.5%)
Large median lobe (>1 cm)	36 (18.0%)	25 (12.5%)	29 (14.5%)	31 (15.5%)	35 (17.5%)	0.546	0.812	156 (15.6%)
Previous TURP	16 (8.0%)	20 (10.0%)	21 (10.5%)	24 (12.0%)	25 (12.5%)	0.613	0.106	106 (10.6%)
Pelvic surgery	1 (0.5%)	1 (0.5%)	4 (2%)	4 (2%)	6 (3%)	0.201	0.022	16 (1.6%)
EPLND	29 (14.5%)	49 (24.5%)	71 (35.5%)	69 (34.5%)	73 (36.5%)	<0.001	<0.001	291 (29.1%)
Salvage robotic radical prosta-tectomy	0 (0%)	2 (1.0%)	3 (1.5%)	4 (2.0%)	5 (2.5%)	0.252	0.017	14 (1.4%)

BMI, Body mass index; TURP, transurethral resection of the prostate; EPLND, extended pelvic lymph node dissection.

from 18% in the first 200 cases to 5% in the last 200 cases. Major complications (grades III and IV) were reduced from 12.5% to 2.5% (20). The surgeon provided targeted changes in the technique to reduce complications during surgery and achieved statistically significant reductions in corneal abrasions, fossa navicularis strictures, and camera-site hernias (19). The majority of complications occurred during treatment of the early cases. Cheng *et al*. reported that an early case series with 79 cases (45 with laparoscopic radical prostatectomy and 34 with RALP) had a 43% overall complication rate and a 7.6% rate of major complications (21). However, the overall mortality of the RALP series was very low (0.1-0.2%) (3, 7, 20).

Preoperative drugs administered to patients included anticoagulants, Chinese herbs, and drugs to treat hyperuricemia or gouty arthritis. In our practice, it is mandatory for all patients to withhold anticoagulants 1 week before RALP and to withhold Chinese herbs 3 weeks before

Table III. *Comparison of operative parameters and complication in 1000 cases of robotic-assisted laparoscopic radical prostatectomy.*

Clinical data	Group I (Cases 1-200)	Group IIa (Cases 201-400)	Group IIb (Cases 401-600)	Group IIIa (Cases 601-800)	Group IIIb (Cases 801-1000)	*p*-Value	*p*-Value for trend	All cases
Console time (mean±SD), min	175.45±53.76	107.10±25.72	108.05±25.51	106.73±25.64	111.36±23.91	<0.001	<0.001	121.72±42.50
Blood loss (mean±SD), ml	179.05±178.92	117.25±164.16	90.07±93.23	99.60±112.48	97.51±86.39	<0.001	<0.001	116.71±136.19
Transfusion rate, n (%)	7/200 (3.5%)	1/200 (0.5%)	2/200 (1%)	0/200 (0%)	1/200 (0.5%)	0.007	0.022	11/1000 (1.1%)
Complication rate, n (%)	24 (12%)	12/200 (6%)	12/200 (6%)	8/200 (4%)	8/200 (4%)	0.005	0.003	64/1000 (6.4%)
Clavien I/II/III/VI	6/13/3/2	5/4/3/0	5/3/2/2	2/4/2/0	3/3/2/0			21/27/12/4
Minor/major complication, n (%)	19/5 (2.5%)	9/3 (1.5%)	8/4 (2%)	6/2 (1%)	6/2 (1%)	0.953	0.629	48/16

SD, Standard deviation.

Table IV. *Complications in 1000 cases of robotic-assisted laparoscopic radical prostatectomy (Clavien classification) (15).*

	Number (by event)*	Details (n)
Clavien I	26	Umbilical wound infection (2), intraoperative bladder injury (4), rectal injury (1), urine leakage (4), ileus (5), lymphocele (1), urine retention (3), obturator nerve injury (2), radial nerve injury (1), ureteral injury (1), intestine tear (1), scrotal ecchymosis (1)
Clavien II	29	Blood transfusion (11), gouty arthritis (6), urine leakage with percutaneous nephrostomy drainage (2), urinary tract infection with stone formation (2), deep vein thrombosis (1), wound infection (2), cellulitis (1), pneumonia (1), internal jugular vein thrombosis(1), herpes zoster (1), postoperative hematoma (1)
Clavien III	12	Anastomosis stricture (2), urethral stricture (1), wound rupture (2), incarcerated inguinal hernia (1), bowel obstruction (1), delayed bleeding (2), urinary bladder clot (1), hem-o-lok stone (1), ureteral kinking (1)
Clavien IV	4	Unrecognized sigmoid colonic injury (1), rectourethral fistula (1), myocardial infarction (1), pulmonary emboli (1)

PCN, Percutaneous nephrostomy; UTI, urinary tract infection; DVT, deep vein thrombosus. *A total of 64 patients had 72 complications: one patient had three events; six patients had two events; and other patients had one event each.

RALP. Mantz *et al*. reported that elective noncardiac surgery (including urological surgery) can be performed safely following continuous administration of antiplatelet agents (22). They did not find a significant difference in terms of occurrence of major thrombotic or bleeding events between patients who continued or discontinued or interrupted their intake of aspirin (22). Some Chinese herbal preparations can protract clotting time by disruption of the coagulation cascade (23). Patients who consume Chinese drugs have elevated risks and can experience severe adverse effects due to potential drug interactions and thus should be investigated preoperatively (24). Cordier and Steenkamp suggested that herbal preparations should be discontinued before patients receive any surgical procedure (23). Gout attack occurred in 4.2% of 359 patients with prostate cancer who underwent radical prostatectomy (open, laparoscopic, or robotic) (20). In our experience, the incidence of gouty arthritis attack was 1.5% in the first 200 cases but decreased to 0.375% in the subsequent 800 cases because we administered preventive medication for hyperuricemia (3).

MRI is increasingly used to study prostate cancer and improves staging, identifiction of spatial anatomic features, and determination of aberrant structures (25). For regional staging, MRI can help predict the site of tumor extracapsular extension and apical tumor to reduce the positive surgical margin (18, 26). MRI can help surgeons to preserve the neurovascular bundle and determine the extent of surgical margins in RALP (27). Because it provides spatial anatomic information about the prostate diameter and the pelvic cavity, MRI can be used to predict the surgical difficulty (operation time, EBL, transfusion rate, and surgical margin positivity) of RALP (28). In the case of aberrant structures, prior MRI can

allow surgeons to repair subclinical inguinal hernia and preserve anomalous accessory pudendal arteries (25, 29). A surgeon's prior knowledge about the anatomy of the patient's prostate, pelvis, and surroundings is valuable and can expedite precise dissection, resection of the prostate, preservation of the neurovascular bundle, and vesicourethral anastomosis. Likewise, surgeons depend on information from MRI to operate safely, shorten the operative time, facilitate rapid recuperation, reduce complications, and improve outcomes. Table IV compares results from the first 200 patients and outcomes from the last 200 patients and shows that the console time was reduced by 36.6%, EBL was reduced by 45.5%, the transfusion rate was reduced by 85.7%, the complication rate was reduced by 66.7%, and the rate of major complications was reduced by 60%. MRI benefits both inexperienced surgeons and those who have more experience. Reducing complications involves multiple types of learning and is a life-long learning process. For the Authors, a dedicated robotic team performed every step of RALP, including patient positioning, protection, trocar setting, and wound closure. Such a setting provides a fast learning experience, expedites proficiently, reduces complications, and improves outcomes as experience is accumulated (3).

The clinical care pathway provides evidence that supports clinical decision-making (30). We abide by the clinical care pathway for RALP. Any deviation from the normal postoperative course and clinical care pathway, requires early diagnosis with a computed tomographic scan and subsequent management of complications. The most common complications in our series were blood transfusions and bowel problems. During the course of our work, the blood transfusion rate was gradually reduced. Several authors have reported that urine leaks are the most common complication and have an incidence from 0.3% to 15.4% (8, 31). The sequelae of urine leaks can involve vesicourethral anastomotic strictures and incontinence. In our series, the incidence of urine leak was 0.6% (6/1000: Clavien score I in four patients and Clavien score II in two). Our method of vesicourethral anastomosis involved posterior reconstruction of the rhabdosphincter (32) and intraoperative bladder challenge with normal saline (200 ml) with bladder compression (33). Coelho *et al*. compared 473 patients with modified posterior reconstruction of the rhabdosphincter and 330 without posterior reconstruction following RALP. The anastomotic leakage rate was only 0.4% in posterior reconstruction-treated patients and was associated with early recovery of continence but was 2.1% in patients without posterior reconstruction (32). In our series, after the security of the watertight vesicourethral anastomosis was confirmed intraoperatively, there was no need for postoperative cystography (33).

One study reported a series of 79 cases who underwent laparoscopic radical prostatectomy and 34 who received RALP by multiple surgeons, and the total complication rate was 43% (21). The complication rate was larger in early cases that involved multiple surgeons. Our series showed low complication rates from a high-volume surgeon who performed the RALP. These results cannot be generalized to earlier experiences and series that involve multiple surgeons. The strengths of our study include the prospectively collected data and standardized reports using the Clavien system, and we complied with 9 out of 10 criteria set out by Martin *et al*., except for the risk factors in the analysis (5). These results can provide valuable information for comparisons with other series of RALP and suggest how to prevent and deal with complications.

Conclusion

In conclusion, this series of 1,000 cases of RALP showed significantly fewer blood transfusions and lower complication rates even among patients with older age, higher ASA scores, greater BMI, advanced clinical stages, and more operative difficulties. Importantly, preoperative evaluation can prevent bleeding during and after RALP by identifying the need to withhold drugs that influence the clotting time, and can prevent gouty attack postoperatively. We also excluded patients with severe cardiopulmonary distress and ASA score IV. Preoperative MRI mapping and planning can identify and help resolve operative difficulties and also helps the surgeon to avoid the iliac vessel, the bladder, and rectal injury during the operation. A dedicated robotic team is the key to reducing intraoperative complications. Postoperatively, a carefully predefined clinical care pathway can help identify complications and facilitate rapid management.

Conflicts of Interest

None declared.

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