Simple prostatectomy using the open and robotic approaches for lower urinary tract symptoms: A retrospective, case-control series

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Abstract

Introduction: We aimed to assess the outcome of our series of simple prostatectomy using the open simple prostatectomy (OSP) and robotic-assisted simple prostatectomy (RASP) approaches, at our institution.
Methods: A retrospective chart review of men who underwent OSP and RASP at Western University, in London, ON. Preoperative, intraoperative, and postoperative data were collected and analyzed.
Results: From 2012–2020, 29 men underwent a simple prostatectomy at our institution. Eight patients underwent an OSP and 21 patients underwent a RASP. The median age was 69 years. Preoperative median prostate volume was 153 cm^3 (range 80–432 cm^3). The surgical indications were failed medical treatment, urinary retention, hydronephrosis, cystolithiasis, and recurrent hematuria. The median operative time was 137.5 minutes in OSP and 185 minutes in the robotic approach (p=0.04). Median estimated blood loss was 2300 ml (range 600–4000 ml) and 100 ml (range 50–400 ml) in the open and robotic procedures, respectively (p=0.4). The mean length of hospital stay was shorter in the RASP group, one day vs. three days (z=4.152, p<0.005). Perioperative complication rates were significantly lower in the group undergoing RASP, with

no complications recorded in this group (p=0.004). Both groups demonstrated excellent functional results, with most patients reporting complete urinary continence (p=0.8).
Conclusions: We report very good perioperative outcomes, with a minimal risk profile and excellent functional results, leading to marked improvement in patients' symptoms at followup after both the OSP and RASP approaches. RASP was associated with a shorter length of hospital stay, decreased blood loss, and a lower complication rate.

Introduction

The preferred surgical technique for the treatment of an enlarged prostates (≥ 80 g), leading to lower urinary tract symptoms (LUTS), remains controversial. Historically, open simple prostatectomy (OSP) has been regarded as the gold standard for the treatment of large prostate glands; however, this technique can also be associated with a higher blood loss and transfusion rates, and a longer hospital stay[1]. In 2008, Sotelo et al.[2] were the first to report the robotic assisted simple prostatectomy (RASP) technique. Since introduction, this procedure has slowly gained popularity. The increased availability of surgical robots, as well as the higher frequency of robotic assisted procedures, especially robotic assisted laparoscopic radical prostatectomy (RARP) for prostate cancer, has naturally led to the expanded use of this approach for simple prostatectomies. RASP has been reported to be a good surgical option for men with large prostate glands (≥ 80 g), with surgical outcomes comparable to Holmium Laser Enucleation of Prostate (HoLEP) and superior to OSP[3,4].

In 2015, Hoy et al.[5] reported on the initial Canadian experience performing RASP. Their robotic cohort included 4 patients. They concluded that compared to OSP, the robotic approach was associated with reduced length of hospital stay and intraoperative blood loss. They recommended further investigation and consideration at other Canadian centers. We report the experience of our institution in performing both OSP and RASP for the treatment of LUTS and urinary retention, secondary to an enlarged prostate.

Methods

Following institutional review board (IRB) approval, we performed a retrospective chart review of all patients that underwent simple prostatectomies at Western University. OSP were performed by two fellowship-trained, experienced surgeons. RASP was performed using the da Vinci Si surgical system by a single fellowship-trained and experienced surgeon. The decision on the type of procedure was based on surgeon preference. All patients were followed up in the clinic postoperatively.

This review includes demographic data, as well as preoperative, intraoperative and postoperative data. Study data were collected and managed using REDCap electronic data capture tools hosted at Lawson Health Research Institute[6,7].

Statistical analysis

Descriptive statistics were used to assess demographics. Statistical analysis for differences in patient age, BMI, pathologic weight of adenoma, and drop in hemoglobin (Hb) were performed using student t test. Length of operation was tested using Welch t test as variances were not equal. Mann Whitney U test was performed to analyze non-parametric data (length of hospitalization, length of follow up, and complications). Indications for the surgery and need for transfusion were analyzed using Fisher's exact test. Comparison between transrectal ultrasound (TRUS) and abdominal ultrasound (US) was performed using Mann Whitney U test and differences in adenoma weight by Wilcoxon signed rank test. For all analyses, reported p-values are from 2-tailed tests and considered statistically significant if $p<0.05$ with 95% confidence interval (CI). All analysis was performed using IBM SPSS® Statistics version 26.0 (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0 Armonk, NY: IBM Corp.)

The operative technique

OSP was performed through a lower midline incision in an extraperitoneal trans-capsular technique. All RASP procedures were performed via a transperitoneal six port approach, with the prostate approached trans-vesically, for adenoma enucleation.

Postoperative management

In the open approach, the urethral catheter is typically removed 14 days following the procedure, whereas in the robotic approach it is removed after 7 days. The timing of removal of the catheter was dependent on the clarity of the urine and the discretion of the operating surgeon.

Results

We studied the records of 29 patients who underwent simple prostatectomy between the years 2012 – 2020. Eight of the patients had OSP, whereas 21 underwent RASP. Demographic and preoperative data are presented in table 1. Mean preoperative estimated prostate volume was 229 cm^3 (SD ±114.8 cm^3) and 152 cm^3 (SD ±49.2 cm^3) in the OSP and RASP groups respectively ($p=0.03$). The surgical indications were failed medical treatment (25%, 28.5%), urinary retention (37.5%,52.3%), hydronephrosis (25%, 14.2%), cystolithiasis (0%, 4.7%) and recurrent hematuria (4.7%, 12.5%) for OSP and RASP respectively ($p=0.5$). Some of the patients had multiple indications. Operative and postoperative data are provided in table 2. Median operative time was 137.5 minutes (range 86-240 mins) in the open surgical approach and 185 minutes (range 140-283 mins) in the robotic approach ($p=0.04$). None of the robotic procedures were converted into an open approach.

Median estimated blood loss was 2300 ml (range 600-4000 ml) and 100 ml (range 50-400 ml) in the open and robotic procedures respectively (p=0.4). The mean postoperative drop in hemoglobin was 39 g/L and 22 g/L in OSP and RASP respectively (p=0.03). Patients undergoing RASP had a significantly lower risk of postoperative blood transfusion (p=0.06), with none requiring any blood products compared with 2 patients (25%) in the OSP cohort who needed blood transfusions perioperatively, requiring a total of 9 units of packed red blood cells. While there was no significant difference between the two surgical approaches in terms of blood loss, likely secondary to the small sample size, RASP was associated with a significantly lower postoperative decrease in Hb and blood transfusion rate.

The RASP cohort also had a shorter length of hospital stay with a mean stay of 1 day (±0.46 days), compared to 3 days (±1.03 days) in the OSP group($p<0.005$). A urethral catheter was left indwelling for 14 and 7 days in all patients undergoing OSP and RASP respectively, at the discretion of the operating surgeon. All patients were able to void spontaneously after the urethral catheter was removed and none of the patients required re-catheterization due to urinary retention. Median length of follow up was 15 (range 3-81) and 4 (range 3-12) months for OSP and RASP respectively. 92.8% of patients reported complete urinary continence at follow-up, with no statistical significance between the two surgical approaches (p=0.7). In the OSP group one patient reported severe urinary incontinence and is planned to undergo insertion of an artificial urinary sphincter (AUS). Comparatively, in the RASP group two patients (10%) reported minimal incontinence which required no further treatment. All preoperatively diagnosed hydronephrosis resolved on postoperative ultrasound imaging. The mean difference between the pre and post-operative PVR was 364 ml (p=0.1). The median decrease in PSA following the surgical procedures was 5.91 ($z=-3.75$, $p<0.0005$).

There was no difference in pathologic weight of resected adenoma between OSP and RASP approaches with median weights of 121g (range 63 – 255g) and 103g (range 52-240g) respectively (p=0.1). There was a significant difference between preoperative prostate volume estimation, by both abdominal US and TRUS, and resected adenoma weight by a median difference of 55 grams ($z=-4.782$, $p<0.0005$). In comparing both preoperative imaging modalities, TRUS and abdominal US, we report no significant differences between the two in the ability to estimate resected prostate size (p=0.3)23 patients (79%) were reported to have benign tissue in the pathology report. Three patients had an incidental finding of low-risk prostate adenocarcinoma, while 3 patients were found to have intermediate risk prostate cancer.

The rate of perioperative complications was found to be significantly higher in the OSP group, with no complications being reported in patients undergoing RASP (p=0.04). In the OSP group, a total of 6 (75%) patients experienced postoperative complications. Two patients had a grade 1 Clavien Dindo complication, including one patient who had a urinary tract infection (UTI), which was treated with antibiotics; and a second patient with persistent gross hematuria which required prolonged continuous bladder irrigation until it resolved without further

management. Two patients had a grade 2 Clavien Dindo complications and required a blood transfusion. Finally, two patients had a grade 3b Clavien Dindo complication; including one patient who developed a bladder neck stricture treated with bladder neck incision, and a second patient who developed significant urinary incontinence and is planned to undergo insertion of an AUS.

Discussion

We report on our experience with simple prostatectomies, for both OSP and RASP approaches, in the treatment of patients with large obstructing prostates.

In our cohort, RASP was found to have a very good safety profile with minimal blood loss. The patients experienced an unremarkable postoperative period with no complications, short hospital stay and excellent functional outcomes at a follow-up.

The most recent European Association Urology (EAU) guidelines[8] indicate that the standard surgical techniques for simple prostatectomy are OSP, HoLEP, and bipolar enucleation. The guidelines conclude that both laparoscopic and RASP seem comparable to OSP in terms of efficacy and safety, providing similar improvements in maximum urinary flow rate (Qmax) and International Prostate Symptom Score (IPSS). However, these results are based on retrospective studies. In the 2018 American Urological Association (AUA) guidelines[9] no surgical technique is specified as the preferred one, and it is advised to choose the technique according to the surgeon's expertise. Alternatively, the Canadian Urological Association (CUA) guidelines[10] still recommend OSP as first choice for the treatment of a large prostate, and do not include RASP as one of the potential management options.

Hoy et al.[5] described the initial Canadian experience with RASP. They performed a retrospective chart review of 4 patients undergoing RASP and 28 undergoing OSP. They reported that RASP had significantly longer operative time (161 vs. 79 min; $p = 0.008$) but a shorter length of hospital stay (2.3 vs. 5.5 days; $p = 0.0001$). In their series OSP was associated with higher blood loss (835.7 vs. 218.8 mL; $p = 0.0001$); however, there was no significant difference in the overall complication rate between the two techniques.

In our study we report similar results with regard to operative time and length of hospital stay; while we were unable to demonstrate a difference in intraoperative blood loss, OSP was associated with a significantly high postoperative Hb drop and blood transfusion rate. In addition, in our cohort, OSP was also associated with a significantly higher complication rate ($p=0.004$).

Opponents of RASP have noted the longer operative time when compared to OSP and HoLEP. Studies comparing the operative times have reported that RASP took significantly longer than OSP (161 vs. 79 mins, $p <0.008$)[1] and HoLEP (103 vs. 274 minutes, $p<0.001$)[8]. In our study we report on statistically significant longer operative time in RASP, with a median operative time of 137.5 and 185 minutes for OSP and RASP respectively ($p=0.04$). The longer

operative time is likely due to the docking and undocking of the robot, as well as the extraction of the specimen.

Multiple studies have reported on the significantly decreased blood loss in minimally invasive simple prostatectomies when compared to OSP[1,4,12,13]. We report that the median EBL in our cohort was 2300 and 100 ml for the open and robotic approaches respectively. Two patients undergoing OSP received blood transfusions perioperatively, while none of the patients undergoing RASP required any blood products. To note, in our cohort, the indication in one of the patients undergoing OSP was severe recurrent hematuria. The patient required blood transfusions peri-operatively. This may have resulted in skewing the results of EBL and blood transfusions. Nevertheless, we believe that the reduced blood loss in the robotic approach favors the robotic approach over the open procedure.

In a literature review by Shah et al.[1] they reported that major complications, considered as Clavien Dindo ≥ 3, were almost double in OSP compared to RASP. The major complications noted were extensive bleeding, persistent hematuria leading to clots which required intervention, and bladder neck or urethral strictures. We report similar results, with postoperative complications occurring only in the OSP group (p=0.004). In our cohort, there were two grade 1, two grade 2 and two grade 3b Clavien Dindo classification complications in the OSP cohort.

It is well documented that minimally invasive procedures usually result in a shorter hospital stay when compared to open procedures[1]. Mourmouris et al. reported that in their hands, hospitalization times were significantly shorter in RASP compared to OSP (3.4 vs 8 days, p<0.001)[12]. Our results mirror this finding with the median length of hospital stay in our study being statistically longer in OSP cohort (3 days) compared to patients treated with RASP (1day, p<0.005).

Studies comparing the functional outcomes of Minimally Invasive Surgical Procedures (MISP), including both laparoscopic and robotic simple prostatectomy to OSP, have demonstrated that MISP offered similar improvement in patient reported –IPSS score, quality of life, Q-max and post-void residual urine volume (PVR)[14,15]. A previous prospective study has demonstrated comparable functional outcomes with both RASP and OSP techniques[9]. A recently published prospective randomized control trial (RCT) comparing extraperitoneal laparoscopic simple prostatectomy (LSP), RASP and HoLEP in prostate volumes ≥ 120 ml reported that LSP and RASP had equivalent efficacy, perioperative morbidity and functional outcomes when compared to HoLEP[16].

In our study, the majority of patients in both groups reported on excellent functional outcomes, with no significant difference seen between the two cohorts (p=0.7). In the OSP group, one patient suffered from severe urinary incontinence; whereas, in the RASP group, two patients reported persistent minor, but they did not require any treatment. Unfortunately, IPSS scores were not collected within our series.

The opponents of RASP have noted the increased cost associated with robotic procedures. Sutherland et al.[3] compared the operative costs of RASP and OSP in a study from 2011. They reported that the average cost for RASP was $5212 USD compared to $2415 USD for OSP. On the other hand, Matei et al. reported in a study from 2012 that RASP was actually less costly than OSP, mainly due to the associated longer period of bladder continuous irrigation, lower transfusion rate and shorter length of hospital stay[17]. At our institution, we estimated the total cost of RASP to be 13,166 $CAD per case. The estimated cost of OSP was found to be 10,052 $CAD. This price estimate includes the labor, instrumentation used during the procedure, robotic service contract as well as the price of hospital stay.

In our study we report on a significant discrepancy in preoperative prostate volume estimation and the volume of resected prostate adenoma reported by pathology. Both TRUS and abdominal US significantly over-estimated prostate volume preoperatively. A study by Matthews et al.[18] compared TRUS prostate volume estimates to volumes of unfixed radical prostatectomy specimens. They reported that the preoperative estimates differed significantly from the volumes of corresponding prostatectomy specimens. In their study, they found that TRUS tended to overestimate the volume in small prostates (<30 ml) and underestimated the volume in large (>50 mL) prostate glands. Studies comparing TRUS to abdominal US reported a strong correlation between the transrectal and transabdominal approaches, with no statistically significant differences[19,20]. In our study, we report that both abdominal US and TRUS significantly overestimated the prostate volume by a median difference of 55 cm^3 ($p<0.0005$). Although, the whole prostate is not removed in simple prostatectomies, which affects the postoperative pathology prostate weight, we believe that this over-estimation is significant and may have impacted preoperative surgical decision making and patient counselling. When comparing the preoperative volume assessment utilizing TRUS and abdominal US with the final volume of resected adenoma in the pathology report, we found no significant differences between the two modalities ($p=0.3$).

To our knowledge, our study is the largest series of RASP described in Canada. However, there are some limitations to our study. First, the cohort is relatively small and retrospective, with the inherent biases. In addition, all robotic surgical procedures were performed by a single experienced surgeon and thus generalization of the results would need to be evaluated. Third, we do not routinely record IPSS scores and uroflowmetry perioperatively and therefore we are unable to report on functional outcomes with that tool. Fourth, OSP were performed several years prior to RASP and thus a true contemporaneous comparison cannot be made. Fifth, the follow up time in the RASP group was shorter than the OSP group, making it difficult to compare long term results and complications. A randomized prospective study would be required to improve the level of evidence.

Conclusions

Our experience demonstrates excellent functional results for both OSP and RASP. Furthermore, our experience with RASP exhibits the feasibility at a Canadian urologic centre.

RASP was associated with low blood loss, shorter length of hospital stay and a lower complication rate, when compared to OSP. The main disadvantages we have identified with the robotic approach were the longer operative time and higher cost. We believe that both OSP and RASP are excellent choices in treating men with enlarged obstructing prostates. Our study has demonstrated that RASP can be safely and effectively performed in centers with sufficient expertise, with excellent postoperative outcomes.

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Figures and Tables

Table 1. Demographic and preoperative data			
Demographic	**OSP (n=8)**	**RASP (n=21)**	**p**
Age, median (range)	69 (59 – 78)	69 (54 – 86)	0.74
Median BMI, kg/m^2 (range)	29.8 (24.9 – 32.1)	26.9 (19.9 – 34.6)	0.34
Mean preoperative estimated prostate volume, cm^3 (SD)	229 (±114.8)	152 (±49.2)	0.03
Prostate volume estimation technique, n (%)			
TRUS	5 (62.5)	7 (33.5)	
Abdominal US	3 (37.5)	12 (57.1)	0.04
Cystoscopy	0 (0)	1 (4.7)	
MRI	0 (0)	1 (4.7)	
Median PSA, ng/mL (range)	12.5 (2.98 – 42.6)	7.2 (2.06 – 19.5)	0.09
Prior prostate biopsy, n (%)	5 (62.5)	9 (42.8)	0.427
Preoperative urinary retention, n	3	11	NS
Mean preoperative PVR, ml (SD)	378 (±229)	324 (±390)	0.93
Comorbidities, n (%)			
Diabetes mellitus	1 (12.5)	4 (19)	NS
Hypertension	4 (50)	10 (47.6)	NS
Dyslipidemia	2 (25)	6 (28.5)	NS
CVA	0 (0)	1 (4.7)	NS
OSA	0 (0)	1 (4.7)	NS
Surgical indication, n (%)			0.57
Failed medical treatment	2 (25)	6 (28.5)	
Urinary retention	3 (37.5)	11 (52.3)	
Hydronephrosis	2 (25)	3 (14.2)	
Cystolithiasis	0 (0)	1 (4.7)	
Recurrent hematuria	1 (12.5)	0 (0)	

BMI: body mass index; CVA: cerebrovascular accident; DRE: digital rectal exam; MRI: magnetic resonance imaging; NS: non-significant; OSA: obstructive sleep apnea; PSA: prostate-specific antigen; PVR: postvoid residual; SD: standard deviation; TRUS: transrectal ultrasound; US: ultrasound; UTI: urinary tract infection.

Table 2. Operative, postoperative outcomes, and complications			
Demographics	**OSP (n=8)**	**RASP (n=21)**	**p**
Median operative time, minutes (range)	137.5 (86-240)	185 (140 – 283)	0.04
Conversion to open procedure: n (%)	-	0	-
Median estimated blood loss, ml (range)	2300 (600 – 4000)	100 (50 – 400)	0.4
Blood transfusion, n (%)	2 (25%)	0 (0)	0.06
Mean postoperative drop in hemoglobin, g/l (SD)	39 (±21)	22 (±17)	0.03
Perioperative complications, n (%) Significant hematuria Urinary tract infection Bladder neck stricture	 1 (12.5) 1 (12.5) 1 (12.5)	 0 (0) 0 (0) 0 (0)	0.004
Mean length of hospital stay, days (SD)	3 (±1.03)	1 (±0.46)	<0.005
Median length of followup, months (range)	15 (3 – 81)	4 (3 – 12)	0.09
Incidental finding of prostate adenocarcinoma, n (%)	2 (25)	3 (14)	1.0
Median pathological weight of adenoma, grams (range)	121 (63 – 255)	103 (52 – 240)	0.17
Median postoperative PSA, ng/mL (range)	0.88 (0.1 – 1.4)	0.81 (0.007 – 5.2)	0.7
Mean postoperative PVR, ml (SD)	25.6 (36.2)	21.5 (29.5)	0.7
Patient reported urinary continence, n (%) Completely continent Minimal incontinence Moderate incontinence Severe incontinence	 7 (87.5) 0 (0) 0 (0) 1 (12.5)	 19 (90) 2 (10) 0 0	0.7

PVR: postvoid residual; SD: standard deviation.