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ORIGINAL ARTICLE

Robot-assisted simple prostatectomy for prostates greater than 100 g

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Abstract

Purpose Efforts are ongoing to treat severe benign prostatic hyperplasia as traditional endoscopic treatment options are often difficult to perform and associated with significant complications. This manuscript highlights our initial experience of robot-assisted simple prostatectomy [RASP] with minimum a year follow-up. We also compared our outcomes with published literature.

Methods After an Institution Review Board approval, we gathered data of 50 cases of RASP between Jan 2014 and May 2021. Patients with prostate volume > 100 cc [calculated from magnetic resonance imaging (MRI)] and prostate biopsy confirmed benign prostate were candidates for RASP. Patients underwent RASP via transperitoneal route either by suprapubic or trans-vesical approach. Preoperative demographics, peri-operative parameters and post-operative parameters such as hospital stay, catheter removal, urinary continence and uroflow were recorded in standard database and presented as descriptive statistics.

Results Patients presented with a baseline median International Prostate Symptom Score (IPSS) of 23 (inter-quartile range (IQR) 21,25) and a median PSA of 7.7 ng/ml (IQR 6.4,8.7). Median preoperative prostate volume was 167 ml (IQR, 136,198 ml). Median console time was 118 min, and median estimated blood loss was 148 ml (IQR 130, 167 ml). None of our cohort needed intraoperative transfusion, conversion to open surgery or developed any complications. Median time to Foley removal was 10 days (IQR 8,12). Significant drop in the IPSS score and improvement in Qmax was noted over the period of follow-up.

Conclusion RASP is associated with considerable improvements in urinary symptoms. However, comparative studies with endoscopic treatment options of large prostatic adenomas are warranted and ideally include cost analysis of different procedures.

Keywords Benign prostatic hyperplasia · Prostatectomy · Urinary symptoms

Introduction

Urologist are commonly faced by a technically challenging situation in patient was significant or complicated LUTs (lower urinary tract symptoms) due to large prostate glands (> 80 gm) [1, 2]. While open Simple prostatectomy (OSP) has been considered the gold standard in such scenarios, it is still associated with substantial perioperative complications of up to 42% [3]. Therefore, many alternatives minimally invasive options have been proposed and implemented with

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the aim of reducing surgical morbidity. These alternatives encompass both laser and bipolar – based procedures [4, 5].

Robotic assisted simple prostatectomy (RASP) was regarded as the evolution of OSP in a minimally invasive direction. In 2008, Sotelo et al. first demonstrated the feasibility of RASP [6]. Subsequently, the procedure was embraced by many other reports that highlighted the potential advantages compared with the standard OSP [7, 8].

A meta-analysis including 764 patients confirmed that laparoscopic and robotic simple prostatectomy provide improvements similar to those of OSP, with a longer operative time but less blood loss and shorter hospital stay [9]. Many other studies confirmed the feasibility of RASP with results that are comparable to modern laser and bipolar technology [10, 11]. The familiarity of many urologists with robotic radical prostatectomy overcame a flat learning curve that is required with procedures like HoLEP (Holmium laser enucleation of the prostate). Additionally, the availability of robot reduced the need for extra coasty equipment related to HoLEP. Data on 799 patients from The Healthcare Cost and Utilization Project (HCUP) State Databases from Florida and New York compared the cost between RASP and HoLEP and interestingly, RASP was significantly cheaper (average difference $1,149, $p < 0.001$) [12].

The aim of the current study is to report single center / Single surgeon experience in RASP including detailed technique with two different approaches, transvesical (TV) and suprapubic (SP). Additionally, to report outcome in 1 year follow-up.

Materials and methods

Study population

This study was approved by the Institutional Review Board (GCO#14–0175) of the Icahn School of Medicine at Mount Sinai within the Mount Sinai Health System in New York City. We retrospectively reviewed our institution's Robot-assisted prostatectomy database to extract patient records. Between January 2014 and May 2021, 50 men underwent RASP by a single expert surgeon (A.K.T.). Criteria for RASP were severe lower urinary tract symptoms attributed to benign prostatic hyperplasia, prostate volume [measure by Ultrasound or MRI] > 100 cc and prostate biopsy confirmed benign prostate. Regarding MRI, volume was calculated based on 3D ellipsoid measuring technique performed by our radiology colleagues. In TRUS, Volume was estimated by traditionally utilized ellipsoid formula using height, width and anteroposterior prostate diameters. Preoperative, perioperative and post-operative parameters were recorded in standard database. Urinary continence, IPSS and Uroflow were recorded preoperatively and at 6 weeks postoperatively.

Methods

All men underwent standardized mpMRI prior to prostate biopsy. Examinations were compliant with American College of Radiology recommendations for technical specifications and were performed using a 3-Tesla MRI system equipped with an 18-element phased-array pelvic coil. mpMRI results were evaluated according to the PI-RADS v2 by clinical radiologists with experience in prostate imaging. All patients underwent 12-core systematic biopsy with a spring-loaded biopsy gun and 18-gauge needles. Biopsy samples were reviewed by an experienced genitourinary pathologist (K.H.III). The simple prostatectomy specimens were weighted, measured, and fixed in 10% neutral formalin. Subsequently, pathology sections stained with hematoxylin and eosin were histologically evaluated by one experienced urogenital pathologist [KH. III].

Technique and steps of surgery

If patient had any bladder pathology as stones or diverticulum, Transvesical approach was utilized. Otherwise, it was based on surgeon experience. Patient positioned in steep Trendelenburg with six laparoscopic ports were inserted [four robotic and two for assistant].

Transperitoneal suprapubic approach [Supplementary Fig. 1A-1E]: After bladder drop, anterior bladder neck is incised and deepened till the Foley catheter was seen. The catheter grasped with third arm with firm anterior traction. Using the shaft of the catheter as a landmark, the mucosa at the posterior bladder neck was incised precisely. We then developed a plane under the posterior bladder neck and above the peripheral zone of the prostate. We then developed a plane between the adenoma (transition zone) and the peripheral zone of the prostate. We continued in the developed plane all the way to the apex of the prostate. Then, the urethra was sharply dissected and the specimen was collected. Using a V-lock suture and a self-cinching technique we complete the posterior reconstruction. A tension free urethro-vesical anastomosis is performed using double armed strata-fix suture.

Transperitoneal transvesical approach [Supplementary Fig. 2A-2G]: The bladder was distended with 300 ml sterile saline and the dome was identified. A vertical bladder incision was made from the dome to the mid bladder. A circular mucosal incision was made around the bladder neck, and prostate tissue was dissected away from the bladder, starting posteriorly and then progressing laterally and anteriorly. Posteriorly we entered the plane between the transition zone and the peripheral zone of the prostate.

Dissection was continued in the plane postero-laterally and anteriorly up to the apex of the gland. A robotic tenaculum was used to aid with retraction of the BPH tissue. Hemostasis was achieved with electrocautery during dissection. After dissection of the apex, the foley was removed and the urethra was transected. The BPH tissue was removed en-bloc and placed in an endocatch bag. Hemostasis was achieved in the resection bed and the dead space of the resection site was closed with running 3–0 V-lock sutures. The ureteral orifices were identified with clear urine efflux. A tension free urethral anastomosis was completed with double armed Stratafix suture. A new 18Fr foley catheter was easily placed and the balloon was inflated with 30 ml. Bladder closure was performed in 2 layers. 2–0 Stratafix suture was used to close the detrusor and mucosal layers, with careful approximation of the mucosal edges.

Outcome definition and statistical analysis

Descriptive statistics were performed. Continuous variables were reported as median and interquartile range. Statistical analyses were performed using STATA 12 (StataCorp LP, College Station, TX, USA). All tests were two-tailed with a significance level of $P < 0.05$.

Results

Demographics

Main patient characteristics are summarized in Table 1. Patients presented with a baseline median International Prostate Symptom Score (IPSS) of 23 (inter-quartile range IQR 21,25) and a median PSA of 7.7 ng/ml (IQR 6.4,8.7). Median preoperative prostate volume was 167 ml (IQR 136,198). In 80% of cases, patients had an indwelling urethral Foley catheter.

Table 1 Base line patient characteristics

Variable	Robot-assisted simple prostatectomy (IQR/%)
Median Age in years	72 (68, 75)
Median BMI, kg/m^2	26.2 (25, 27)
Prior abdominal/pelvic surgery	16 (32)
Median baseline IPSS	23 (21, 25)
Median baseline QoL	5 (4,6)
Median baseline Qmax	5 (3,7)
Median baseline PSA	7.7 (6.4, 8.7)
Indwelling Foley, *n*	40 (80)
Bladder diverticula, no	8 (16)
Bladder stone, *n*	12 (24)
Median preoperative prostate volume, cc	167 (136, 198)

IQR inter-quartile range, *BMI* Body mass index, *IPSS* international prostate symptom score, *QoL* quality of life, *PSA* prostate specific antigen

Surgical outcomes

Main surgical outcomes are described in Table 2. All cases were done via transperitoneal approach. Median console time was 118 min, and median estimated blood loss was 148 ml (IQR 130,167 ml). None of our cohort needed intraoperative transfusion, conversion to open surgery or developed any complications. Length of hospital stay was 1 day for all study group, whereas median time to Foley removal was 10 days (IQR 8,12). Significant drop in the IPSS score and improvement in Qmax was noted over the period of follow-up.

Urinary continence

Initial continence rate at 6 weeks follow-up was 56%. Over a period of 9 months all patients developed full urinary continence with no need for pads (Table 3).

Discussion

Removal of large prostate adenoma still represents a true challenge for urologist. While the OSP has been considered the standard of care by current guidelines, it is associated with a considerable morbidity [3]. This includes prolonged catheterization time, bladder neck contracture, increased

Table 2 Main surgical outcomes

Variable	Robot-assisted simple prostatectomy (IQR/%)
Surgical approach, no. (%)	
SP	42 (84)
TV	8 (16)
Median total console time, min	118 (110, 130)
Median total surgery time, min	148 (130, 167)
Median estimated blood loss, ml	200 (175, 230)
Intraoperative complications/transfusions	0
Conversion to open	0
Length of hospital stays, days	1
Median time to Foley removal	10 (8, 12)
Median specimen weight, gm	122 (104, 138)
Median post-operative IPSS	4 (3,5)
Median post-operative Qmax	15 (12, 18)

IQR inter-quartile range, *SP* suprapubic approach, *TV* transvesical approach, *IPSS* international prostate symptom score

Table 3 Patients continence rates over the 12 month follow-up period

Usage of pads per day	6 weeks	3 months	6 months	9 months	12 months
No of pads	28 (56%)	40 (80%)	44(88%)	50 (100%)	50 (100%)
1	14 (28%)	7 (14%)	6(12%)	–	–
2	5 (10%)	3 (6%)	–	–	–
≥ 3	3 (6%)	–	–	–	–

estimated blood loss (EBL), length of hospital stay (LOS), and a transfusion rate of more than 24%.

In a trial of facing these sequelae, it was intuitive to think to mimic OSP in a more minimally invasive technique to achieve better outcomes in a safer way. RASP is keeping the same surgical principles as OSP including challenging extirpative steps (adenoma dissection) and reconstructive steps (hemostasis of the prostate bed, retrigonization, and bladder suturing) [6, 7, 12]. In our retrospective study, amount of blood loss and operative time of RASP showed the improvement over time, but neither showed significant improvement beyond 10 cases. We estimated the learning curve for RASP to be ~10 to 15 cases for experienced robotic surgeons which is similar to previously published series [13].

Of note there was considerable improvements in IPSS and Qmax which is attributed to the procedure itself. RASP allows complete enucleation of the adenoma, duplicating the established principles of the open procedure. The procedure appears to be relatively safe because of the short operative time and limited blood loss. None of our cohort needed blood transfusion or conversion to open surgery. According to our findings, 56% of patients were fully continent at 6 weeks follow-up and all of them achieved this target by the end of first year follow-up. This is comparable to published studies regarding regaining continence after RASP [13] (Supplementary Fig. 3).

It may be thought that having no complications in our study may be related to under reporting. However, we believe that this excellent outcome is solely related to our surgeon intense experience with robotic prostatectomy. This was clearly reflected on his preference of a transperitoneal approach for all patients due to high experience with to radical prostatectomy. The selection of one technique over the others (SP vs. TV) was influenced by a variety of factors, including preference, configuration of the adenoma and presence of associated pathology.

Soeto published feasibility, since then the literature is replete with reports that support this technique [6]. With the adoption of robot-assisted surgery, more complex suturing tasks have been explored, such as plication of the prostatic capsule or vesicourethral anastomosis. Those tasks were considered really challenging in the laparoscopic or even during OSP. On review of the literature we found most reports related to RASP are comparative studies with other endoscopic procedures specially HoLEP [10–12]. Although we adopt a busy HoLEP service, the comparison with RASP is beyond the scope of the current study. We opted to focus on our RASP describing two different techniques with its outcomes.

Our results are in concordance with other RASP reports. Table 4 compares our current study similar studies in the literature [11, 14–19]. Of note our patient cohort had a higher median prostate volume, higher PSA. Although our cohort included only 50 patients, this was still more than patient number in other published series. Our hospital stay duration was one day for all patients which reflects smooth early postoperative period devoid of complications necessitated further stay. Worth to mention that we had a longer period of catheter removal (median of 10 days) when compared to other series. We attribute this relatively longer catheter time to creation of a cystotomy in TV technique. Additionally, we preferred to leave the catheter a little bit longer in patients presented with chronic retention. Finally, the surgeon preference was to delay catheter removal for patient with intraoperative findings of wide bladder neck. We have not experienced any problems with urine leakage from the cystotomy closure, which we attribute to careful technique and the use of a double-layer closure of the bladder wall or prostate capsule.

Many systemic reviews have depicted substantial postoperative improvement in urinary symptoms and conclude that RASP seems to be an effective and safe treatment option [7, 12, 20, 21]. Our study population mirrors those reported in other studies in this setting, featuring severely symptomatic patients (median IPSS: 26.2) with huge prostate glands (median prostate volume: 167 ml). We have used both subjective (IPSS) and objective parameters (Qmax) to prove postoperative improvement. Furthermore, we report no complications in our cohort.

An additional advantage of performing RASP is the ability to treat concomitant bladder conditions, such as bladder stones or diverticula. This was the case for a small subgroup of patients in our population. It gives another advantage of this approach in a commonly encountered clinical scenarios in this patient category.

Certain limitations exist in the current study. First, it is retrospective nature. It also included relatively small number of patients. Additionally, the reported outcome

Table 4 Comparison of our study with other important studies in the literature

Year of publication	2012	2015	2016	2016	2017	2018	2019	
Study	Matei et al. [14]	Pokorny et al. [15]	Garzon et al. [13]	Pavan et al. [16]	Zhang et al. [11]	Johnson et al. [17]	Nestler et al. [18]	Our series
No. of patients	35	67	76	130	32	12	35	50
No of surgeons	1	2	1	3	2	2	1	1
Median age [yr]	65.5	69	64.5	67.4	71	70	71	72
Median Preop PSA [ng/dl]	5.4	6.5	10	6	–	6.4	–	7.7
Preop. Prostate volume, cc, Median	106	129	75.5	119	110	121	95	167
Preop. IPSS	28	25	23	23	–	23	23	23
Surgical route	Trans-vesical	–	Intra-fascial	Trans and Extra-peritoneal	–	–	–	Trans-peritoneal (SP/TV)
Median op time, min	186	97	–	150	274	157	182	118
EBL/change in Hb	120	200	535	250	− 2.5 g/dl	− 5.4 g/dl	− 1.4 g/dl	200
Duration of catheter, days	7	3	9	5	8	4	5	10
Specimen weight [gm]	87	84		77	–	61	77	122
Transfusion rate [%]	0	1.5	6.3		9.3	3.3	9.4	0
Hospital stay	3	4	–	5	8	4	5	1
Postop IPSS	7	3	6	5	–	–	–	4

PSA prostate specific antigen, *EBL* estimated blood loss, *IPSS* international prostate symptom score

represents the experience of a single surgeon with extensive robotic expertise. So the "zero complication – perfect outcome" should not be taken as standardized reference. In addition, we did not perform a head-to-head comparison of endoscopic procedures. A matched comparison could be done on this same data set for a future comparative analysis. Finally, cost analysis for RASP was not analyzed and need future studies as well.

Conclusion

In experienced hands, RASP is associated with a relatively low risk of complications and excellent functional outcomes, including considerable improvements in symptoms. Additionally, it enables simultaneous management of concomitant as bladder stones and/or bladder diverticula. However, comparative studies with endoscopic treatment options of large prostatic adenomas are warranted and ideally include cost analysis of different procedures.

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Author contributions VGW: Project development, Data collection, Manuscript writing. OZ: Project development, Manuscript writing. PK: Project development, Manuscript editing. AP: Project development, Manuscript writing. KHIII: Project development, Manuscript writing. AT: Project development, Manuscript writing.

Data availability The datasets generated during and/or analysed during the current study are not publicly available due to ethical considerations but are available from the corresponding author on reasonable request.

Declarations

Conflict of interest Dr Ash Tewari has served as a site-PI on pharma/industry-sponsored clinical trials from Kite Pharma, Lumicell Inc, Dendreon, and Oncovir Inc. He has received research funding (grants) to his institution from DOD, NIH, Axogen, Intuitive Surgical, AMB-FF, and other philanthropy. Dr Ash Tewari has served as an unpaid consultant to Roivant Biosciences and advisor to Promaxo. He owns equity in Promaxo. Rest of the authors don't have conflicts of interests.

Research involving human participants, their data or biological material This retrospective study was approved by the Institutional Review

Board (GCO#14–0175) of the Icahn School of Medicine at Mount Sinai within the Mount Sinai Health System in New York City.

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