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Research Article

Robotic-assisted simple prostatectomy after prostatic arterial embolization for large benign prostate hyperplasia: Initial experience

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ABSTRACT

Background and objective: We aimed to evaluate the safety and efficacy of robot-assisted simple prostatectomy (RASP) after prostatic arterial embolization (PAE) in large benign prostatic hyperplasia (BPH).
Material and methods: This retrospective study included 11 cases of PAE and subsequent RASP, performed on 11 patients with BPH from March 2018 to September 2020. Clinical information on the patients was collected before surgery and 3 months after surgery. For the quantification of lower urinary tract symptoms (LUTS), International Prostate Symptom Scores (IPSSs), prostate-specific antigen (PSA) levels, urinary peak flow rate (Qmax), voided volume (Vvol), and postvoid residual volume (PVR) were measured.
Results: PAE and the subsequent RASP were successfully performed in all 11 patients. The mean total prostate volume was 129.7 ± 65.1 mL, and the transitional zone volume was 71.7 ± 5.9 mL. The mean resected prostate volume was 60.8 ± 26.1 mL. The mean hemoglobin level of the patients prior to PAE was 14.2 ± 2.3 g/dL, and one day after RASP, the hemoglobin level was 12.4 ± 1.9 g/dL. The outcome indicated that there was a considerable decline in IPSS and PVR after RASP was performed compared to before PAE (21.6 ± 9.4 vs. 10.6 ± 8.0 and 159.4 ± 145.8 mL vs. 43.9 ± 45.9 mL). Qmax and Vvol significantly improved after RASP was performed (7.6 ± 5.2 mL/s vs. 26.1 ± 12.6 mL/s; 114.2 ± 92.5 mL vs. 192.4 ± 91.8 mL, respectively).
Conclusion: This research demonstrated that RASP could be performed safely and effectively after PAE in patients with large BPH.

1. Introduction

Among elderly males, the most common cause of lower urinary tract symptoms (LUTS) is benign prostatic hyperplasia (BPH). Nearly 50% of men over 50 years and 80% of men over 80 years have LUTS due to BPH.[1] The LUTS include urinary retention, urinary tract infections, bladder stones, and chronic renal insufficiency. BPH should be properly managed to avoid LUTS and a deterioration in health.

Transurethral resection of the prostate (TURP) is the traditional gold standard surgical treatment for BPH.[2] Various surgical techniques have been developed to improve clinical outcomes. Among them, robot-assisted simple prostatectomy (RASP) has shown promising results in large-sized BPH.[3] In 2008, RASP was first introduced by Sotelo in an attempt to further the laparoscopic approach.[4] Thereafter, many studies have focused on the safety and efficacy aspects of RASP. For patients with an extremely large prostate, RASP is technically less demanding than Holmium enucleation of the prostate (HoLEP) in that RASP has a lower bleeding risk and a lower rate of complications.[3]

For decreasing blood loss during prostate surgery, various techniques applying substances such as estrogen, vasopressin, and finasteride have been researched.[5,6] According to prior studies, preoperative prostatic arterial embolization (PAE) was shown to reduce intraoperative blood loss and the complications of BPH

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surgery.[7–9] PAE also causes ischemic changes and shrinkage of the prostatic gland.[10] Thus, PAE may make subsequent surgery simpler and safer, as well as lessen LUTS. However, there is an insufficient number of studies regarding RASP after PAE. This study aimed to investigate the safety and efficacy of RASP after PAE.

2. Patients and Methods

2.1. Study Population

The study enrolled large BPH patients with severe LUTS and refractory to medical treatment. This retrospective study included 11 cases of PAE and subsequent RASP performed on 11 patients with BPH from March 2018 to September 2020 (mean age, 71.7 ± 5.9 years; range, 64–80 years). The study was implemented after obtaining approval from the Institutional Review Board of our hospital (IRB No. CUH 2018-10-015-002).

2.2. Clinical and Laboratory Assessment

Clinical information before RASP and 3 months after RASP were collected. International Prostate Symptom Scores (IPSSs), prostate-specific antigen (PSA) levels, urinary peak flow rate (Qmax), voided volume (Vvol), and postvoid residual volume (PVR) were measured.

2.3. Angiography and Embolization Technique

The PAE was conducted by a right transfemoral approach under local anesthesia. Retrograde puncture of the right common femoral artery was performed under ultrasound guidance. After the insertion of a 6-F introducer sheath in the right common femoral artery, an angiographic catheter was inserted via the introducer until its tip was located in the distal aorta. Cone-beam computerized tomographic angiography was conducted to investigate the distribution of blood vessels and determine the origin of the prostatic

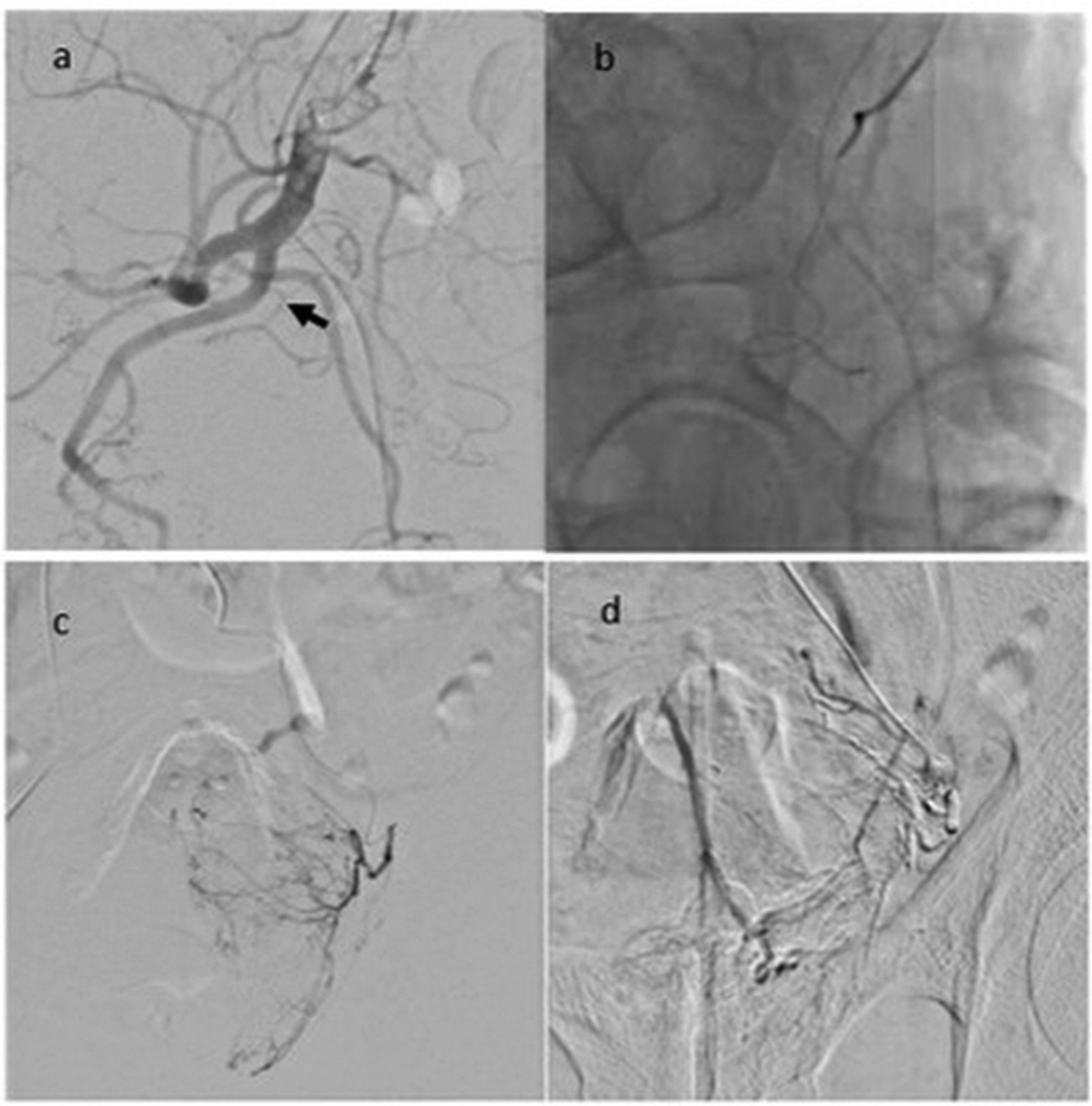

Fig. 1. Images from prostate arterial embolization. (a) Left internal iliac arteriography showed left prostatic artery originated from the proximal internal pudendal artery (b) Superselection of the prostatic artery was performed with 2.0-Fr microcatheter (c) Prostatic artery angiography showed the left hemisphere of the prostate gland. (d) Complete devascularization was gained after embolization.

artery. Using the 3D CT angiographic scan, the origin of the prostatic artery was superselected with the use of a 2.0-F microcatheter. The tip of the microcatheter was located to allow the embolization of both the central and peripheral zones (Fig. 1). After completion of contralateral-side embolization, the ipsilateral prostatic artery was superselected with the same catheter. Then PAE was repeated in the same manner.

2.4. Robot-assisted simple prostatectomy procedure

Surgery was performed 2 days after PAE by a single surgeon (YS Shin) experienced in RASP. The patient underwent general anesthesia and was placed in a steep Trendelenburg position. The 4-arm da Vinci Surgical System and a 6-port transperitoneal approach were used. A transverse incision was made at the bladder dome, and the bladder was opened (Fig. 2). Once the plane between the prostatic capsule and the adenoma was identified, enucleation was performed. Upon completion, the adenoma was placed in an Endocatch bag, and hemostasis was achieved by direct cautery. A 20-French three-way catheter was placed, the balloon was inflated to 50 mL, and the repairs were tested for leaks. The robotic arms were then removed.

2.5. Statistical analysis

Preoperative characteristics, including prostate volume and perioperative outcomes, were evaluated by intent-to-treat analysis. Vvol, Qmax, and PVR were compared using the Student t test. SPSS software v. 18.0 was used for statistical analysis, and a $P<0.05$ was considered statistically significant.

3. Results

PAE and a subsequent RASP were successfully performed in all 11 patients. All the baseline parameters of age, prostate volume, IPSS, PSA level, Qmax, Vvol, Rvol, and hemoglobin are listed in Table 1. The mean total prostate volume was 129.7 ± 65.1 mL, and the transitional zone volume (T-zone volume) was 71.7 ± 5.9 mL.

The mean resected prostate volume was 60.8 ± 26.1 mL. The mean hemoglobin level of the patients prior to PAE was 14.2 ± 2.3 g/dL and 12.4 ± 1.9 g/dL one day after RASP. The mean difference between the preoperative and postoperative hemoglobin levels was 1.8 ± 0.9 g/dL.

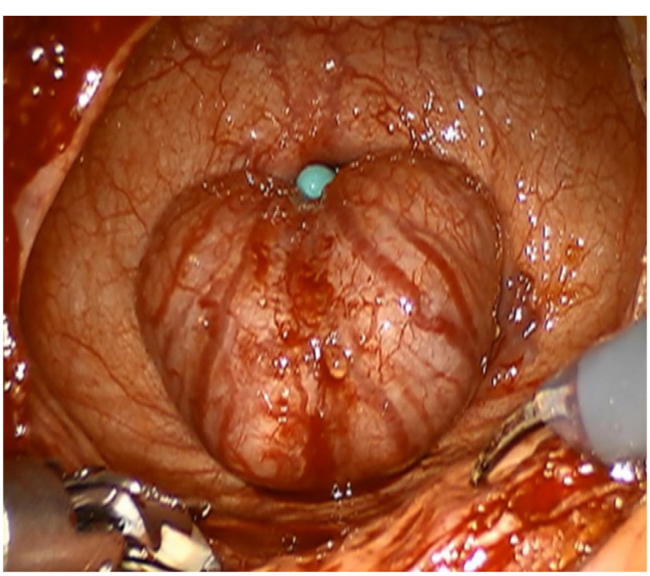

Fig. 2. During robotic-assisted simple prostatectomy, after a transverse incision is made at the bladder dome, prostate adenoma is identified.

Table 1
Baseline characteristics

Variable	Before PAE	After surgery	3 months after surgery	P value
Age, years	71.7 ± 5.9			
Prostate volume, mL	129.7 ± 65.1			
T-zone volume, mL	87.9 ± 52.6			
IPSS	21.6 ± 9.4		10.6 ± 8.0	<0.001
PSA level, ng/mL	10.6 ± 9.0		0.8 ± 0.5	<0.001
Qmax, mL/s	7.6 ± 5.2		26.1 ± 12.6	<0.001
Vvol, mL	114.2 ± 92.5		192.4 ± 91.8	<0.001
PVR, mL	159.4 ± 145.8		43.9 ± 45.9	<0.001
Hemoglobin, g/dL	14.2 ± 2.3	12.4 ± 1.9		

IPSS, international prostate symptom score; PAE, prostatic arterial embolization; T-zone, transitional zone; PSA, prostatic specific antigen; PVR, postvoid residual volume; Qmax, maximal flow rate; Vvol, voided volume.

The IPSS, PSA level, Qmax, Vvol, and PVR results are summarized in Table 1. There was a significant decline in the 3-month IPSS and PVR compared to those before PAE and RASP (IPSS, 21.6 ± 9.4 vs. 10.6 ± 8.0; PVR, 159.4 ± 145.8 mL vs. 43.9 ± 45.9 mL). Qmax and Vvol were significantly improved compared to before PAE and RASP (Qmax, 7.6 ± 5.2 mL/s vs. 26.1 ± 12.6 mL/s; Vvol, 114.2 ± 92.5 mL vs. 192.4 ± 91.8 mL). Also, there was a considerable decline in PSA levels from 10.6 ± 9.0 ng/mL to 0.8 ± 0.5 ng/mL. The catheter was removed at 7 days postoperation. After a 3-month recovery period after surgery, surgical wound healing complications were not found.

4. Discussion

TURP, which has long been regarded as the standard surgical treatment for BPH, has been related to complications, including bleeding risk and TURP syndrome. The incidence of complications increases with the volume of the prostate.[11] Other surgical methods have been designed to increase efficacy and reduce complication rates. RASP has been reported to be a highly reliable treatment for patients with large BPH.

RASP showed its efficacy when performed on patients with >80-gram prostate glands. RASP, compared to open simple prostatectomy (OSP), has a lower percentage of transfusions, reduced indwelling catheter time, shorter hospital stay, and increased perioperative mortality and postoperative complications.[12,13] The precision of the surgical intervention is elevated by taking advantage of the visual and articular apparatus of the robot.[3] For surgeons, RASP tends to have a more favorable learning curve compared to other surgical procedures. In addition, it is also easier to perform on patients than pure laparoscopy. The technique's resemblance to robot-assisted radical prostatectomy contributes to its successful outcomes.[14]

DeMeritt et al unexpectedly discovered that PAE could reduce the volume of the prostatic gland, which alleviates patient LUTS.[15] Since then, PAE has been introduced as a minimally invasive treatment to alleviate patients with LUTS induced by BPH.[16] PAE reduces blood supply to the prostate glands, thus inducing ischemia and later, necrosis of the glands. Therefore, successful PAE may result in shrinkage of the prostate gland and decrease blood loss during surgery and the length of surgery. The effectiveness of PAE in controlling massive blood loss following biopsy, prostatectomy, or TURP has been reported.[17–19] Despite large BPH, our study showed a high success rate of RASP after PAE with minimal blood loss. PAE did not induce adhesive changes in the prostate, which make surgery unmanageable.

Although the favorable safety and volume reduction effects of PAE have been reported, it is still too early that PAE could replace surgery. The first reason is the limited volume reduction effect of PAE. The volume reduction effect of PAE is limited to a range of 25%. This could be achieved with medical therapy. Thus, patients needing urgent deobstruction due to hydronephrosis may not achieve enough improvement. In addition, acute edematous changes of the glands induced by PAE paradoxically aggravate LUTS in the early period. The second reason is the questionable long-term efficacy of PAE. In a recent randomized controlled trial, a large number of patients had recurrent LUTS, which required reoperation after PAE. Our study suggested that PAE may be used as bridging therapy before surgery. PAE may provide moderate volume reduction effects as a primary treatment and may also reduce the complications of subsequent surgery. In the pool of BPH treatments, PAE could be a versatile treatment for patients who need more than medical therapy alone.

Our study had several limitations. First, this was a retrospective case analysis, and the sample size was too small. Second, RASP without a preceding PAE was not analyzed. Third, a large prostate was not exactly defined. Therefore, it is hard to suggest the indication of preoperative PAE based on the size of the prostate glands. Fourth, the cost-effectiveness of preoperative PAE is still unknown.

5. Conclusion

RASP can be performed safely and effectively after PAE in patients with large BPH. This study demonstrated the potential role of PAE as adjuvant therapy. Further large-scale prospective studies are needed to analyze the efficacy and cost-effectiveness of PAE and subsequent RASP.

Conflicts of interest

The authors reports no conflicts of interest in this work.

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