Prostate Artery Embolization for Giant Prostatic Enlargement: Short-Term Efficacy and Safety

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ABSTRACT

Eight patients with giant prostatic enlargement > 200 mL and lower urinary tract symptoms who underwent bilateral prostatic artery embolization (PAE) were reviewed. Mean prostate volume decreased from 318.2 mL to 212.2 mL ($P < .01$). At 5-month mean follow-up, International Prostate Symptom Score decreased by 16.7 points ($P < .05$), and urinary quality of life improved by 3.0 points ($P < .01$). Three of 4 catheter-dependent patients no longer needed catheterization after the procedure. No major complications were encountered. Preliminary results suggest PAE is safe and effective in patients with giant prostatic enlargement > 200 mL.

ABBREVIATIONS

HoLEP = holmium laser enucleation of the prostate, IIEF = International Index of Erectile Function, IPSS = International Prostate Symptom Score, LUTS = lower urinary tract symptoms, PAE = prostatic artery embolization, QoL = quality of life

Patients with very large prostates (> 80–100 mL prostate volume) and moderate to severe lower urinary tract symptoms (LUTS) refractory to medical therapy are typically offered gold standard simple prostatectomy (1,2). As simple prostatectomy carries considerable morbidity, including risk of blood transfusion (7%–14%), urinary incontinence (< 10%), and bladder neck stenosis/urethral strictures (6%), less invasive treatments have been an area of great interest, including endoscopic urologic options, such as holmium laser enucleation of the prostate (HoLEP) or thulium laser enucleation of the prostate (1–4). Although laser enucleation is less morbid than surgery, the risks remain significant, including urethral stricture (3.2%), reoperation (2.8%), transfusion (1%), bladder mucosal injury (3.9%), and high incidence of retrograde ejaculation (2,4). Moreover, the procedure is technically difficult, limiting its widespread use (4).

Prostatic artery embolization (PAE) has shown significant promise in treating benign prostatic hypertrophy in patients with very large prostates. Multiple prospective and retrospective studies of PAE for prostate volumes > 80 mL have shown significant improvements in symptom burden and prostate volume reduction, while maintaining a favorable safety profile (5–12). Mean baseline prostate volume in these studies varied from 118.0 mL to 167.3 mL (5–8,11,12). A case report has been published for PAE in a prostate with volume 571 mL, with good reduction in volume and symptom burden (13). Aside from that case report, PAE has not been specifically studied in patients with giant prostate enlargement, which has been defined as prostate volume > 200 mL (14). Also, it is unknown if there is an upper size limit for PAE, beyond which the technique may be ineffective. Conceivably, giant prostates may not shrink enough to provide sufficient symptomatic relief compared with less markedly enlarged prostates. This study examined the safety and short-term efficacy of PAE in patients with LUTS owing to giant benign prostatic enlargement > 200 mL.

MATERIALS AND METHODS

After institutional review board approval, a single-center retrospective analysis was conducted on all patients who underwent PAE between April 2012 and September 2018.

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Table 1. Data of 8 Patients with Giant Prostatic Enlargement > 200 mL Who Underwent PAE

Patient	Age (y)	Before PAE				After PAE				Last Follow-up (mo)
		TPV (mL)	IPSS	QoL	IIEF	TPV (mL)	IPSS	QoL	IIEF	
1	63	402.8	24	5	17	246.3	3	0	25	6
2	72	267	22	5	24	168	3	1	20	8
3	87	653.5	16	3	—	450	6	1	—	1
4	74	207.8	16*	5	22	120.9	2	0	25	6
5	65	201.4	N/A*,†	6	20	131.5	14‡	4	25	6
6	69	210.4	30*	2	—	191.7	3	0	—	6
7	83	391	15	3	—	289	6	2	—	1
8	86	212.1	N/A*,†	6	—	100	17	3	—	6
Mean ± SD (range)	74.9 ± 9.4 (63–87)	318.2 ± 159 (201–654)	20.5 ± 5.9 (15–30)	4.4 ± 1.5 (2–6)	20.8 ± 3.0 (17–24)	212.2 ± 116 (100–450)	3.8 ± 1.7 (2–6)	1.4 ± 1.5 (0–4)	23.8 ± 2.5 (20–25)	5 ± 2.6 (1–8)

IIEF = International Index of Erectile Function; IPSS = International Prostate Symptom Score; N/A = not applicable; PAE = prostatic artery embolization; QoL = quality of life; TPV = total prostate volume.
*Indwelling bladder catheter.
†No baseline IPSS before catheter placement, excluded from IPSS analysis.
‡Downgraded to intermittent self-catheterization after procedure.

Patients were considered for PAE if they had moderate-to-severe LUTS that were unresponsive to medical therapy and were either unfit for surgery or refused surgery. PAE was also considered in patients with refractory hematuria of prostatic origin. Prostate volumes were calculated in 55 patients who underwent bilateral PAE with computed tomography (CT) or magnetic resonance (MR) imaging before the procedure, and all patients with volumes > 200 mL were reviewed for the study. Eight patients were included with a mean baseline prostate volume of 318.2 mL ± 159 (range, 201–654 mL). Mean patient age was 74.9 years ± 9.4 (range, 63–87 y). All 8 patients had moderate or severe LUTS. One patient also had refractory hematuria secondary to prostatic bleeding; this patient had also undergone transurethral resection of the prostate 10 years previously. Aside from the latter patient, all procedures were performed in the outpatient setting. Four patients had an indwelling bladder catheter, which had been in place for a mean duration of 5.2 weeks ± 3.4 (range, 2–10 weeks). International Prostate Symptom Score (IPSS), urinary quality of life (QoL), and International Index of Erectile Function (IIEF) were collected.

Prostate Measurement

Measurements were obtained in sagittal craniocaudal and anteroposterior planes and axial transverse planes. Measurements were performed on MR imaging or CT of the pelvis before the procedure and had interobserver agreement between 2 of the investigators. Prostate volumes were calculated using the ellipsoid volume formula ($L \times W \times H \times \pi/6$).

Technique

All procedures were performed by a single operator (J.P.M.) with 5–9 years of experience over the course of the study. All patients received 1 dose of intravenous ciprofloxacin 400 mg for antibiotic prophylaxis. All procedures were performed under moderate sedation via right common femoral artery access. Internal iliac angiography in ipsilateral oblique projection was performed using 5-F Cobra 2 (Cook Medical, Bloomington, Indiana) catheter for the contralateral side, and either a Waltman loop technique or a Simmons 1 (Cook Medical) catheter for the ipsilateral side, with identification of the right and left prostatic arteries and accessory prostatic arteries, if present. All arteries supplying the prostate were catheterized using a 2.4-F Maestro (Merit Medical Systems, Inc, South Jordan, Utah) microcatheter (n = 5) or a 2.0-F PROGREAT ALPHA (Terumo Interventional Systems, Somerset, New Jersey) microcatheter (n = 3) and 0.014-inch Synchro Soft (Stryker Neurovascular, Fremont, California) micro–guide wire (n = 7) or 0.014-inch Transend (Stryker Neurovascular, Fremont, California) micro–guide wire (n = 1). Bilateral PAE was then performed to stasis using 300–500 μm Embosphere (Merit Medical Systems, Inc) microspheres (n = 7) or 250 μm Embozene (Boston Scientific, Marlborough, Massachusetts) microspheres (n = 1). Accessory prostatic vessels were catheterized and received embolization in 2 patients. Protective coil embolization of a left middle rectal artery with a 0.018-inch Interlock (Boston Scientific) coil was performed in 1 patient.

Follow-up

Clinical follow-up was obtained in all patients at 5 months ± 2.6 (range, 1–8 months) after the procedure and included history and physical examination and IPSS, QoL, and IIEF questionnaires. Prostate volumes after embolization were calculated using contrast-enhanced CT of the pelvis (n = 6), noncontrast CT of the pelvis (n = 1), or MR imaging of the prostate (n = 1) obtained at 6.4 months ± 1.3 (range, 4–8 months) after the procedure.

Table 2. Selected Literature Summary of Studies Involving PAE in Large Prostates > 80–100 mL

Reference	Before PAE			After PAE			Mean Follow-up (mo)	*P* Value
	TPV (mL)	IPSS	QoL	TPV (mL)	IPSS	QoL		
Kurbatov et al (6)*	129.3 ± 45.6	23.9 ± 5.9	N/A	71.2	10.4	N/A	12	< .05
de Assis et al (7)	135.1 ± 44.9 (90–252)	18.3 ± 5.8 (7–28)	4.8 ± 0.8 (3–6)	91.9 (48.3–162.3)	2.7 (0–9)	0.9 (0–3)	3	< .0001
Wang et al (8)	118.0 ± 35.0 (86–164)	26 ± 5.5 (21–35)	5.0 ± 1.0 (4–6)	69.0 ± 18.0	9.0 ± 5.5	3.0 ± 1.0	24	< .01
Bhatia et al (11)	141.7 ± 77.2 (80–424)	22.3 ± 7.3 (7–35)	4.4 ± 1.5 (2–6)	85.2 ± 42.7	7.3 ± 6.7	1.3 ± 1.5	12	< .01
Bhatia et al (12)	167.3 ± 108.6 (55–557)	Catheter-dependent	5.3 ± 1.1 (3–6)	115.9 ± 59.6 (27–248)	6.3 ± 6.8 (0–27)	0.6 ± 1.2 (0–4)	TPV = 3; QoL = 12	< .001

Note–Values are presented as mean ± SD (range).
*No ranges were provided.

Statistical Analysis

Prostate volume reduction, IPSS, QoL, and IIEF scores were analyzed with a Wilcoxon signed rank test using PRISM 8 software (GraphPad Software, San Diego, California). $P < .05$ was considered significant. Two of the patients with indwelling bladder catheters did not have a baseline IPSS; these patients were excluded from the IPSS analysis. The other 2 patients with indwelling bladder catheters were included in IPSS analysis because they had baseline IPSS scores before bladder catheter placement. Four patients were not sexually active and were excluded from IIEF analysis.

RESULTS

Bilateral PAE was technically successful in all patients. There were no major complications. Three patients experienced transient bladder spasms, which are considered a normal side effect of the procedure and require only symptomatic treatment (12,15). The patient with refractory hematuria before PAE had cessation of bleeding immediately following the procedure and was discharged 3 days later. Three of the 4 patients with an indwelling bladder catheter were able to spontaneously urinate after PAE, with catheter removal occurring at 4.0 weeks ± 2.6 (range, 2–7 weeks) after the procedure. The fourth patient was able to undergo bladder catheter removal after PAE but still required intermittent self-catheterization owing to high postvoid residuals.

Patient data before and after PAE are presented in Table 1. Prostate volume by imaging follow-up decreased from 318.2 mL ± 159 (range, 201–654 mL) to 212.2 mL ± 116 (range, 100–450 mL), with a mean volume reduction of 32.5% ± 11% (range, 8.8%–42%), at 6.4 months ± 1.3 (range, 4–8 months) after the procedure ($P < .01$). IPSS decreased by 16.7 points ± 6.9 (range, 9–27 points), from an average of 20.5 points ± 5.9 (range, 15–30 points) to 3.8 points ± 1.7 (range, 2–6 points) ($P < .05$). Urinary QoL decreased by 3.0 points ± 1.5 (rang, 1–5 points), from 4.4 points ± 1.5 (range, 2–6 points) to 1.4 points ± 1.5 (range, 0–4 points) ($P < .01$). IIEF increased by 3.0 points ± 5.1 (range, −4 to 8 points), from 20.8 points ± 1.5 (range, 17–24 points) to 23.8 points ± 2.5 (range, 20–25 points), but this was not a significant difference ($P > .05$).

DISCUSSION

Various urologic treatments are available for patients with LUTS secondary to benign prostatic hyperplasia, but treatment options are limited for patients with giant prostate enlargement > 200 mL. Simple prostatectomy (laparoscopic, robotic, or open) has traditionally been the gold standard, but it carries a considerable risk of complications, including hemorrhage, urinary incontinence, bladder neck contracture, and anesthesia-associated risks (1,2). Endoscopic urologic options include laser procedures, such as

HoLEP and thulium laser enucleation of the prostate (1–4). Both modalities can rapidly vaporize prostatic tissue without significant deep tissue penetration, limiting morbidity and injury to regional structures (1). A randomized controlled trial comparing HoLEP with open prostatectomy for prostates > 100 mL demonstrated comparable improvements in symptom severity and micturition parameters (1,3,4). Importantly, HoLEP has also demonstrated comparable improvements in giant prostates > 200 mL (14). Thus, HoLEP and thulium laser enucleation of the prostate are considered the size-independent standard for minimally invasive endoscopic urologic treatments (1). Limitations of laser enucleation, however, include a steep learning curve, need for general anesthesia, risk of bleeding, urinary incontinence, urethral strictures, and high incidence of retrograde ejaculation (1–4).

PAE is a feasible and effective treatment modality for very large prostate glands. Multiple studies, including a study in catheter-dependent patients, have demonstrated significant prostate volume reduction, decreased symptom severity, and improved QoL (5–12,15). The results of selected PAE studies in prostate glands > 80–100 mL are summarized in **Table 2**. Three prospective trials enrolling 358 patients have studied PAE outcomes in very large prostates. These trials reported IPSS improvement by 13.6–15.6 points, QoL improvement by 2.0–3.9 points, and significant reduction in prostate volume by 32.0%–44.9%. An American cohort of 93 patients with very large prostates showed similar results, with significant IPSS improvement of 15 points and significant QoL improvement of 3.1 points (11). Additionally, a study investigating PAE specifically in catheter-dependent patients with very large prostates demonstrated 53.4 mL reduction in volume and 86% success in catheter removal at mean 18.2 days after the procedure (12). The mean baseline prostate volume in these studies varied from 118.0 mL to 167.3 mL, and some prostates > 200 mL were undoubtedly included in these series, but outcomes specifically in giant prostates were not reported.

Bilateral PAE in this series of 8 patients with prostate volume > 200 mL demonstrated similar short-term efficacy to the aforementioned studies investigating the efficacy of PAE on prostate glands > 80–100 mL. The mean baseline prostate volume in this series was 318.2 mL ± 159 (range, 201–654 mL). This suggests that PAE may be similarly effective in patients with giant prostatic enlargement > 200 mL. Furthermore, the safety profile of PAE is preserved, with no major complications encountered in this series.

Limitations of this study include the single-center, retrospective nature and small cohort of patients. Follow-up times were also short (range, 1–8 months), and thus durability of outcomes is unknown. Additionally, CT was largely used for calculation of prostate volume and may be less accurate than MR imaging for precise measurements.

In conclusion, preliminary results from this cohort suggest that PAE is feasible, is safe, and significantly improves urinary symptoms and QoL in patients with giant prostatic enlargement > 200 mL and moderate to severe LUTS.

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