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Prostatic Artery Embolization: An Alternative Treatment for Benign Prostatic Hyperplasia

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Abstract

Purpose Prostatic artery embolization (PAE) has emerged as a minimally invasive alternative for patients with prostates >80 mL and has demonstrated lower morbidity rates. We sought to evaluate PAE at a single tertiary medical center.

Methods A retrospective review of all patients who underwent PAE was completed. Demographic, clinicopathologic, procedure, and outcome data were collected to include international prostatic symptom score (IPSS) and quality of life (QoL) assessments.

Results The pre-PAE mean prostate-specific antigen (PSA) was 8.4 ng/mL, mean prostate volume was 146.9 mL (9% >200 mL), and mean postvoid residual (PVR) was 208.2 mL (21.9% 200–300 mL). IPSS mean was 19.8 and QoL was "mostly dissatisfied." Following PAE, mean PSA was reduced by 3.2 ng/mL (38.1%, $p = 0.3014$), the mean prostate volume reduction was 59.2 mL (40.3%, $n = 19$, $p < 0.0001$), and the average PVR reduction was 150.3 mL (72.2%, $n = 27$, $p = 0.0002$). Average IPSS score was also lower (11.9; 60.1%, $n = 25$, $p < 0.0001$) and QoL was reduced to "mostly satisfied" ($p < 0.0001$). Technical success was 100% with 24% minor morbidities.

Conclusion PAE is a successful treatment for patients with BPH resulting in large prostates that are not good candidates for simple prostatectomy, providing optimal care with less operative and postoperative complications.

Keywords
- prostatic artery embolization
- benign prostatic hyperplasia
- prostate volume >80 mL

Introduction

Benign prostatic hyperplasia (BPH) often presents with lower urinary tract symptoms (LUTS) which typically can be medically managed; however, medical refractory LUTS may require surgery. Transurethral resection of the prostate (TURP) has been considered the standard treatment,[1] but is associated with short-term bleeding and long-term side effects, such as incontinence, dilutional hyponatremia, and sexual dysfunction. It may not be a feasible option in patients with severe comorbidities.[2] Alternatives to TURP have been developed to treat medical refractory LUTS, including water vapor therapy (Rezum), prostatic urethral lift (UroLift), and photoselective vaporization of the prostate (PVP). These procedures are less invasive, can be performed in the office, have a decreased risk of sexual dysfunction, and have shown considerable efficacy for prostates under 80 mL.[3] However, they

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have also been associated with increased retreatment rates when compared to TURP.[4]

For prostates too large to safely utilize TURP (>80 mL), simple prostatectomy is historically the treatment of choice[5]; however, this surgical procedure is associated with substantial morbidity.[6] Endoscopic enucleation of the prostate (EEP) is another option for prostates >80 mL, but it is a technically challenging procedure with a steep learning curve, and patients in many areas of the United States do not have access to a urologist that performs the procedure.[7] Prostatic artery embolization (PAE) has emerged as an alternative, less invasive option to simple prostatectomy and EEP for patients with large prostates over 80 mL, but data regarding its efficacy are limited. PAE is an interventional radiology technique where the prostatic arteries are embolized utilizing trisacryl gelatin microspheres,[8] resulting in reduced blood supply and prostatic infarction, decreasing overall prostatic volume. PAE was first used as a primary treatment for BPH in two patients in 2009 and showed promising results as an alternative therapy.[9] Since then, PAE data have shown its effectiveness in patients with prostates too large for TURP and demonstrated lower morbidity rates.[10] However, PAE is currently only recommended by the American Urological Association (AUA) for patients who have BPH refractory to other medical treatments or as an alternative to surgery in large prostates.[10] Three randomized control trials compared PAE to TURP, but results between the trials were inconsistent and the sample sizes were small,[11-13] prompting the guidelines to recommend that the use of PAE for LUTS secondary to BPH should be restricted to the context of clinical trials.[14] However, the benefits of PAE, especially in prostates that are too large for TURP, appear to be clear. PAE has demonstrated efficacy in relieving the symptoms commonly associated with BPH,[15] has led to the weaning of catheters and relieving obstructive urinary symptoms in patients with severe urinary flow blockage,[15] and has been shown to positively affect international prostatic symptom score (IPSS), quality of life (QoL), and Sexual Health Inventory for Men (SHIM).[16] Specifically, PAE has been correlated with positive clinical outcomes, significantly decreasing the whole prostate gland, median lobe, central gland, and peripheral zone volumes.[17]

Given the benefits purported to PAE as a noninvasive treatment for BPH, we sought to evaluate its use at a single tertiary medical center.

Materials and Methods

Following institutional review board (IRB) approval, a retrospective review of BPH patients who underwent PAE at a tertiary medical center and were identified by a multidisciplinary team of urologists and interventional radiologists between 9/1/2017 and 8/1/2020 was completed. Patients were included if they were inoperable due to prostate size and/or comorbidity, a poor surgical candidate, or had declined surgery. Additionally, all patients displayed criteria based on AUA guidelines—renal insufficiency, refractory urinary retention, recurrent urinary tract infections (UTIs), or gross hematuria secondary to their BPH.[14] Patients with recurrent bladder stones, those for whom LUTS from BPH was refractory to other therapies, or those that declined the use of other therapies were also included.[14] Patients selected for PAE procedure all had prostates >80 mL and were considered poor candidates for surgery due to comorbidities (advanced age, cardiac insufficiencies, severe hepatic disease, frailty, systemic infection, and so forth), desire for a nonsurgical procedure, or request for PAE. Patients with dementia, those unable to complete IPSS or QoL questionnaires, and patients with incomplete medical records were excluded.

Typical demographic and clinicopathologic variables were collected to include pre- and post-PAE prostate-specific antigen (PSA) levels, prostate volume, postvoid residual (PVR), IPSS, QoL, and follow-up. All pre-PAE values were recorded as the last result prior to PAE. PSA values, in conjunction with risk stratification algorithms[14] for BPH, were used to indicate an increased prostate size. All patients were recommended to have a biopsy per standard protocol. Specifically, if a patient had a suspicious prostate exam, PSA > 10; quickly rising PSA (velocity of >0.35 ng/mL per year; a constantly rising PSA while taking a 5-alpha-reductase inhibitor; a family history of prostate cancer; or African-American decent, they were indicated for magnetic resonance imaging (MRI)/biopsy.

Some patients refused. Generally, while PSA < 10 is considered low risk,[18] biopsies were still recommended, but most did not have a biopsy pre-PAE.

Prostatic volume was measured with MRI or ultrasound (US; enlarged prostate considered > 80 mL) and PVR was measured with bladder ultrasound (PVR < 50 mL is considered adequate bladder emptying; PVR > 200 mL indicates inadequate emptying).[5,19]

Embolization was completed as follows. Each 20 mL syringe of particles (Embospheres 100–300 or 300–500 µm particles; Merit Medical), South Jordan, UT was diluted in 8 mL Omnipaque contrast (GE Healthcare), Raleigh, NC and then mixed. Embolization proceeded utilizing the radial of femoral arterial (predominant) approach—5 French base catheter was inserted into internal iliac artery and select prostatic arteries with a 2.4 French microcatheter.

IPSS and QoL were measured with questionnaires (►**Table 1**, ►**Table 2**).[20] IPSS scores ranged from 0 to 35. Data collected post-PAE were variable in time from the procedure with the majority recorded at 1-month follow-up; 3- and 6-month follow-up values were recorded if available. Pre- and post-PAE differences in variables such as percent reduction in prostate volume, change in PVR, technical success, catheter dependence, and postoperative (major and minor)[21] complications were also recorded. Data were analyzed using Fisher *t*-tests and analysis of variance (ANOVA) where appropriate, with 0.05 as significant. The small sample size was considered in all analyses.

Results

Overall, 34 patients with prostates >80 mL that met the AUA guidelines for symptoms secondary to their BPH were evaluated in the study. Mean patient age was 76 years (range 59–92 years) comprised primarily by Caucasians

Table 1 International prostate symptom score (IPSS)[ab]

In the past month	Not at all	<1 in 5 times	<Half the time	About half the time	>Half the time	Almost always
1. Incomplete emptying: How often have you had the sensation of not emptying your bladder?	0	1	2	3	4	5
2. Frequency: How often have you had to urinate less than every two hours?	0	1	2	3	4	5
3: Intermittency: How often have you found you stopped and started again several times when you urinated?	0	1	2	3	4	5
4: Urgency: How often have you found it difficult to postpone urination?	0	1	2	3	4	5
5. Weak stream: How often have you had a weak urinary stream?	0	1	2	3	4	5
6. Straining: How often have you had to strain to start urination?	0	1	2	3	4	5
7. Nocturia: How many times did you typically get up at night to urinate?	0	1	2	3	4	5

[a]Gutman et al.[27]
[b]All information was self-reported.

Table 2 Quality of life aspect of the international prostate symptom score[ab]

Quality of life due to urinary symptoms	Delighted	Pleased	Mostly satisfied	Mixed	Mostly dissatisfied	Unhappy	Terrible
If you were to spend the rest of your life with your urinary condition just the way it is now, how would you feel about that?	0	1	2	3	4	5	6

[a]27.
[b]All information was self-reported.

(*n* = 32; 91.2%), with 2.9% African-American (*n* = 1) and 5.9% Hispanic (*n* = 2; ►**Table 3**). Average body mass index (BMI) was 28.2 (range 20.8–38.1) and 50% of the cohort was classified as overweight (BMI 25–29.9), with 32.4% classified as obese (BMI >30[22]; ►**Table 3**). The most frequent comorbidity of the cohort was hypertension (*n* = 26; 76.5%; data not shown). Overall, seven patients had PSA >10 pre-PAE and had biopsies. Four other patients had MRI PI-RADS 3 lesions and also had biopsies pre-PAE.

Prior to treatment, BPH indicators were evaluated (*n* = 32; ►**Table 4**). The mean PSA of the cohort was 8.4 ng/mL (*n* = 32; *n* = 7 PSA > 10). Patients with <5 ng/mL made up 50% of this cohort (*n* = 16), with 28% having a PSA between 5 and 10 ng/mL. Pre-PAE mean prostate volume was 146.9 mL (*n* = 32), with 12.5% of the cohort having <100 mL (*n* = 4), 43.8% 100 to 150 mL (*n* = 14), 34.4% at 150 to 200 mL (*n* = 11), and the largest prostate volumes (>200 mL) comprising 9.4% (*n* = 3; ►**Table 4**). Mean PVR for the group was 208.2 mL (*n* = 32), with the largest cohort (*n* = 10; 31.2%) retaining <100 mL and the second largest group (*n* = 9; 28.1%) retaining between 100 and 200 mL. Those with 200 to 300 mL PVR comprised 21.9% (*n* = 7) and those with >300 mL made up 18.8% of the group (*n* = 6; ►**Table 4**). IPSS scores had a mean of 19.8 (*n* = 28) pre-PAE, with only three patients reporting a score <10 (10.7%), 10 between 10 and 20 (35.7%), and 16 scoring >20 (53.6%) (►**Table 4**).

The mean QoL reported by pre-PAE patients was 4.5 (mostly dissatisfied; *n* = 32; ►**Table 4**), with the majority reporting being unhappy or having a terrible QoL due to their BPH (59.4%; *n* = 19). A mixed view or mostly dissatisfied quality of life was reported by 34.4% of patients (*n* = 11) and only two patients reported that they were pleased or mostly satisfied (6.2%).

Post-PAE BPH indicators were also evaluated (►**Table 4**). The mean PSA was 5.2 ng/mL (*n* = 12), with 75% of the cohort having <5 ng/mL and only one patient with a PSA of >20 ng/mL. The mean prostate volume of the post-PAE group was 87.7 mL (*n* = 20; ►**Table 4**), with 80% (*n* = 16) having prostates <100 mL and 20% with 100 to 200 mL (*n* = 4); none of the cohort had prostates >150 mL. Post-PAE mean PVR was 57.9 mL (*n* = 28) with 85.7% reporting residual <100 mL; only one patient had a post-PAE PVR between 200 and 300 mL

Table 3 Demographics

n = 34	Total (%)
Age (years)	
Mean	76
Range	59–92
x < 65	1
65 < *x* < 70	2
70 < *x* < 75	12
75 < *x* < 80	11
80 < *x* < 85	2
x > 85	6
Race	
Caucasian	31
African-American	1
Other	2
BMI[a]	
Mean	28.2
Range	20.78–38.06
x < 18.5	0
18.5 < *x* < 25	6
24.9 < *x* < 30	17
29.9 < *x* < 35	9
34.9 < *x* < 40	2
x > 40	0

[a]Body Mass Index; categories obtained from cdc.gov; accessed 9/1/2020 Centers for Disease Control and Prevention[22].

and no patients had >300 mL retention (►**Table 4**). Patients reported a more favorable IPSS (mean 7.9; *n* = 27; ►**Table 4**) post-PAE, with 66.7% <10 and 29.6% between 10 and 20; only one IPSS was >20. Patient-reported QoL (*n* = 26) was more favorable post-PAE (mean 1.5; ►**Table 4**) as 84.6% of patients reported that they were pleased or mostly satisfied (*n* = 22), 11.5% (*n* = 3) reported having a mixed view of life or were mostly dissatisfied, and only one patient (3.8%) reported being unhappy or having a terrible quality of life due to BPH.

There was an average reduction of PSA by 3.2 ng/mL (38.1%, *n* =12, p=0.3014; ►**Table 5**) after PAE. The average decrease in prostatic volume was 59.2 mL (40.3%, *n* =19, *p* < 0.0001) with the average PVR reduction of 150.3 mL (72.2%, *n* = 27, *p* = 0.0002). IPSS score was reduced an average of 11.9 (60.1%, *n* = 25, *p* < 0.0001), with average QoL reduction of 3.0 (66.7%, *n* = 26, *p* < 0.0001; ►**Table 5**).

Catheter dependence was noted in 35% of patients prior to PAE (*n* = 12, data not shown). Out of those 12 patients, 11 (91.7%) did not require the use of a catheter post-PAE.

TURP was performed for further LUTS for two patients after PAE (6%) and one patient had a simple prostatectomy (3%; data not shown) for insufficient relief of symptoms. A technical success rate of 100% was achieved (catheterization and embolization of at least one pelvic side), with 76.5% (*n* = 26) bilateral embolization (►**Table 6**). Out of the eight patients who received unilateral embolization, 37.5% (*n* = 3) had unsuccessful embolization of one side due to tortuous or occluded prostatic or collateral vessels, 25% (*n* = 2) had renal insufficiency, and 12.5% (*n* = 1) did not have a left prostatic artery presumably due to surgical ligation. In comparison of patients who underwent unilateral versus bilateral embolization (►**Table 6**), there were no significant differences in age, prostate volume, PVR, IPSS, and QoL. Six out of eight patients with unilateral embolization did not require further therapy due to clinical success. Out of the other two patients, one had insufficient relief of symptoms with unilateral procedure requiring further embolization. The other patient was staged to have embolization of the other side one month later due to procedure length, contrast dose, and radiation exposure.

Overall, minor complications were reported in 23.5% patients (*n* = 8; ►**Table 6**) with hematuria most frequently reported (*n* = 4; 50%; 12% of all PAE), followed by acute urinary retention (*n* = 3; 37.5%; 9% of the total group), UTI in two (25%; 6% of the PAE patients), and external iliac artery dissection in one (12.5%; 3% of the total cohort). One patient had both acute urinary retention and hematuria, and another patient had both UTI and hematuria. The external iliac artery dissection was repaired with self-expandable stent and the patient was discharged the next day with no future complications. The remainder of minor complications mentioned resolved without any additional intervention.

Discussion

The prevalence of BPH increases with age, and life expectancy and population aging are increasing worldwide.[23,24] According to data from "World Population Prospects: the 2019 Revision," by 2050, the amount of people in the world older than 65 years will have increased from 1 in 11 to 1 in 6,[23,24] increasing the number of patients with BPH and other age-related comorbidities. PAE for the treatment of BPH is an alternative for patients with significant comorbidities or are otherwise poor candidates for surgery. Here we present the clinical outcomes of 34 patients with prostate volumes over 80 mL who underwent PAE for BPH in terms of changes in PSA, prostatic volume, PVR, IPSS scores, and QoL scores. Notable comorbidities in this cohort included elevated BMI and hypertension pre-PAE, which have both been reported as risk factors for BPH.[25,26] Additionally, 91.7% patients who were catheter dependent pre-PAE were able to void independently without a catheter post-PAE, similar to reported literature.[15] While typically, patients with IPSS <10 are considered to have mild LUTS and do not usually require treatment, three of the patients in our study had IPSS <10 but also a high QoL score, high PVR, high prostate volume, or a combination of these factors, leading to PAE treatment.[27] The technical success of the procedure was 100%, also similar to the literature.[28] There was improvement in all values measured in the study, and these data demonstrate that PAE effectively improves patient satisfaction, decreases symptoms, and objectively reduces PVR and prostate volume.

Table 4 Pre-and post-PAE BPH indicators[a]

	Pre-PAE n (%)	Post-PAE n (%)	Change	*p*-Value
PAE PSA (ng/mL)	***n* = 32**	***n* = 12**		
Mean	8.4	5.2	−3.2	0.3014
$x < 5$	16 (50)	9 (75)	−7	0.1405
$5 < x < 10$	9 (28.1)	1 (8.3)	−8	0.1675
$10 < x < 15$	3 (9.4)	1 (8.3)	−2	0.9111
$15 < x < 20$	2 (6.2)	0 (0)	−2	0.3829
$x > 20$	2 (6.2)	1 (8.3)	−1	0.8072
Prostate volume (mL)	***n* = 32**	***n* = 20**		
Mean	146.9	87.7	−59.2	**<0.0001**
$x < 100$	4 (12.5)	16 (80)	**+12**	**<0.0001**
$100 < x < 150$	14 (43.8)	4 (20)	−10	0.0823
$150 < x < 200$	11 (34.4)	0 (0)	−11	**0.0034**
$x > 200$	3 (9.4)	0 (0)	−3	0.1618
PVR (mL)	***n* = 32**	***n* = 28**		
Mean	208.2	57.9	−150.3	**0.0002**
$0 < x < 100$	10 (31.2)	24 (85.7)	**+14**	**<0.0001**
$100 < x < 200$	9 (28.1)	3 (10.7)	−6	0.0954
$200 < x < 300$	7 (21.9)	1 (3.6)	−6	**0.0393**
$x > 300$	6 (18.8)	0 (0)	−6	**0.0165**
IPSS	***n* =28**	***n* =27**		
Mean	19.8	7.9	−11.9	**<0.0001**
$x < 10$	3 (10.7)	18 (66.7)	**+15**	**<0.0001**
$10 < x < 20$	10 (35.7)	8 (29.6)	−2	0.6329
$x > 20$	15 (53.6)	1 (3.7)	−14	**0.0001**
QoL	***n* =32**	***n* =26**		
Mean	4.5	1.5	−3.0	**<0.0001**
$x = 1, 2$	2 (6.2)	22 (84.6)	**+20**	**<0.0001**
$x = 3, 4$	11 (34.4)	3 (11.5)	−8	**0.0445**
$x = 5, 6$	19 (59.4)	1 (3.8)	−18	**<0.0001**

[a]Variables were not available for all patients due to individual urology practice guidelines.
Abbreviations: BPH, benign prostatic hyperplasia; IPSS, international prostatic symptom score; PAE, prostatic artery embolization; PSA, prostate-specific antigen; PVR, postvoid residual; QoL, quality of life survey.

Table 5 Summary of cohort change pre- versus post-PAE[a]

Average difference					% Reduction				
PSA (ng/mL)	Volume (mL)	PVR (mL)	IPSS	QoL	PSA (ng/mL)	Volume (mL)	PVR (mL)	IPSS	QoL
−3.2	−59.2	−150.3	−11.9	−3.0	38.1	40.3	72.2	60.1	66.7

Abbreviations: IPSS, international prostatic symptom score; PAE, prostatic artery embolism; PSA, prostate-specific antigen; PVR, postvoid residual; QoL, quality of life survey.
[a]Variables were not available for all patients due to individual urology practice guidelines.

In addition to these measures, it is important to understand other benefits associated with PAE compared to procedures like simple prostatectomy, EEP, and TURP. PAE is usually performed on an outpatient basis, while most patients undergoing TURP, EEP, or simple prostatectomy stay at least 1 or 2 days post procedure.[28,29] Patients who have had PAE also report significantly shorter time to return to normal activities compared to TURP, and some studies have shown less adverse events with PAE.[13,30] When compared to simple prostatectomy, PAE has less operative and postoperative

Table 6 Unilateral versus bilateral embolization[a]

		Total *n* = 34	Unilateral *n* = 8	Bilateral *n* = 26	*p*-Value
Age	Mean	76	79	75	0.1600
	Range	59–92	70–88	59–92	
PSA		***n* = 32**	***n* = 7**	***n* = 25**	
	Pre	8.4	5.1	9.4	0.3137
		***n* = 12**	***n* = 1**	***n* = 11**	
	Post	5.2	1	5.5	
	% Reduction	38.1	80.4	41.5	**0.0580**
Prostate volume		***n* = 32**	***n* = 8**	***n* = 24**	
	Pre	146.9	152.5	145.0	0.6483
		***n* = 20**	***n* = 4**	***n* = 16**	
	Post	87.7	73.5	91.3	0.1749
	% Reduction	40.3	51.8	37.0	0.4625
PVR[b]		***n* = 32**	***n* = 7**	***n* = 25**	
	Pre	208.2	157	222.5	0.4353
		***n* = 28**	***n* = 7**	***n* = 21**	
	Post	57.9	32.4	66.4	0.1602
	% Reduction	72.2	79.4	70.2	0.6162
IPSS		***n* = 28**	***n* = 6**	***n* = 22**	
	Pre	19.8	14.8	21.1	0.0804
		***n* = 27**	***n* = 6**	***n* = 21**	
	Post	7.9	9	7.6	0.5993
	% Reduction	60.1	39.2	64.0	0.2205
QoL		***n* = 32**	***n* = 8**	***n* = 24**	
	Pre	4.5	4	4.7	0.1634
		***n* = 26**	***n* = 5**	***n* = 21**	
	Post	1.5	1	1.6	0.3126
	% Reduction	66.7	75	66.0	0.6379
	Reason for unilateral[c]	***n* = 8**	***n* = 8**		
	Occluded vessels	3 (38%)	3 (38%)		
	Renal insufficiency	2 (25%)	2 (25%)		
	No L prostatic artery	1 (12%)	1 (12%)		
	Bilateral later	2 (25%)	2 (25%)		
	Complications[de]	***n* = 8**	***n* = 8**	***n* = 26**	
	Hematuria	4	2	2	
	Acute urinary retention	3	0	3	
	UTI	2	0	2	
	External iliac artery dissection	1	0	1	

Abbreviations: IPSS, international prostatic symptom score; PSA, prostate-specific antigen; PVR, postvoid residual; QoL, quality of life survey.
[a]All patients that underwent PAE had a successful procedure (100%).
[b]PVR went up in the bilateral patients, however, there is inherent poor reliability in this calculation due to collection procedures.
[c]The reasons that a unilateral procedure was completed was due to occluded prostatic vessel.
[d]Twenty-four percent of patients that underwent PAE (*n* = 34) had a complication.
[e]Patients may have had more than one complication.

Table 7 Literature comparison

Reduction %	Pike[a] (PAE)	Westwood[b] (Rezum)	Rukstalis[b] (UroLift)	Rieken[b] (PVP)	Jones[c] (HoLEP)	Jones[c] (simple prostatectomy)	Zell[d] (HoLEP >200 mL)
PSA	38.1			42–43			90
Vol (mL)	40.3						
PVR	72.2	5–35	8.4	65–100	98	98	
IPSS	60.1	45–58	50.9	55–73	58–90	61–89	63
QOL	66.7	38–61	49.6	50–60	58	66	43

Abbreviations: IPSS, international prostatic symptom score; PSA, prostate-specific antigen; vol, volume; PVR, postvoid residual; QoL, quality of life survey.
[a]All prostates in this study were >80 mL.
[b]Prostates were <80 mL.
[c]Prostates were 115–125 mL.
[d]Prostates were >200 mL; other studies[33–37] did not assess change in prostate volume.

complications.[31] In our study, there were no major complications and 23.5% patients experienced minor complications.[21]

Additionally, eight of the 34 patients in our study received unilateral embolization, and their results in every category were not statistically different than those with bilateral. Two out of the eight did receive embolization of the contralateral side within 2 months of first PAE due to persistent symptoms. This is a small sample size of patients who received unilateral embolization, but it shows that perhaps, as has been suggested by other studies, bilateral embolization is not necessarily required to achieve adequate results.[20,29,32]

Recent studies have also been performed analyzing the effects of Rezum, UroLift, and PVP therapies on IPSS and QoL scores. Rezum has been reported through multiple studies to decrease PVR between 5 and 35%, IPSS between 45 and 58%, and QoL by 38 to 61%.[33] UroLift data showed an 8.4% reduction in PVR, 50.9% reduction in IPSS, and a 49.6% reduction of QoL.[34] PVP results from multiple studies have shown a reduction in PVR by 65 to 100%, IPSS by 55 to 73%, and QoL by 50 to 60%.[35] Our data portray similar improvement in large prostates over 80 mL for these measures, whereas the prostatic volume used in these studies was <80 mL (►**Table 7**).

When looking at enucleation procedures and simple prostatectomy performed on larger prostates >80 mL, our data also show similar outcomes. A systematic review and meta-analysis regarding holmium laser enucleation of the prostate (HoLEP) and simple prostatectomy included multiple studies of patients with mean prostate volumes between 110 and 125 mL. HoLEP led to a decrease in IPSS by 58 to 90% and QoL by 58%. Simple prostatectomy decreased IPSS by 61 to 89% and QoL by 66%.[36] In a study on the use of HoLEP in prostates over 200 mL, IPSS was reduced by 63% and QoL by 43% (►**Table 7**).[37]

At our institution, PAE has produced results similar to performing TURP, Rezum, UroLift, and PVP on prostates <80 mL and to enucleation and simple prostatectomy on prostates >80 mL. These data support the use of PAE in large prostates >80 mL and in patients who are poor surgical candidates, or who desire a less invasive procedure than simple prostatectomy. In some cases, PAE could be used to shrink the prostate small enough to perform TURP, Rezum, UroLift, or PVP. Two of our patients had a TURP after PAE for the treatment of LUTS. This result should not be considered a failure, as ultimately, those patients were able to treat their large prostate without using simple prostatectomy. Our study limitations include the retrospective nature of the study, the small sample size, and short follow-up intervals. More studies should be performed on PAE before it is implemented as a routine treatment for BPH-LUTS in patients with large prostates.

Conclusion

Our study demonstrates that PAE is a safe, effective procedure for the treatment of BPH-related LUTS in patients with prostates larger than 80 mL. Additionally, PAE is often the only safe treatment option for some patients with large prostates due to comorbidities. Although limited by small sample size (n = 8), it appears that unilateral PAE could be adequate for some patients suggesting the feasibility of a unilateral embolization to limit procedural complications. A research study involving a larger patient cohort followed over a longer postprocedure time would be helpful to substantiate this observation.

Conflict of Interest

M.D. is a paid consultant for Boston Scientific and speaker for Ethicon/Johnson and Johnson.
He also reports personal fees from Boston Scientific and from Johnson and Johnson/Ethicon, outside the submitted work.
All other authors declare they have no conflicts of interest.

Ethical Approval

For this type of study, formal consent is not required.

Informed Consent

This study has obtained IRB approval from Health Sciences, South Carolina, and the need for informed consent was waived.

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