Medium- and Long-Term Outcome of Prostate Artery Embolization for Patients with Benign Prostatic Hyperplasia: Results in 630 Patients

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ABSTRACT

Purpose: To confirm that prostatic artery embolization (PAE) has a positive medium- and long-term effect in symptomatic benign prostatic hyperplasia (BPH).

Materials and Methods: Between March 2009 and October 2014, 630 consecutive patients with BPH and moderate-to-severe lower urinary tract symptoms refractory to medical therapy for at least 6 months or who refused any medical therapy underwent PAE. Outcome parameters were evaluated at baseline; 1, 3, and 6 months; every 6 months between 1 and 3 years; and yearly thereafter up to 6.5 years.

Results: Mean patient age was 65.1 years ± 8.0 (range, 40–89 y). There were 12 (1.9%) technical failures. Bilateral PAE was performed in 572 (92.6%) patients and unilateral PAE was performed in 46 (7.4%) patients. The cumulative clinical success rates at medium- and long-term follow-up were 81.9% (95% confidence interval [CI], 78.3%–84.9%) and 76.3% (95% CI, 68.6%–82.4%). There was a statistically significant ($P < .0001$) change from baseline to last observed value in all clinical parameters: International Prostate Symptom Score (IPSS), quality-of-life (QOL), prostate volume, prostate-specific antigen, urinary maximal flow rate, postvoid residual, and International Index of Erectile Function. There were 2 major complications without sequelae.

Conclusions: PAE had a positive effect on IPSS, QOL, and all objective outcomes in symptomatic BPH. The medium- (1–3 y) and long-term (> 3–6.5 y) clinical success rates were 81.9% and 76.3%, with no urinary incontinence or sexual dysfunction reported.

ABBREVIATIONS

AUR = acute urinary retention, BPH = benign prostatic hyperplasia, CI = confidence interval, DSA = Digital subtraction angiography, IIEF = International Index of Erectile Function, IPSS = International Prostate Symptom Score, LUTS = lower urinary tract symptoms, PAE = prostate artery embolization, PSA = prostate-specific antigen, PV = prostate volume, PVA = polyvinyl alcohol particles, PVR = postvoid residual volume, Qmax = maximal flow rate, QOL = quality of life

Benign prostatic hyperplasia (BPH) is the most frequent benign tumor in men and is present in > 50% of men ≥ 60 years old (1). The incidence increases with age, and all men can develop BPH if they live long enough (2). BPH clinically manifests with lower urinary tract symptoms (LUTS), including frequency, nocturia, urgency, hesitancy, decreased and interrupted stream, and incomplete bladder emptying. All these symptoms have a significant impact on daily life and sleep patterns (3). Medical and surgical therapies for BPH may be associated with major complications, including sexual dysfunction (4–9). To reduce the morbidity of therapy for BPH, a new

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None of the authors have identified a conflict of interest.

J Vasc Interv Radiol 2016; 27:1115–1122

http://dx.doi.org/10.1016/j.jvir.2016.04.001

procedure with good results and a lower rate of adverse events is needed; one such procedure is prostatic artery embolization (PAE). A few patients may not improve; however, their condition does not worsen or result in severe adverse events. PAE is a minimally invasive therapy that has been shown to be safe and effective for LUTS associated with BPH, resulting in good short-term and medium-term outcomes, a decrease in prostate volume (PV), and significant clinical improvement (10–15). Nonspherical polyvinyl alcohol (PVA) particles have been the most commonly used embolic agent for PAE (14–28). The aim of this retrospective cohort study was to confirm that PAE has a positive effect on all objective outcomes in symptomatic BPH between 2 and 6.5 years of follow-up.

MATERIALS AND METHODS

Study Population

This single-center, retrospective cohort study was approved by the institutional review board. Eligible patients had been informed regarding the embolization procedure through a schematic drawing, and all provided informed consent. From March 2009 to October 2014, 630 consecutive patients underwent PAE for the relief of BPH symptoms (ie, moderate-to-severe LUTS). Of 630 patients, 429 had been refractory to medical therapy for at least 6 months, 120 had previously refused any medical or surgical therapy, 67 had presented with acute urinary retention (AUR), and 14 had undergone surgery 1–12 years before PAE. A second PAE was required in 58 patients. The short-term and medium-term results of the first 255 patients in this series have been previously published (16–18).

Before the procedure, every patient was evaluated at baseline for the degree of LUTS using the International Prostate Symptom Score (IPSS), the quality of life (QOL) questions in IPSS, and the International Index of Erectile Function (IIEF) questionnaire. The following parameters were evaluated: PV measured using transrectal ultrasound in all patients and using magnetic resonance imaging in 87 patients, prostate-specific antigen (PSA), and urinary maximal flow rate (Qmax) and postvoid residual (PVR) volume in patients who did not have AUR. Prostate biopsy was performed whenever a suspicious focal lesion was detected on transrectal ultrasound, magnetic resonance imaging, or digital rectal examination or when the PSA was $>$ 4 mg/mL. Computed tomography (CT) angiography was performed before the procedure in all patients, as previously described, to study the iliac and prostatic arteries (20). An interventional and diagnostic radiologist with 10 years of experience interpreted all CT angiography images. Based on CT angiography data, the patients were informed regarding the anticipated difficulty of the procedure and probability of technical and clinical success.

Patients were administered an acid-suppressing drug (omeprazole 20 mg once daily [Pantoprazole; Bluepharma, Coimbra, Portugal]), an antiinflammatory (naproxen 1,000 mg twice daily [Naprosyn; Roche, Basel, Switzerland]), and an antibiotic (ciprofloxacin 750 mg twice daily [Ciprofloxacina Jaba; Porto Salvo, Portugal]) for 2 days before and 7 days after PAE. On the day of PAE, medications were administered during breakfast and dinner 8 hours after the procedure. During embolization, an antihistamine (hydroxyzine 25 mg [Atarax; Paço de Arcos, Portugal]) was orally administered, and an analgesic (metamizole 2 g [Nolotil; Boehringer Ingelheim GmbH, Ingelheim am Rhein, Germany]) and an antiinflammatory (ketorolac trometh-amine 30 mg [Toradol; Roche]) were intravenously administered (16–18).

The inclusion criteria were age $>$ 40 years, a diagnosis of BPH with moderate-to-severe LUTS (IPSS $\geq$ 18 and QOL $\geq$ 3), Qmax $\leq$ 12 mL/s or AUR, refractoriness to medical or other treatment for at least 6 months, PV $>$ 30 mL, and acceptance of the risk of developing sexual dysfunction after treatment (16–18). Patients with PV $<$ 30 mL were included if the urodynamic study showed infravesical obstruction. Urodynamic studies were performed in cases of possible infravesical obstruction or bladder dysfunction or neurogenic bladder, particularly if the Qmax was $>$ 15 mL/s. Exclusion criteria included malignancy, advanced atherosclerosis and tortuosity of the iliac and/or prostatic arteries on CT angiography, secondary renal insufficiency (eg, secondary to prostatic obstruction), large bladder diverticula or stones, neurogenic bladder, detrusor failure, active urinary tract infection, and unregulated and uncontrollable coagulation parameters (16–18).

Procedures

Procedures were performed on an outpatient basis. PAE was performed under local anesthesia by a unilateral approach whenever possible, usually through the right femoral artery. A 5-F 11-cm or 23-cm sheath (Terumo, Tokyo, Japan) was introduced into the right femoral artery. A Roberts uterine catheter (Cook, Inc, Bloomington, Indiana) and a 0.035-inch hydrophilic guide wire (Terumo) were used for catheterization of the left internal iliac artery and its anterior division (16–18). However, if the iliac arteries were very tortuous, a bilateral femoral approach was used. For bilateral cases, a Rösch inferior mesenteric catheter (Cook, Inc) was introduced into the ipsilateral internal iliac artery. Digital subtraction angiography (DSA) of the anterior division of the internal iliac arteries was performed with ipsilateral anterior oblique (35°) with cranial tilt (−10%) views. For selective catheterization of the prostatic arteries, a Progreat 2.7 or Progreat 2.0 microcatheter

(Terumo) and a 0.016-inch hydrophilic guide wire (Glidewire GT; Terumo) or a 2.5 Cantata microcatheter (Cook, Inc) and a 0.016-inch guide wire (Sagita, Cook, Inc) were used. After catheterization of the prostatic artery, DSA was performed in the same ipsilateral anterior oblique and posteroanterior views. DSA was performed with power injection of 5 mL of total contrast media at 3 mL/s at a concentration of 350 mg/mL iodine. If there was risk of nontargeted embolization because of anastomoses with other important pelvic arteries (internal pudendal, accessory internal pudendal, penile, vesical, and middle rectal arteries), embolization by coils was performed to avoid complications.

The embolization was usually initiated using straight 0.18-inch, 7-mm-long pushable coils and completed using 3-mm-diameter, 3-cm-long pushable coils (Tornado; Cook, Inc). PAE was performed using 100 μm and/or 200 μm nonspherical PVA particles (Cook, Inc) in 418 patients, 300–500 μm spherical PVA particles (Bead Block; Biocompatibles UK Ltd, London, United Kingdom) in 167 patients, and 400 μm Polyzene-coated hydrogel microspheres (Embozene; CeloNova BioSciences, Inc, San Antonio, Texas) in 33 patients (15,24,27). The embolization endpoint selected was occlusion of the arterial branches supplying the prostate, prostate gland opacification, and reflux toward the origin of the prostatic artery or the anterior division of the internal iliac artery. The embolization endpoint was the same for all embolic agents. On completing embolization of the left prostatic artery, the Roberts uterine catheter was placed in the right prostatic artery, embolization was completed in the same manner. After reaching the embolization endpoint, injection of particles was completed without any delay for nonspherical PVA particles and after 3 minutes for the remaining embolic agents. Patients were discharged from the hospital on the same day, an average of 4 hours after the procedure (range, 3–8 h); patients with high blood pressure or who lived alone remained in the hospital overnight.

Outcome Measures

Technical success was defined as selective prostatic arterial catheterization and embolization on at least one side. Unilateral embolization was considered a technical success because at least 50% of these patients have clinical success (21). Pain assessment was evaluated during PAE and at discharge using a visual analog scale. Patients were asked to rate their pain severity from 0 (no pain) to 10 (the worst pain).

All patients were clinically evaluated at 1, 3, and 6 months; every 6 months for up to 3 years; and yearly thereafter using IPSS, QOL, and IIEF and measuring PSA level, Qmax, PVR, and PV. Clinical success was defined as improved symptoms (IPSS $\leq$ 15 points and a decrease of at least 25% from the baseline score), improved QOL (QOL score $\leq$ 3 points or a decrease of at least 1 point from baseline), and no need of any medical or other therapy after PAE (25). Clinical failure was considered when there was absence of at least one of the three above-mentioned criteria. A clinical failure after initial success was considered to be a recurrence. Adverse events were recorded according to the Society of Interventional Radiology (SIR) classification.

Statistical Analysis

Rates of clinical success over time were analyzed using the Kaplan-Meier method to consider incomplete follow-up times. Between-group comparisons were performed using the log-rank test. Hazard rates were obtained using Cox proportional hazards model. To evaluate the degree of improvement in the clinical parameters, the change from baseline in subjects with complete data up to 36 months was analyzed with paired *t* tests. The Kruskal-Wallis test was used for comparison of procedure and fluoroscopy times and radiation dose between particle types. Stata software, release 11 (StataCorp LP, College Station, Texas) was used for all analyses. Statistical differences were accepted when $P < .05$.

RESULTS

Between March 2009 and October 2014, 630 patients underwent PAE. Mean patient age was 65.1 years ± 8.0 (range, 40–89 y) (**Table 1**). AUR with an indwelling bladder catheter for 1–6 months before PAE was present in 67 (10.6%) patients. The procedure was performed under local anesthesia using a unilateral femoral approach in 602 (95.6%) patients and a bilateral approach in 28 (4.4%) patients. PAE was technically successful in 618 (98.10%) patients. In 12 (1.9%) patients, the procedure was impossible to perform because of tortuosity and atherosclerotic changes of the iliac and prostatic arteries or a very angled origin of the prostatic artery. Bilateral PAE was performed in 572 (92.6%) patients, and unilateral PAE was performed in 46 (7.4%) patients. Nonspherical PVA particles were used in 418 (67.6%) patients, BeadBlock particles were used in 167 (27.0%) patients, and Embozene particles were used in 33 (5.3%) patients. Mean procedure time was 77 minutes (range, 16–258 min). Mean fluoroscopy time was 19.5 minutes (range, 4.9–91 min). Mean dose area product was 2,415 Gy/cm^2 (range, 625–9,503 Gy/cm^2). There were no significant differences in procedure ($P = .55$) and fluoroscopy ($P = .81$) times or radiation dose between the different embolic agents used.

The mean procedure pain score (on a 0-to-10 visual analog scale) during PAE was 1.6 (range, 0–9); 537 (85.2%) patients did not feel any pain. The mean pain score at discharge was 0.4 (range, 0–5). Of patients, 578 (91.7%) were discharged 3–6 hours after PAE, and the remaining 52 (8.3%) patients spent the night at the

Table 1. Baseline Patient Data

Variable	n	%	Mean	SD	Range
Age (y)	630	100.0	65.1	8.0	40–89
Previous medical therapy					
α_1-ARA monotherapy	156	24.8			
5-ARI monotherapy	87	13.8			
Combination therapy	186	29.5			
Previous prostate surgery	14	2.2			
Acute urinary retention	67	10.6			
Refused any therapy	120	19.1			
Baseline evaluation					
IPSS	589	93.5	23.1	5.86	2–35
QOL	591	93.8	4.23	0.85	0–6
IIEF	584	92.7	18.5	8.08	0–34
PV (cm^3)	629	99.8	81.4	40.7	18–383
PSA (ng/cm^3)	572	90.8	5.13	5.81	0–58.7
PVR (cm^3)	572	90.8	109.4	93.6	0–537
Qmax (cm^3/min)	578	91.7	11.2	29.7	0–713

α_1-ARA = α_1-adrenergic receptor antagonist; 5-ARI = 5-α reductase inhibitor; IIEF = International Index of Erectile Dysfunction; IPSS = International Prostate Symptom Score; QOLPSA = prostate-specific antigen; PV = prostate volume; PVR = postvoid residual; Qmax = maximal flow rate; QOL = quality of life.

hospital and were discharged the next morning (18 h later). Therefore, all patients were considered to be outpatients because hospital stays were < 24 hours. During discharge, patients were asked about their urinary symptoms and if they noted any changes, and 218 (34.6 %) reported that they experienced immediate improvement of LUTS.

Of the 67 patients with AUR, 60 (95.3%) had the bladder catheter removed and were able to spontaneously void between 2 days and 3 months (mean 65.6 d ± 15.3) after the procedure. Among the patients in whom PAE was technically successful, 47 (7.5%) were lost to follow-up before any evaluation could be conducted. Therefore, follow-up efficacy data are available for 571 patients only. This cohort was observed for a median of 24 months (range, 12–78 mo), with a median follow-up of 30 months (range, 3–78 mo) among the censored patients. There were 104 (18%) clinical failures: 85 (82.5%) at short-term (up to 12 mo after PAE) follow-up, 14 at medium-term (1–3 years after PAE) follow-up, and 5 at long-term (3–6.5 years after PAE) follow-up. Of the 85 short-term clinical failures, 50 (55%) were early failures at up to 1 month, 7 recurrences occurred at 3 months, 13 recurrences occurred at 6 months, and 15 recurrences occurred at 12 months. Once the patients were deemed to have had clinical failure, no further data were collected for this study, although they improved after a second PAE.

The mean changes from baseline of the clinical parameters at each time period are shown in Table 2. An analysis based on only the 328 subjects with complete data at 36 months showed a mean IPSS improvement of 12.1 points ± 8.6, mean QOL improvement of 1.69 points ± 1.34, mean PV reduction of 14.0 cm^3 ± 27.3 (12.6% ± 26.9), mean PSA reduction of 1.34 ng/mL ± 5.89, mean Qmax improvement of 3.21 mL/min ± 10.3, and mean PVR reduction of 37.4 mL ± 82.7 (all differences statistically significant with $P <$ .0001). IIEF improved an average of 1.17 points ± 5.74 ($P = .0003$). In 63.5% of patients, IIEF improved or remained the same. For patients with decreased IIEF, the average reduction was 3.84 points ± 3.18. The wives of six patients conceived and delivered live newborns. They were unable to conceive before PAE, possibly as a result of retrograde ejaculation caused by treatment with α_1-adrenergic blockers.

Kaplan-Meier estimates of cumulative rates of clinical success were 85.1% (95% confidence interval [CI], 81.9%–87.8%) at short-term follow-up, 81.9% (95% CI, 78.3%–84.9%) at medium-term follow-up, and 76.3% (95% CI, 68.6%–82.4%) at long-term follow-up (Table 3, Fig). Of the 104 patients with clinical failures, 58 patients underwent a second PAE; seven underwent open surgery; seven underwent transurethral resection of the prostate; and the remaining patients, including patients with no improvement after repeat PAE, were offered medical therapy. The seven patients with persistent AUR and unsuccessful PAE were treated with repeat PAE (four patients) or open surgery (three patients).

Because of recurrent LUTS in 58 patients, a second PAE was performed as previously described; among these patients, 28 additionally underwent CT angiography before the procedure. We routinely repeat CT angiography before the second PAE because the prostatic artery may be occluded from the previous embolization or secondary to progression of atherosclerosis. The number of repeated PAE procedures decreases with time. For example, at long-term follow-up, only two

Table 2. Mean Changes of Parameters at Different Times and SD

Variable	Study Period	n	Mean Change from Baseline	SD	95% CI	
IPSS	Short term	499	−13.71	7.16	−14.34	−13.08
	Medium term	237	−14.50	7.36	−15.44	−13.32
	Long term	36	−16.94	8.70	−19.89	−14.00
	Last observation	546	−11.72	7.15	−12.32	−11.12
QOL	Short term	503	−1.94	1.20	−2.04	−1.83
	Medium term	236	−1.98	1.21	−2.13	−1.82
	Long term	38	−1.74	1.45	−2.21	−1.26
	Last observation	556	−1.77	1.19	−1.87	−1.67
IIEF	Short term	407	1.74	6.26	0.86	2.08
	Medium term	227	1.56	5.58	0.73	2.29
	Long term	32	3.44	6.59	1.06	5.81
	Last observation	507	1.22	5.86	0.71	1.73
PV (cm^3)	Short term	450	−17.24	27.96	−19.83	−14.65
	Medium term	232	−15.19	29.13	−18.96	−14.42
	Long term	35	−16.85	25.70	−25.68	−8.02
	Last observation	536	−14.91	28.32	−17.31	−12.50
PV (%)	Short term	450	−16.66	24.29	−18.91	−14.41
	Medium term	232	−13.45	27.66	−17.03	−9.87
	Long term	35	−15.71	24.38	−24.08	−7.33
	Last observation	536	−13.64	25.79	−15.83	−11.45
PSA (ng/mL)	Short term	437	−1.38	4.07	−1.76	−1.00
	Medium term	234	−1.72	6.15	−2.52	−0.93
	Long term	35	−2.34	4.53	−3.90	−0.78
	Last observation	539	−1.20	5.00	−1.63	−0.78
PVR (mL)	Short term	401	−43.89	89.11	−52.64	−35.14
	Medium term	210	−47.92	76.44	−58.32	−37.52
	Long term	30	−52.16	94.22	−87.34	−16.98
	Last observation	494	−44.83	85.85	−52.42	−37.24
Qmax (mL/min)	Short term	400	3.07	5.84	2.49	3.64
	Medium term	211	4.12	11.32	2.59	5.66
	Long term	32	7.98	4.83	3.24	6.73
	Last observation	493	3.33	8.82	2.55	4.11

CI = confidence interval; IIEF = International Index of Erectile Dysfunction; IPSS = International Prostate Symptom Score; PSA = prostate-specific antigen; PV = prostate volume; PVR = postvoid residual; Qmax = maximal flow rate; QOL = quality of life.

Table 3. Cumulative Clinical Success Rate over Time

Period	Month	At Risk	Fail	% Clinical Success	95% CI	
Short term	1	571	50	91.2	88.6	93.3
	3	521	7	90.0	87.3	92.2
	6	513	13	87.7	84.8	90.2
	12	496	15	85.1	81.9	87.8
Medium term	18	378	9	83.1	79.7	86.0
	24	343	5	81.9	78.3	84.9
	30	249	0	81.9	78.3	84.9
Long term						
	36	232	3	80.8	77.1	84.0
	48	103	0	80.8	77.1	84.0
	60	36	2	76.3	68.6	82.4
	78	8	0	76.3	68.6	82.4

CI = confidence interval.

patients had undergone repeat PAE (Table 4). Of the 58 patients who underwent repeat PAE, 10 were lost to follow-up before any data could be obtained. The cumulative rates of clinical success in the 48 remaining patients were 62.9% (95% CI, 47.1%–75.2%) at short-term follow-up, 43.6% (95% CI, 37.0%–69.1%) at medium-term follow-up, and 43.6% at long-term follow-up (Table 4). These rates are lower than the rates for a single PAE (Table 2). Although there was a suggestion that short-term failures had lower rates of clinical success, the difference was not statistically significant (hazard ratio = 2.44; 95% CI, 0.78–7.60; $P = .10$).

Adverse events were mild (Table 5). Five patients died of unrelated causes, and one patient had a stroke during follow-up. These patients had controlled LUTS during the event, and none of the events were related to the procedure. There was one PAE-related major adverse event, a case of bladder wall ischemia treated by simple surgery; another patient had uncomfortable perineal pain lasting for 3 months. During that time, the patient was unable to drive. There were no sequelae from these complications.

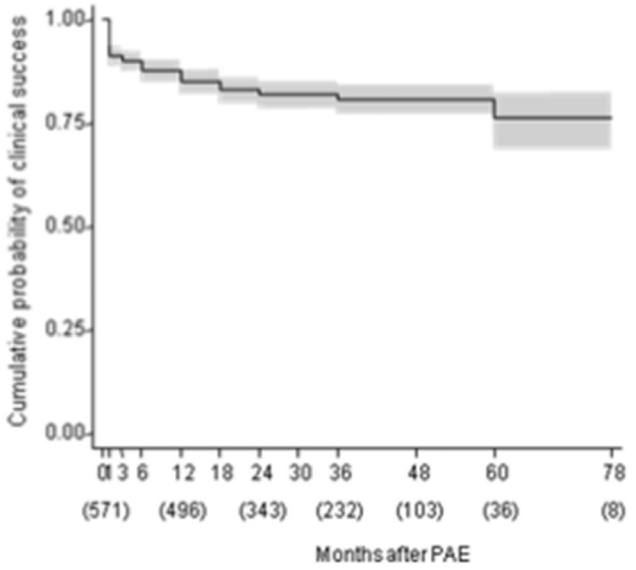

Figure. Kaplan-Meier estimates and 95% confidence bands of the cumulative probability of clinical success after PAE. Numbers in parentheses are number at risk at several time points.

DISCUSSION

Some small-sized and medium-sized series have shown the short-term and medium-term results of PAE, confirming that the procedure is safe, with low morbidity, no sexual dysfunction, and a good outcome (13–25). The present study aimed to show the medium-term and long-term results in a large series of 630 patients. Most clinical failures occurred during the short-term follow-up, with most occurring at 1 month in patients who did not improve at all. As time increased after PAE, the incidence of clinical recurrence decreased, with only 14 failures at medium-term follow-up and 5 at long-term follow-up. The clinical success rate of 76.3% at long-term follow-up, coupled with the low morbidity and lack of sexual dysfunction or urinary incontinence, may indicate that PAE is a leading treatment option in patients with symptomatic BPH in whom embolization can be performed with technical success.

At the beginning of our experience with PAE, only patients who were refractory to medical therapy for at least 6 months were eligible to undergo the procedure. However, more recently, PAE has been offered to some patients who refuse any other medical or surgical treatment, similar to 120 (19.1%) of the studied patients. The symptomatic improvement can be rapid, as observed in 34.6% of the patients who reported improved urinary flow and noted relief of other urinary symptoms during discharge. The rapid clinical improvement may be due to early ischemia of the gland preventing the conversion of testosterone into dihydrotestosterone, the main factor associated with LUTS.

Initially, PAE was repeated in patients who had recurrence of LUTS if they had prostatic arteries feasible for repeat embolization based on DSA performed during the first PAE. However, the angiographic appearance of the prostatic arteries changed in some patients with time, such that repeated embolization was impossible in some of them. Therefore, CT angiography should be performed before a second PAE to evaluate the feasibility

Table 4. Cumulative Clinical Success Rate after Repeated PAE

Period	Month	At Risk	Fail	% Clinical Success	95% CI	
Short term	1	48	6	87.5	74.3	94.2
	3	41	1	85.4	71.7	92.7
	6	40	7	70.4	55.2	81.3
	12	28	3	62.9	47.1	75.2
Medium term	18	15	2	54.5	37.0	69.1
	24	9	0	54.5	37.0	69.1
	30	5	0	43.6	20.7	64.5
Long term	36	2	0	43.6	20.7	64.5

CI = confidence interval; PAE = prostate artery embolization.

Table 5. PAE-Related Adverse Events

Adverse Events	No. Patients	%
Major		
Bladder wall ischemia	1	0.2
Persistent perineal pain	1	0.2
Minor		
Dysuria	152	24.1
Frequency	145	23.0
Obstipation	76	13.3
Hematuria	48	7.6
Hematospermia	46	8.0
Rectal bleeding	34	5.9
UTI	27	4.7
AUR	11	1.9
Inguinal hematoma	12	1.9
Balanitis	4	0.7

AUR = acute urinary retention; PAE = prostate artery embolization; UTI = urinary tract infection.

of repeat embolization. Among the 58 repeated PAE procedures, 43 were performed after short-term, 12 after medium-term, and 3 after long-term failure. Patients should be informed that the outcomes of a second PAE may not be as successful as a single procedure.

After PAE, IIEF score improved in 21.9% of patients. This improvement may be due to the discontinuation of medication for BPH. Most of those medications, particularly 5-α reductase inhibitors, may affect sexual function. Although IPSS is a validated questionnaire, the reporting of symptoms is very subjective; therefore, patients fill out the questionnaire by themselves. The dropout rate in this study was low. The advantages of PAE with regard to outcome are that there is no retrograde ejaculation, no impotence, low morbidity, rapid improvement of symptoms, possible maintenance of fertility, and termination of BPH medication. The procedure is advantageous because it requires only local anesthesia, it can be performed as an outpatient procedure, and patients recover rapidly.

This study has some limitations. It is a single-center, nonrandomized study, and several patients were lost to follow-up either after a first or a second PAE. The number of patients treated varied with each type of embolic agent; because only a few patients were treated with some types, results with the different agents could not be compared. There was no control group of patients undergoing other BPH therapies for comparison. A randomized placebo-controlled study is required to confirm the therapeutic value of the procedure.

In conclusion, PAE in patients with BPH who have moderate-to-severe LUTS has a positive effect on all objective outcomes with low morbidity and without urinary incontinence or sexual dysfunction. Clinical success was 85.1% at short-term, 81.9% at medium-term, and 76.3% at long-term (up to 6.5 y) follow-up. PAE should be considered an excellent procedure for treating BPH. PAE can be used as a first-line therapy in patients with prostatic arteries suitable for the procedure.

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CME TEST QUESTIONS: AUGUST 2016

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The CME questions in this issue are derived from the article "Medium- and Long-Term Outcome of Prostate Artery Embolization for Patients with Benign Prostatic Hyperplasia: Results in 630 Patients" by Pisco et al.

In this study, the authors report the medium- and long-term outcomes after prostate artery embolization (PAE) for benign prostatic hyperplasia (BPH).

1. What was the most common indication for PAE in this study population?
   a. Acute urinary retention.
   b. Persistent symptoms despite medical therapy for 6 months.
   c. Patient preference.
   d. Persistent symptoms despite prior surgery.

2. In this study, what was the reported rate of technical success, defined as successful unilateral or bilateral selective catheterization and embolization of the prostatic artery(ies)?
   a. 35%
   b. 50%
   c. 75%
   d. >90%

3. In this study, approximately what fraction of the patients reported immediate improvement of lower urinary tract symptoms after PAE?
   a. None.
   b. One-quarter.
   c. One-third.
   d. One-half.

4. Which one of the following statements best represents the approximate cumulative rate of clinical success at the measured short-term and long-term intervals?
   a. 65% and 55%, respectively.
   b. 75% and 65%, respectively.
   c. 85% and 75%, respectively.
   d. 95% and 85%, respectively.

5. True OR False? In this cohort, clinical failures were identified early on, often within the first month after PAE, and were treated with additional embolization with some clinical benefit.
   a. True
   b. False