Prostatic Artery Embolization

Treatment for Patients with Symptomatic Benign Prostatic Hyperplasia
Prostatic Artery Embolization (PAE)

- Minimally invasive, non-surgical, outpatient treatment
- Embosphere® Microspheres (FDA-granted June 2017) are introduced into the arteries supplying blood to the prostate
- Decreases blood flow to and shrinks the prostate
- Embolization used since the 1970s to control bleeding post-biopsy, post-prostatectomy, and for refractory hematuria¹
Studies conclude that PAE is a safe and effective treatment for BPH patients who:

<table>
<thead>
<tr>
<th>are poor surgical candidates&lt;sup&gt;2-3&lt;/sup&gt;</th>
<th>suffer from hematuria&lt;sup&gt;6-7&lt;/sup&gt;</th>
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<tbody>
<tr>
<td>have urinary retention with IBC&lt;sup&gt;4-5&lt;/sup&gt;</td>
<td>have large prostate glands &lt;sup&gt;≥150 grams&lt;/sup&gt;&lt;sup&gt;8-10&lt;/sup&gt;</td>
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*See Appendix for article summaries and bibliography*
Clinical Evidence for PAE Candidates

- PAE is a safe and feasible procedure for the relief of LUTS related to BPH
- BPH patients with failed medical treatment, who are considered high-risk for surgical procedures and/or anesthesia can be treated safely and effectively through PAE\(^2-^3\)
- Patients with severe symptoms and acute urinary retention caused by BPH, including those patients with an indwelling bladder catheter, can be treated safely by PAE\(^4-^5\)
- PAE is safe and effective in the management of RHPO and may preclude the need for more invasive surgery\(^6-^7\)
- PAE can reduce large prostate volumes and can be an ideal first-line treatment for Giant Prostatic Hyperplasia (GPH)\(^8-^10\)
- Embosphere\(^\circ\) Microspheres for PAE are a safe and effective treatment for patients suffering from LUTS due to BPH\(^11\)

*See Appendix for article summaries and bibliography*
**Contraindications**

- Active UTI or prostatitis
- Prostate or bladder cancer
- Chronic renal failure
- Bladder atonia
- Neurogenic bladder
- Bladder stones
- Urinary obstruction due to causes other than BPH
- Excessive vessel tortuosity or severe atherosclerosis

*Embosphere PRO® Prostatic Artery Embolization Kit IFU*
Patient-focused studies published in more than 40 articles highlight the following benefits:

- Significant improvement in International Prostate Symptom Score (IPSS) and overall quality of life\(^\text{11}\)
- Improvement in urine flow rate (\(Q_{\text{max}}\))\(^\text{11}\)
- Reduction in prostate volume\(^4,\text{12}\) especially large prostates\(^8\)
- No reports of PAE related erectile dysfunction or retrograde ejaculation\(^\text{13}\)
- Low risk of urinary incontinence\(^\text{13}\)
Symptom Relief & Recovery

• Patients can be discharged same day
• Medication: Ibuprofen, Ciprofloxacin (antibiotics), Pyridium® (urinary analgesic), VESIcare® (bladder relaxant), Dulcolax® (laxative)
• Restrict activity for 2–3 days
• Relief of LUTS, which is sustained for one year following PAE4, 12
• One month post-procedure: patient discontinues all meds related to LUTS
• Patient may experience “post-embolization” syndrome, temporary painful or difficult urination, temporary urinary frequency
• Patients with hematuria: PAE can control bleeding within 24 hours6, 7
• Patients with IBC: first attempted removal performed at 15 days3, 5

ONE YEAR AFTER PAE: average prostate size reduced by 30%4, 12
Potential Complications*:

- “Post-PAE Syndrome” (AKA Post-Embolization Syndrome) can last two to three days following the procedure and can include nausea, vomiting, diarrhea, fever, pelvic pain
- Non-target embolization
- Skin burn
- Blood in urine, semen, or stool
- Bladder spasm
- Hematoma
- UTI
- Urinary retention
- Constipation

*Please refer to the Instructions for Use for a complete list of indications, contraindications, warnings, precautions, and directions for use.
Coordinated Patient Care

Labs and Imaging
- PSA, CBC, CMP, PT, and INR
- TRUS
- Urinalysis
- Urodynamic
- Uroflowmetry ($Q_{\text{max}}$)
- Post Void Residual (PVR)
- MRI with contrast
- Exclude malignancy—DRE, PSA, and biopsy

Baseline History of Patient is Considered to Measure Symptom Improvement
- International Prostate Symptom Score (IPSS) must be $\geq 12$ to be considered
- Sexual Health Inventory in Men (SHIM) score
- Age/Duration of symptom onset
- Current prostate medications
- Previous prostate surgery
- Self-catheterization
SUMMARY

PAE is ideal for patients who are poor surgical candidates or who are seeking a less-invasive prostate-reduction procedure

The treatment provides you and your patients with an additional safe and effective course of action when other options may be exhausted

Collaboration between urologists and interventional radiologists is important for optimum patient care
Clinical Evidence for Poor Surgical Candidates

**Purpose**
To evaluate the efficacy and safety of PAE in BPH patients who are at high risk for surgery and/or anesthesia.

**Methods**
BPH patients with LUTS refractory to BPH-related medical therapy or had an IBC due to refractory urine retention were prospectively enrolled in the study. All 22 patients were at high risk for surgery and/or anesthesia. Pre- and 1, 3, 9 months post-intervention, all patients assessed by detailed medical history, physical examination, serum prostate-specific antigen (PSA), uroflowmetry, and abdominal and transrectal ultrasonography.

**Results**
Twenty-two patients with mean age of 72.50 years and mean prostate volume of 77.30 ± 14.89 cm³ were included. The PAE procedure was successful in all patients. Throughout follow-up, there was a significant improvement in LUTS and urinary flow rate, and reduction in prostate volume and serum PSA (for all p < 0.001). No major complications reported.

**Conclusion**
Results show BPH patients with failed medical treatment who are at high risk for surgery and/or anesthesia could be treated safely and effectively through PAE.

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Purpose
To assess discontinuation of IBC and relief of LUTS due to BPH following PAE in poor surgical candidates.

Methods
Patients ineligible for surgical intervention offered PAE after ≥1 month of IBC for management of urinary retention secondary to BPH. All patients were affected by at least one significant comorbidity such as hypertension, congestive heart failure, renal disease or cancer. Patients followed for ≥6 months and evaluated for IPSS, QoL, prostate size and uroflowmetric parameters.

Results
Mean follow-up time was 13 months. Out of 41 patients embolized:
- Mean prostate size decreased from 75.6 ± 33.2 g to 63.0 ± 23.2 g (sign rank p = 0.0001)
- IBC removal achieved in 80.5% of patients
- Mean post-PAE IPSS was 9.8 ± 3.2 (range 5-16, sign rank p = 0.0001 compared to baseline)
- Mean IPSS reduction was 40.1 ± 25.9% (range -6.0 to 63.6%)
- Mean QoL was reduced to 1.2 ± 0.7 (range 0-4, sign rank p < 0.0001 compared to baseline)

Of the 20 patients who presented for uroflowmetry eval (others deemed ineligible due to continued IBC or poor clinical status), mean Qmax was 9.2 ± 2.5 mL/s (range 5.8-14.7) and mean PVR was 49.7 ± 51.8 mL (range 0-195).

Conclusion
Results show BPH patients with failed medical treatment who are at high risk for surgery and/or anesthesia could be treated safely and effectively through PAE.

**Purpose**
To show that PAE improves QoL and LUTS in patients with acute urinary retention caused by BPH.

**Methods**
This single-center prospective study included 11 patients with BPH managed with indwelling urinary catheters. IPSS, ultrasound, MRI, QoL, and urodynamic tests were used to assess outcomes. Prostate size ranged from 30 to 90 g, and embolizations were performed with 300–500μm Embosphere Microspheres.

**Results**
PAE technical and clinical success rates were 75% and 91%, respectively. Ten of 11 patients urinated spontaneously after Foley catheter removal 4-25 days after PAE. Post embolization syndrome manifested as mild pain in the perineum, retropubic area, and/or urethra, but no major complications were observed.

Follow up ranged from 19-48 months. After 1 year, mean prostate volume reduction was greater than 30%, symptoms were mild (mean IPSS, 2.8 ± 2.1; P = .04), no erectile dysfunction was observed, and QoL improved significantly (mean, 0.4 ± 0.5; P = .001).

**Conclusion**
Patients with severe symptoms and acute urinary retention caused by BPH can be treated safely by PAE, which improves clinical symptoms and QoL.

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Clinical Evidence for IBC Patients

**Purpose**
To evaluate efficacy and safety of PAE in urinary catheter-dependent patients with large prostate volumes and high comorbidity scores.

**Methods**
This retrospective single-center review included 30 patients (mean age, 73.1 y; range, 48-94 y) with urinary retention at time of PAE. Age-adjusted Charlson comorbidity index was 4.5 (0-10), duration of urinary retention was 63.4 days (2-224 d), IPSS-QoL was 5.3 (3-6), and prostate volume was 167.3 cm$^3$ (55-557 cm$^3$). These parameters were collected at 3, 6, and 12 months after PAE. Trials of voiding were performed approximately 2 weeks after PAE and, if failed, every 2 weeks thereafter.

**Results**
At a mean of 18.2 days (range, 1-72 d), 26 (86.7%) patients were no longer reliant on catheters. Follow-up was obtained in all patients eligible at 3 and 6 months and 17 of 20 (85.0%) patients eligible at 1 year:
- Mean (range) IPSS-QoL improved significantly to 1.2 (0-5), 0.7 (0-4), and 0.6 (0-4) at 3, 6, and 12 months (all P < .001).
- Mean (range) prostate volume decreased significantly to 115.9 cm$^3$ (27-248 cm$^3$) at 3 months (P < .001).
- Two patients experienced grade II urosepsis complications, which were successfully treated with intravenous antibiotics. All other complications were self-limited grade I complications.

**Conclusion**
PAE represents a safe and effective option for management of patients with urinary retention, especially patients with large prostates who are not ideal surgical candidates.

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Clinical Evidence for RHPO Patients

**Purpose**
To describe our experience with PAE as a minimally invasive alternative treatment option in patients with RHPO secondary to iatrogenic urologic trauma.

**Methods**
Three patients presented with RHPO. The etiologies were transurethral resection of prostate surgery, Foley catheter removal with a supratherapeutic international normalized ratio, and self-traumatic Foley catheter removal respectively. Stepwise management with conservative and medical methods failed to control bleeding. Bilateral PAE was performed using 300-500 um Embosphere Microspheres until stasis was achieved.

**Results**
Technical and clinical successes were achieved in all three patients. Hematuria resolved within a period of 24 hours. There were no intra- or periprocedural complications.

**Conclusion**
PAE offers a reasonable option in treatment of RHPO, regardless of the cause and may be attempted prior to surgical techniques or sometimes in conjunction.

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Clinical Evidence for RHPO Patients

**Purpose**
To describe the current management of RHPO and the technique of PAE and to review its efficacy and associated morbidity.

**Conclusion**
PAE has evolved as a safe and effective technique in the management of RHPO. Use of a superselective approach optimizes clinical success while minimizing complications. This minimally invasive approach improves patients with haemodynamic instability, serves as a bridge to elective surgery, and is a highly effective treatment for RHPO. It may obviate the need for more invasive and morbid surgical therapies.

Clinical Evidence for GPH Patients

**Purpose**
To present a case of giant prostatic hyperplasia (GPH) with acute urinary retention that was treated with PAE.

**Methods**
An 80-year-old man with a decade-long history of progressive LUTS presented with acute urinary retention. The patient had been taking tamsulosin for more than a decade and had stopped dutasteride treatment 1 year prior because of sexual side effects. PSA was elevated at the peak value of 116 ng/mL, IPSS was 26 (severely symptomatic), QoL score was 6 (terrible), and SHIM score was 13 (mild to moderate erectile dysfunction). MRI revealed an enlarged prostate with a volume of 571.2 cm³. Prior biopsies were negative for prostate cancer. The patient declined open prostatectomy. PAE was performed using 300–500 μm Embosphere Microspheres.

**Results**
There were no complications after the procedure. At the 10-day voiding trial, the patient was able to void with a moderate stream. Tamsulosin therapy was stopped. IPSS now measured 6 (mildly symptomatic), QoL score was 2 (mostly satisfied), and SHIM score was 17 (mild erectile dysfunction). At 3 months, prostate gland volume was approximately 270 cm³. The patient exhibited reduced LUTS. Postvoid residual was less than 50 mL. IPSS and QoL measured 4 and 1, respectively.

**Conclusion**
The minimally invasive nature of the procedure and avoidance of potential perioperative morbidity related to open surgery could make this procedure an ideal first-line treatment for GPH. There is no consensus on the upper limit of the weight of the prostate gland that can be managed with PAE. Further studies are needed to validate the role of PAE in the treatment of GPH.

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Clinical Evidence for Large Prostate Volume Patients

Purpose
To describe the safety and efficacy of PAE with spherical microparticles to treat LUTS associated with BPH in patients with prostate volume > 90 g.

Methods
This prospective, single-center, single-arm study involved 35 patients with prostate volumes ranging from 90-252 g. Mean patient age was 64.8 years (range, 53–77 y). MRI, uroflowmetry, and the IPSS were used to assess clinical and functional outcomes.

Results
Mean prostate size decreased significantly from 135.1 g before PAE to 91.9 g at 3 months of follow-up (P < .0001). Mean IPSS and QoL index improved from 18.3 to 2.7 and 4.8 to 0.9 (P < .0001 for both), respectively. A significant negative correlation was observed between PSA at 24 hours after PAE and IPSS 3 months after PAE (P = .0057).

Conclusion
PAE is a safe and effective treatment for LUTS secondary to BPH in patients with prostate volume > 90 g. Excessively elevated prostate-specific antigen within 24 hours of PAE is associated with lower symptom burden in short-term follow-up.

Clinical Evidence for Large Prostate Volume Patients

Purpose
To investigate clinical benefits and safety of PAE in patients with prostate volume ≥80 cm³ and Charlson comorbidity index (CCI) ≥2 and affected by benign prostatic obstruction (BPO).

Methods
PAE was performed in 88 consecutive patients affected by clinical BPO. Inclusion criteria were symptomatic BPO refractory to medical treatment, IPSS ≥12, total prostate volume (TPV) ≥80 cm³, Qmax <15 mL/s, and CCI ≥2. Primary end points were the reduction of 7 points of the IPSS and the increase of Qmax. Secondary end points were the reduction of TPV, postvoid residue (PVR), PSA, IIEF-5 score, and IPSS-QoL. Follow-up was addressed at 3 months, 6 months, and at 1 year.

Results
The mean IPSS (10.40 vs 23.98; P < .05) and the mean Qmax (16.89 vs 7.28; P < .05) at 1 year were significantly different with respect to baseline. We observed significant variation in terms of PVR (18.38 vs 75.25; P < .05), TPV (71.20 vs 129.31; P < .05), and PSA level (2.12 vs 3.67; P < .05) at 1 year compared with baseline. The mean IPSS-QoL significantly changed from baseline to 1 year after PAE (5.10 vs 2.20; P < .05). No minor or major complications were reported.

Conclusion
We showed clinical benefits of PAE for the treatment of LUTS and/or BPO by reducing IPSS, TPV, PSA, PVR, and improvement in urinary flow and QoL after 1 year in patients with prostate volume ≥80 cm³ and CCI ≥2.

Clinical Evidence for Embosphere® Microspheres—The BEST Trial\textsuperscript{11}

- Composite database of 286 patients from 12 clinical sites
- All suffering from LUTS due to BPH with an IPSS of MODERATE to SEVERE
- 12 months—Post PAE, 97% of patients dropped at least 1 symptom category
  - SEVERE to MODERATE
  - MODERATE to MILD
- 12 months—Post PAE, patients reported decrease in IPSS by at least 3 points
- Embosphere® FDA-granted in June 2017. Manufactured by Merit Medical®—Visit \texttt{merit.com/investors/press-releases}

\textbf{Note:} More data regarding the BEST Trial can be found in the product IFU.


Bibliography
A full PAE bibliography is available upon request


11. Data on File


Available Patient Tools

- Brochures
- Office Flip Chart
- FAQ Sheet

Ask4PAE.com