Prostatic artery embolization for symptomatic benign prostatic hyperplasia: results from a single-center prospective study

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Aims and objectives

Lower urinary tract symptoms (LUTS) are one of the most common complaints in elderly men, and are usually caused by the ongoing growth of prostate tissue with advancing age that leads to compression of the prostatic urethra. The bladder outlet obstruction secondary to benign prostate hyperplasia (BPH) can impede normal activities and even result in complications such as infections or acute urinary retention.

Management of mild symptoms might benefit from medical therapies such as α-adrenergic blockers or 5-α-reductase, but many patients experience worsening symptoms despite medical treatment. Prostate surgery is indicated in patients with medical refractory LUTS. Transurethral resection of the prostate (TURPS) is considered the gold standard for moderate prostate enlargement while open prostatectomy is the first-line surgical option for men with very large prostates (>80ml).

Both medical and surgical therapies have shown significant morbidity rates, especially in the elderly patients. Less invasive alternative options have been developed attempting to offer the same effect as former therapies but without the surgical risk.

Prostatic artery embolization (PAE) for BPH has been proposed as an effective and safe procedure in alleviating LUTS.

PAE is a minimally invasive procedure that improves LUTS and reduces complication rates in BPH mainly by shrinking the prostate volume. Its beneficial effect was firstly proposed by DeMerrit in 2000 after seeing that LUTS markedly improved in a man with hematuria treated with transcatheter embolization.

Ten years later, after some studies on animal models by several groups, Carnevale was the first one to report the successful use of PAE in two patients with BHP. For the last seven years, hundreds of cases have been reported, and two randomized clinical trials have compared the efficacy and safety of PAE to that of TURPS. Based on all this data PAE is a viable alternative to surgery in patients who are poor surgical candidates, or in those with enlarged prostates concerned with the complications of the surgical procedures.

The purpose of our study was to evaluate safety and procedural and clinical results of PAE, in a cohort of 16 consecutive patients with refractory LUTS secondary to BPH, with high surgical risk.
Methods and materials

Patient Selection:

This is a single-center prospective study. A total of 16 consecutive patients diagnosed with moderate-to-severe lower urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH) were included in the study. All of the participants were high-risk surgical patients, did not respond to medical treatment and all but one had an indwelling bladder catheter.

Preprocedural imaging:

All patients underwent pelvic CT angiography before PAE. The tests were performed with a 64-detector row CT (Aquilion, Toshiba) or a 8-detector row CT (Brightspeed, GE Medical Systems).

CT angiography protocol entailed the administration of 120mL of non-ionic iodinated contrast material (Vispaque, 320mg/ml iodine) at a rate of 4-5ml/s through a peripheral vein.

Postprocessing was performed at the workstation (Vitrea, Vital Images or Advanced Workstation, GE Healthcare) obtaining maximum intensity projections (MIP) and volume rendering images, showing the optimal obliquity of the prostatic arteries (PA).

Patient evaluation:

Patients were evaluated at least once before the procedure and between 6 and 12 months after intervention. Patient clinical evaluation included IPSS (International Prostate Symptom Score) and Quality of Life Questionnaire (QoL), physical examination, laboratory tests, uroflowmetry, and transrectal ultrasonography (TRUS).

Prostate volumes were measured with transrectal ultrasound, using the ellipsoid method formula, before and after the procedure.

Clinical success was defined by removal of the IBC and at least 7 point improvement of the IPP score after PAE.

Data analysis:
Statistical analysis was performed using SPSS version 23 statistical software package (IBM). Continuous variables were tested for normality and equality of variances with Kolmogorov-Smirnov’s test and the Levene’s Test, respectively. For comparisons of baseline and outcome variables the paired t test and Fisher’s exact test was used. Statistically significant differences were assumed at p<0.05.

PAE technique:

Catheter angiography was performed under local anesthesia through a percutaneous right femoral artery access.

Angiography of the anterior division of the internal iliac arteries was performed in ipsilateral anterior oblique projection, using the optimal obliquity determined in the CT angiography. Selective catheterization of the prostatic artery was then performed. Embolization was done with 100-300µm (and a combination with 300-500µm in some cases) polyvynil-alcohol based microspheres (Bead Bloc; BTG) until all the arterial branches that supply the prostate were completely occluded.

Technical success was defined by the embolization of all the angiographically visible arterial supply to the prostate.
**Fig. 1:** DSA. Oblique view with the 5F catheter on the main trunk of the left internal iliac artery. The solid arrows point to the inferior vesical artery (usually the main prostatic artery). The next step of the procedure will be the selective catheterization of the prostatic artery.

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Fig. 2: DSA. Oblique view. A) Arteriography performed with the tip of the microcatheter in the inferior vesical artery. The microcatheter is then progressed deeply into the ostium of the prostatic arteries and embolization is started. B) Arteriography performed after embolization.

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Fig. 3: DSA. Oblique view with the 5F catheter on the main trunk of the right internal iliac artery. The procedure is usually performed through a right femoral acces with a diagnostic catheter such as a vertebral or cobra-shaped. The left internal iliac artery is directly catheterized after crossing the aorta bifurcation. Upon finishing the embolization of the left prostatic arteries a Waltman loop is performed so the catheter can retrogradely catheterize the common right iliac artery.

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Fig. 4: DSA. Right side. Oblique view. A) Arteriography performed with the tip of the microcatheter in the right inferior vesical artery. The microcatheter is then progressed deeply into the ostium of the prostatic arteries and embolization is started. B) Arteriography performed after embolization.

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Fig. 5: CT volume render

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Results

The 16 patients met the inclusion criteria. The mean age was 79.37± 4.88 years. All patients were high-risk surgical candidates: five of them suffered from ischemic cardiomyopathy, two suffered from Alzheimer’s disease, one from Parkinson’s disease and six had chronic obstructive pulmonary disease. Five patients had refused blood transfusion based on religious beliefs and four were treated with oral anticoagulants.

The procedure was technically successful in 13 patients. PAE was stopped in one patient due to an episode of agitation and only unilateral embolization was performed. In the other two patients unilateral embolization was achieved, but due to severe atherosclerosis selective catheterization of the contralateral prostatic artery was not feasible. One of these patients showed an early clinical improvement after unilateral embolization so contralateral PAE was not performed. PAE was successfully repeated in the contralateral side in the other patient one month after the first procedure.

Clinical success (defined as a seven-point improvement in IPSS and removal of the indwelling bladder catheter (IBC) at the follow-up evaluation) was achieved in 15 patients. Bladder catheters were removed between 10 and 60 days after the procedure. Only one patient remained on urinary retention with IBC, despite successful bilateral embolization and mild prostatic volume reduction. We compared the baseline clinical parameters with those recorded at follow-up evaluation and found a statistically significant improvement in IPSS (mean reduction 18± 6.8, p<0.005), Quality of Life Questionnaire score (mean difference 3.5 points± 1.4, p<0.005) and prostate volume (mean reduction 33.20 ml ± 25.7, p<0.005).

There was only one important procedure-related complication. One patient complained of a small wound on the glans penis seven days after the procedure, with necrotic tissue appearing a few days later. Conservative management with antibiotics was decided and the wound had completely healed two weeks later. This patient had undergone a successful bilateral prostatic artery embolization. However the prostate volume was the greatest in our cohort (166cm3) and the penis wound was probably a consequence of non-target embolization as a result of reflux of microspheres with distal migration and occlusion of small arteries in the penis.

Preprocedural CT angiography role in the evaluation of the of the iliac artery and its branches is very important: knowledge of the anatomy of the pelvis arteries can be useful for avoiding complications such as non-target embolization of surrounding organs. Evaluation of the atherosclerotic changes in this region can help in selecting suitable candidates for PAE and planning the procedure. Volume render images were used to
find the optimal obliquity for visualizing the origin of the prostatic artery. Even though our study did not focus on radiation doses or fluoroscopy time, we found a significant reduction in the procedure duration when we used the obliquities at which those volume rendering images were obtained as guidance during PA catheterization.
Table 1: Baseline, Mean values and range of evaluated clinical parameters.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Baseline (mean± SD)</th>
<th>6-12 months (mean± SD)</th>
<th>Change</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPSS</td>
<td>25,75±3,99</td>
<td>7,36±5,584</td>
<td>18,12</td>
<td>&lt;0,005</td>
</tr>
<tr>
<td>QoL</td>
<td>5,13±0,61</td>
<td>1,50±1</td>
<td>3,6</td>
<td>&lt;0,005</td>
</tr>
<tr>
<td>Prostate Vol (cm³)</td>
<td>98,31±40</td>
<td>65±24</td>
<td>33,25</td>
<td>&lt;0,005</td>
</tr>
</tbody>
</table>

IPSS: International Prostate Symptom Score; QoL: quality of life score.
Conclusion

This single-center prospective study was conducted on high-risk patients refractory to medical therapy. 93.75% of the patients showed a symptomatic improvement and only one patient suffered a procedure-related complication. Although the size of our sample is limited, these results suggest that PAE is a safe and effective procedure in severely symptomatic, BPH patients who are high-risk surgical candidates.
References


