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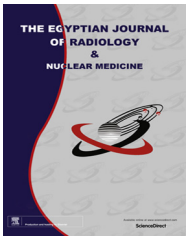

ORIGINAL ARTICLE

Role of prostatic artery embolization in management of symptomatic benign prostatic hyperplasia

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KEYWORDS

Prostatic artery;
Embolization;
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Abstract *Objectives:* To assess the feasibility and efficacy of prostatic artery embolization in relieving symptoms of benign prostatic hyperplasia.
Materials and methods: In a prospective study 28 patients with symptomatic benign prostatic hyperplasia were presented for prostatic artery embolization between June 2012 and June 2014. Patients age was 48–85 years with mean age 68.5 years ± 10.6 SD. International Prostate Symptoms Score (IPSS) before intervention measured 20–35 with mean score 26.3 ± 6.8 SD. Prostatic volume before intervention ranged between 48 and 166 cc^3 with mean of 82.6 ± 11.2 SD.
Results: Technical success was achieved in all cases (100%). All patients were followed for 6 months after the procedure. IPSS improved at 6 months in all patients with post embolization mean of 12.2 ± 3.4 SD with significant *P* value of 0.0006. Mean post-procedure prostatic volume at 6 months was 49.8 cc^3 ± 16.9 SD with 39.7% mean volume reduction. No major complications were recorded. We achieved clinical success in 27 patients (96.4%) with only one non responding patient (3.6%).
Conclusion: Prostatic artery embolization is a feasible technique and preliminary short-term results show promising high technical and clinical success rates in symptomatic patients with benign prostatic hyperplasia.

Abbreviations: IPSS, International Prostate Symptoms Score; BPH, benign prostatic hyperplasia; PSA, prostate specific antigen; PVR, post-void residual volume; PAE, postatic artery embolization; PVA, polyvinyl alcohol; TURP, transurethral resection of the prostate; QOL, quality of life score

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1. Introduction

The prevalence of benign prostatic hyperplasia (BPH) in men above 50 years old is high (1). BPH is presented with lower urinary tract symptoms mainly obstructive symptoms including; hesitancy, weak urinary stream, incomplete emptying, nocturia, frequency and urgency (2,3). Surgery is considered a problem solver in improving symptoms and hindering disease progression yet availability of effective pharmacotherapy made its use reserved for patients with resistant symptoms despite medical treatment (4). Surgical treatment by transurethral resection of the prostate (TURP) is by far the gold standard in BPH treatment. Age, grade of obstruction, baseline prostate volume, International Prostate Symptom Score (IPSS), peak urinary flow (Qmax), serum prostate specific antigen (PSA) value, and post-void residual (PVR) volume are important outcome predictors (5). Despite the efficacy of the surgical treatment, complications are common and include urinary tract infection, strictures, postoperative pain, incontinence or urinary retention, sexual dysfunction, and blood loss (6). This warranted looking for minimally invasive treatments to improve treatment strategy aiming for equivalent efficacy and avoiding surgery related complications (7).

It has been suggested that endovascular treatment of symptomatic BPH by prostatic artery embolization (PAE) may become a popular treatment option as uterine fibroid embolization (8). Preliminary studies of PAE have shown promising outcome (9). PAE is a challenging technique with reported technical failure in 2–3% of patients and around 15% of patients undergo unilateral embolization due to technical difficulties (8).

In PAE many embolic agents can be used as microspheres measuring 300–500 μm and polyvinyl alcohol particles measuring 150–250 μm (10).

In the current study we assess the feasibility of the technique of prostatic artery embolization and evaluate its efficacy in relieving symptoms of patients with symptomatic benign prostatic hyperplasia.

2. Materials and methods

This prospective study started in June 2012 and through 2 years till June 2014; 28 patients were presented to the interventional radiology unit in Ain Shams University, Cairo, Egypt, with symptomatic BPH. Their age ranged between 48 and 85 years with mean of 68.5 years ± 10.6 SD. Inclusion criteria were male patients with age >45 years with a diagnosis of BPH with significant lower urinary tract symptoms refractory to medical treatment for at least 6 months, developing adverse reactions from medical treatment, unfit for surgery or refusing surgery with IPSS score $\geqslant 20$, QOL score $\geqslant 3$, Qmax <12 ml/s, prostate volume >40 cc^3. Exclusion criteria were established diagnosis of cancer prostate, uncorrectable coagulation profile, renal insufficiency, active urinary tract infection and neurogenic bladder. 8 patients were presented with acute urinary retention with inserted bladder catheters.

Before the procedure all patients were subjected to questionnaire to measure the IPSS score and quality of life (QOL) score, uroflowmetry with Qmax measurement, PSA level (Free/Total), pelvic and transrectal US were done in all patients with measurement of prostatic volume and PVR.

Prostatic biopsy was performed in one case of suspected prostatic malignancy based on a suspicious focal lesion detected on transrectal US with elevated PSA; however, malignancy was excluded and PAE was performed 1 month later.

All patients were informed about the embolization technique and possible complications and all of them signed informative consent.

2.1. Definitions and outcome measures

The IPSS is a validated questionnaire which is used to assess the symptoms as regard type and severity and to evaluate the outcome after treatment. The questionnaire yields a total score ranging from 0 to 35 (1–7 for mild symptoms, 8–19 for moderate, and 20–35 for severe) (11,12).

QOL is another questionnaire by which symptom severity can be assessed by asking the patients how they feel about their current urinary symptoms yielding a score from 0 (delighted) to 6 (terrible). Objective measurement of uroflowmetry variables such as Qmax and PVR gives useful information on micturition, and the results can be used to assess severity of obstruction and predict the likelihood of disease progression and response to treatment (13). The normal Qmax in a young healthy adult male subject is approximately 25 ml/s, whereas the Qmax in a patient with BPH reflects a weaker stream as a result of urethral compression. When the Qmax measured by uroflowmetry is lower than 12 ml/s, generally it is indicative of BPH (11).

2.2. Technique

Procedure was performed on an outpatient basis. Two catheter laboratory machines were used in the study; Toshiba machine Infinix INFX-8000V and Toshiba machine Max 1000 P. Embolization procedure was performed as follows: under local anesthesia via right femoral artery puncture, a 6F vascular sheath (Cordis, Warren, New Jersey; USA), then a 5F Cobra head catheter (Cordis, Warren, New Jersey; USA) was introduced in right femoral artery to catheterize the left Internal Iliac artery then catheterizing its anterior division. Then an ipsilateral oblique view (30–40°) was obtained for differentiation of prostatic artery from other branches of anterior division & for identification of prostatic artery origin which is then selectively catheterized as distal as possible with a 2.7F coaxial microcatheter (Progreat; Terumo, Tokyo, Japan). For embolization, nonspherical 150–250 μm PVA (Contour TM, Boston Scientific; Natick, MA, USA) was used with slow injection under fluoroscopy guidance. The endpoint for embolization was stasis in the prostatic artery. Then a loop was formed by the Cobra catheter to catheterize the right internal iliac artery and the right prostatic artery was catheterized by the microcatheter with ipsilateral oblique view (30–40°) and embolized in the same way as the left side (Fig. 1). In 16 patients identification of prostatic blush was facilitated by an inserted UB catheter at the beginning of the procedure including 8 patients presented by previously inserted catheter due to urine retention with identification of the blush below the catheter inflated balloon, and in 12 patients we depended upon anatomical findings only without catheter insertion.

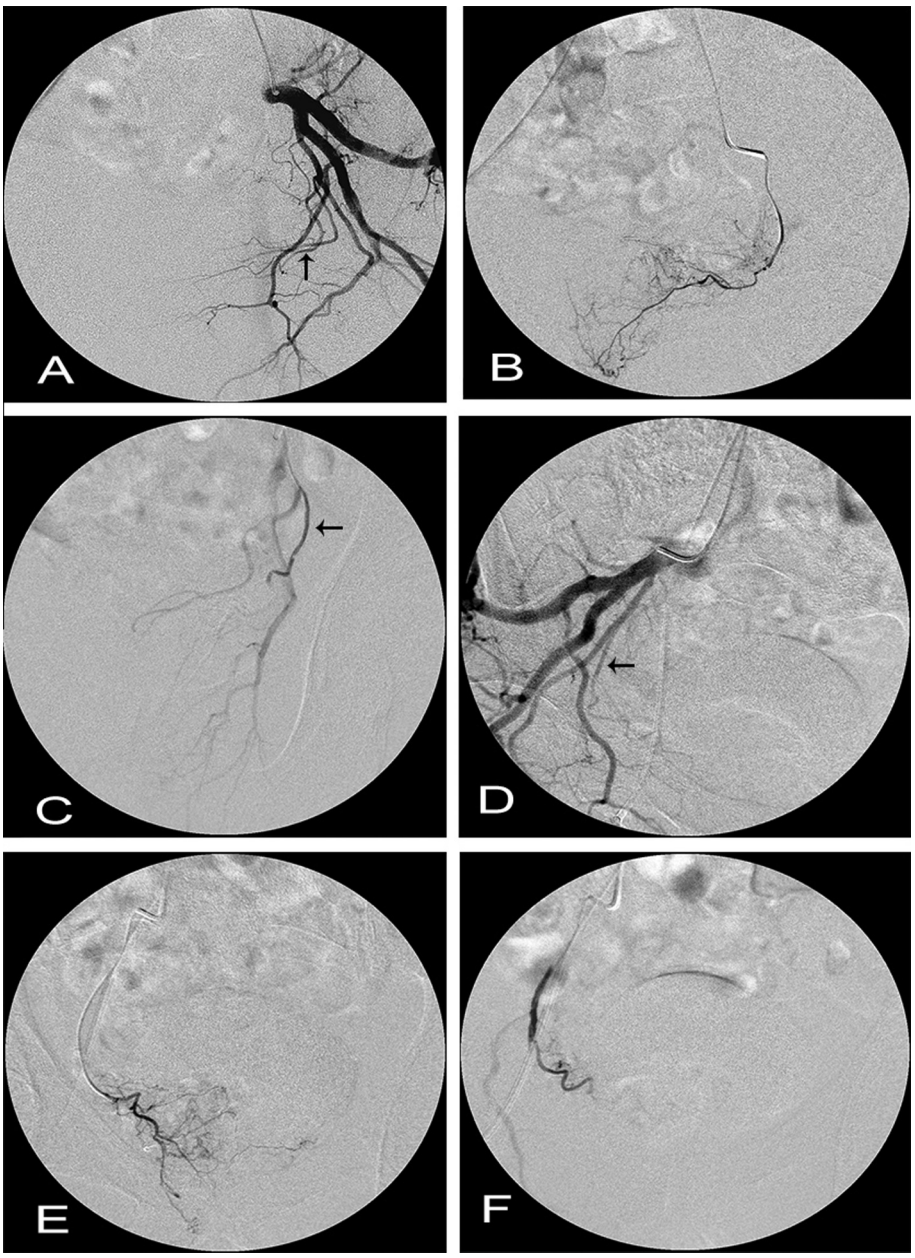

Fig. 1 Steps of prostatic artery embolization. (A) Tip of catheter seen at left internal iliac artery with left prostatic artery arising from pudendal artery (arrow). (B) Selective catheterization of left prostatic artery by microcatheter. (C) Control angiography after embolization of left prostatic artery (arrow). (D) Tip of catheter seen at right internal iliac artery with right prostatic artery arising from pudendal artery (arrow). (E) Selective catheterization of right prostatic artery by microcatheter. (F) Control angiography after embolization of right prostatic artery.

2.3. Follow-up

All patients were discharged the same day of the procedure on medical treatment for 1 week consisting of broad spectrum antibiotics to guard against infection with non steroidal anti-inflammatory drugs to get relief from pain following embolization, and patients were kept in direct contact with us through phone calls or clinic visits to evaluate clinical response and in case there is unusual complaint to assess the patient by US examination and rule out any complications.

6 months after embolization we measured prostatic volume by TRUS (Figs. 2 and 3) and we measured again PVR, IPSS, QOL and Qmax to assess response to treatment.

2.4. Statistical methodology

Analysis of data was done by IBM computer using SPSS (statistical program for social science version 12) as follows: description of quantitative variables as mean, SD and range and description of qualitative variables as number and

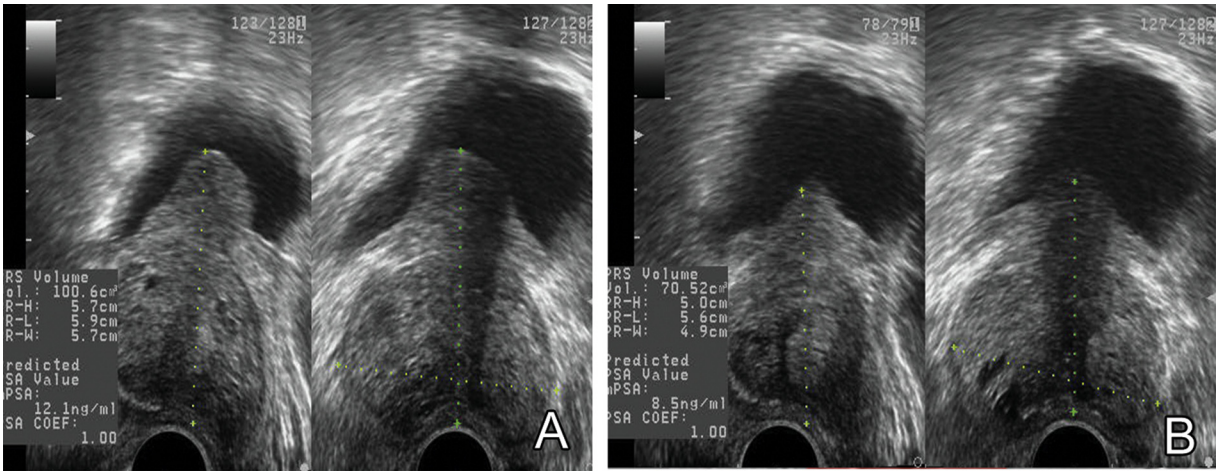

Fig. 2 Transrectal U/S. (A) Before embolization showing enlarged prostate with median lobe adenoma indenting urinary bladder base and total prostatic volume before embolization was 100.6 cc^3. (B) Six months after prostatic artery embolization with reduction of total prostatic volume to 70.5 cc^3.

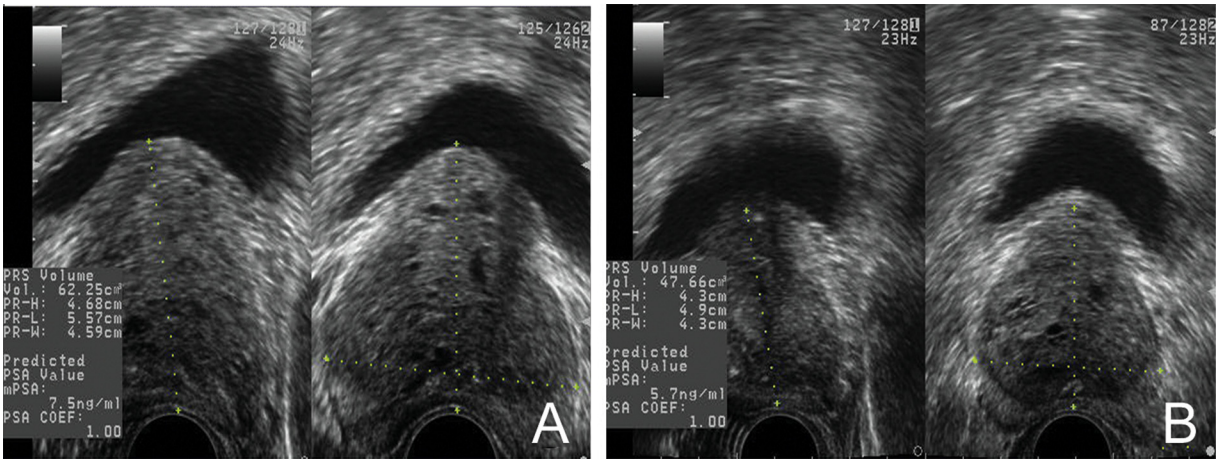

Fig. 3 Transrectal U/S. (A) Before embolization showing enlarged prostate with adenoma indenting urinary bladder base and total prostatic volume before embolization was 62.2 cc^3. (B) Six months after prostatic artery embolization with reduction of total prostatic volume to 47.6 cc^3.

percentage. P value >0.05 is considered as insignificant, $P < 0.05$ is significant and $P < 0.01$ is highly significant.

3. Results

Pre embolization data were as follows: international Prostate Symptom Score (IPSS) ranged from 20 to 35 with mean of 26.3 ± 6.8 SD. Quality of life score (QOL) ranged from 3 to 5 with mean of 4 ± 0.87 SD. Prostatic volume was measured by TRUS and ranged from 48 to 166 cc^3 with mean of 82.6 ± 11.2 SD. 8 patients were presented to us by a urinary catheter so post voiding residual (PVR) urine was measured at time of presentation in 20 patients of the 28 and was ranging from 45 to 160 ml with mean of 75.5 ml ± 43.26. Qmax ranged from 3.2 to 11.5 ml/s with mean of 9.2 ml/s ± 4.3 SD. PSA was measured in the 28 patients included in the study and was ranging from 3.1 to 16.1 with mean of 7.76 ± 4 SD.

Technical success was achieved in 28 patients (100%), bilateral embolization was done in 24 cases (85.7%) and unilateral prostatic artery embolization was done in 4 patients (14.3%) due to technical difficulty in catheterizing one of the prostatic arteries.

6 months after embolization, IPSS improved in all 28 patients and ranged from 9 to 18 with mean of 12.2 ± 3.4 SD with highly significant P value of 0.0006, and QOL ranged from 1 to 3 with mean of 1.35 ± 0.63 SD with highly significant P value of 0.0003 (Fig. 4). Prostatic volume ranged from 33 to 98 cc^3 with mean of 49.8 ± 16.9 SD with 39.7% mean volume reduction (Fig. 5), PVR ranged from 3 to 40 ml with mean of 12.5 ± 6.3 SD with significant P value of 0.00012, Qmax ranged from 13.4 to 20.7 ml/s with mean of 17 ± 2.5 SD with significant P value of 0.0009 (Fig. 6), and PSA ranged from 2.2 to 10.2 with mean of 5.1 ± 2.2 SD.

Clinical success was achieved in 27 patients (96.4%) with only one patient (3.6%) not responding due to associated

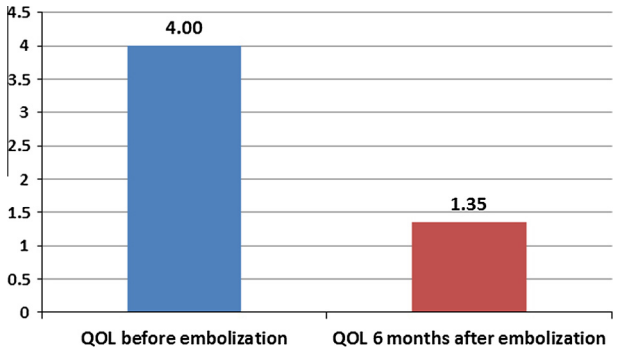

Fig. 4 Mean QOL score before embolization measuring 4 and 6 months after embolization measuring 1.35 with highly significant *P* value (0.0003).

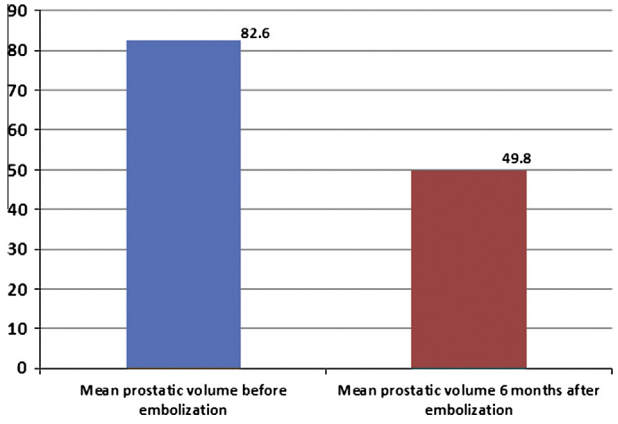

Fig. 5 Mean prostatic volume before and 6 months after embolization with reduction of mean volume form 82.6 cc^3 to 49.8 cc^3 with mean volume reduction of 39.7%.

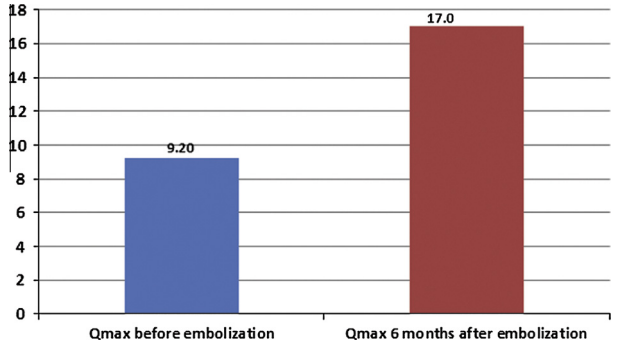

Fig. 6 Mean Qmax before embolization measuring 9.2 ml/s and 6 months after embolization measuring 17 ml/s with highly significant *P* value (0.0009).

chronic prostatitis. Patients started feeling clinical improvement within 6–14 days after embolization. All patients presented by acute urinary retention with inserted urinary catheter could void after catheter removal 7–14 days after embolization. No major complication occurred. Minor post procedure complication in the form of cystitis occurred in 1 patient (3.6%) who had uncontrolled diabetes mellitus, and it was diagnosed by urine culture and was successfully treated by medical treatment.

4. Discussion

For patients with symptomatic BPH medical treatment is considered the first line treatment option, with two main groups of medications; α-blockers and 5α-reductase inhibitors. Surgical therapy which is the gold standard treatment is considered when there is drug intolerance, when patients become refractory to medical treatment or when disease progression occurs while patients are on medical treatment (12).

However prostate weight should be less than 80 g to be treated by TURP; moreover, surgical treatment has many possible complications (14). So, recently prostatic artery embolization (PAE) has been introduced as a minimal invasive treatment modality that can be done as an outpatient procedure with low complication rate (15,16).

PAE shows many advantages compared to TURP as it is a well-tolerated minimally invasive procedure done by femoral artery puncture under local anesthesia with minimal pain (17).

In PAE there is no upper limit for the treated prostate volume, the procedure is done on outpatient basis and patient starts to feel improvement of symptoms after few days. Complications are usually mild with rare major complications (18).

The rationale of this technique is to do super selective catheterization and embolization of prostatic arteries which arise from anterior division of internal iliac arteries, usually one on each side and embolization results in shrinkage of the gland size as a result of subsequent ischemic necrosis leading to symptoms relief (19).

The first case report describing that there might be a therapeutic effect of PAE on BPH was published by De Meritt et al. (10). In this case, the IPSS decreased from 24 to 13 after 1 year, the prostatic volume was reduced by 40% at 12 months, and the PSA level decreased from 40 ng/ml to 4 ng/ml with 90% reduction. There was no sexual dysfunction after the treatment (10). Carnevale et al. reported the first intentional treatment of BPH with PAE (8) and midterm follow-up data was published in 2011 for two patients with acute urinary retention managed with indwelling urinary catheters, confirming the efficacy of the procedure (20).

Many papers then published all assuring feasibility of the technique and good response of patients with low percentage of complications. According to Pisco et al. technical success can exceed 95% of cases (17).

In the current study, we succeeded to achieve 100% technical success, in 24 cases (85.7%) by bilateral embolization and in 4 patients (14.3%) by unilateral prostatic artery embolization. However, we considered unilateral embolization a successful technique as reported by Pisco et al. who considered it of a technical success if at least one side could be embolized (unilateral PAE) (9).

According to Bilhim et al., good clinical outcomes and improvements in urodynamic data could be achieved even in patients who underwent unilateral PAE (21). In another study by Bilhim et al., they explained the clinical success in patients subjected to unilateral prostatic artery embolization by the anastomosis between prostatic arteries from both pelvic sides (22). Also, Wang et al., defined technical success as unilateral or bilateral PAE (23).

Carnevale et al., clarify that the aim of PAE is to achieve as much prostate ischemia as possible to avoid revascularization from the contralateral prostatic arteries or accessory arteries and subsequent later gland regrowth. For that reason, bilateral PAE should be performed if possible, and any additional prostatic branches should also be embolized for greater prostate shrinkage and better long-term clinical success (24).

According to Begla et al., bilateral embolization can be achieved in 74–95% of cases (25) and in current series we performed bilateral embolization in 24 out of 28 cases (85.7%).

In the current study we used non spherical 150–250 μm PVA particles as embolizing material. Bilhim et al., compared the use of 100 with the 200 μ PVA particles reporting no significant differences found in pain and adverse events between groups. Whereas PSA level and PV residual urine showed greater reductions after PAE with 100 μm PVA particles, clinical outcome was better with 200 μ particles (26). Carnevale et al., used larger size spherical particles and Tris-acryl microspheres (Embosphere microspheres; Biosphere) 300–500 μm in his study with no significant differences in results compared to our study or to other published studies using PVA particles (24).

In the current study, erectile dysfunction is not assessed; however, many patients reported improvement in their sexual ability. Pisco et al., assumed that the improvement of erectile function might be explained by the discontinuation of all prostatic medication after PAE, although these results were not statistically significant (9).

Concerning clinical success this current study achieved 96.4% clinical success which is nearly similar to Begla et al. in 2014 who achieved 94% clinical success in 20 patients series with significant similar improvement in IPSS, quality of life, Qmax, prostate volume reduction and PVR at 6 months. There were no minor or major complications (25).

In this study we treated 8 patients presented with acute urinary retention with inserted urinary catheter and all of them could void after catheter removal 7–14 days after embolization. Carnevale et al., in 2012 achieved nearly similar results when they treated 11 patients with acute urinary retention and catheter removal with ability to void was achieved in 10 of these 11 patients (91%) (27).

Concerning complications of PAE, they are usually mild with rare major complications according to Justin et al., in 2014 (18). Only one major complication was recorded till now in the form of small bladder wall ischemic area treated by partial resection (9). In the current study, there are no major complications occurred, only one minor complication in the form of cystitis occurred in 1 patient (3.6%) who had uncontrolled diabetes mellitus, and it was diagnosed by urine culture and was successfully treated by medical treatment.

From our point of view, the limitations of this study are the lack of control group as well as lack of comparison between PAE and TURP which is the gold standard treatment of BPH, so further studies comparing both treatment modalities are recommended.

5. Conclusion

Prostatic artery embolization is a feasible technique and preliminary short-term results show promising high technical and clinical success rates in symptomatic patients with benign prostatic hyperplasia.

Conflict of interest

The authors declared that there is no conflict of interest.

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