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EFFICACY OF UNILATERAL PROSTATIC ARTERY EMBOLIZATION IN TREATMENT OF BENIGN PROSTATIC HYPERPLASIA

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Abstract

Background: Prostatic artery embolization is a minimally invasive, image guided therapy, that has been shown to be safe and effective in symptomatic relief of LUTS associated with BPH with minimal post procedural complications. It is a safer choice as compared to the usual surgical procedures used in this case with comparable results. Technical success is considered when selective prostatic arterial catheterization and embolization is achieved on at least one pelvic side. Sometimes cases can only undergo unilateral prostatic artery embolization due to marked tortuosity or atherosclerotic changes preventing bilateral prostatic artery catheterization. The aim of this study is to evaluate efficacy of unilateral prostatic artery embolization in management of benign prostatic hyperplasia presented with clinically significant lower urinary tract symptoms. In our study unilateral prostatic artery embolization was performed on 7 patients with benign prostatic hyperplasia patients, (mean age of 67.7 years (range 58 - 80 years). The mean prostatic volume measured was 80.29 ml (range 52-122 ml). The mean score of lower urinary tract symptoms were IPSS = 21.67 and QOL = 4.86 (with range of IPSS 18-29 and QOL 4-6). One of them complained of urinary retention and had and an indwelling catheter 4 months before procedure. The mean prostatic volume measured was 80.29 ml (range 52-122 ml). The mean score of lower urinary tract symptoms were IPSS = 21.67 and QOL = 4.86 (with range of IPSS 18-29 and QOL 4-6).

Results: There are statistically significant differences (P values < 0.05) between (Prostate volume, post-voiding urine volume, International prostate symptom score and quality of life) before and after 6 months of Prostatic artery embolization.

Conclusion: Prostatic artery embolization is a safe and effective procedure in management of benign prostatic hyperplasia with satisfactory results even in unilateral prostatic artery embolization due to marked atherosclerosis or vessel tortuosity.

Keywords:

Benign prostatic hyperplasia, Lower urinary tract symptoms, Interventional radiology, Unilateral prostatic artery embolization.

Introduction

Benign prostatic hyperplasia (BPH) is one of the most common diseases in aging men, and its incidence increases with age reaching 8% in the 4th decade of life and up to 90% in 9th decade. The term BPH is given to the increase in in prostatic gland size owing to proliferation of glandular and stromal elements in transitional zone of the prostate while the potential symptoms produced by BPH are termed lower urinary tract symptoms (LUTS).[1]

Transurethral resection of the prostate (TURP) is considered the surgical gold standard after failure of medical treatment (refractory or intolerance), yet is associated with high morbidity and can be complicated by hematuria, urethral stricture, urinary retention, and urinary tract infections. [2]

Prostatic artery embolization (PAE) is a minimally invasive, image guided therapy, that has been shown to be safe and effective in symptomatic relief of LUTS associated with BPH with minimal post procedural complications. [3]

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PAE is a challenging procedure which requires both anatomical knowledge and adequate skills to correctly identify the anatomical pattern of the prostatic arteries which is related to the technical success of PAE and helps to reduce radiation exposure and non-target embolization, this is due to variable degrees of atherosclerosis usually encountered in this age group. [4]

Unilateral embolization sometimes occurs due to significant vascular atherosclerotic lesions with or without marked tortuosity of the iliac and prostatic arteries or due to angled origin of prostatic arteries from superior vesical artery and their tortuous course or in some cases due to arterial thrombosis. [5]

Some patients have major anastomotic channels between both prostatic halves which can be exploited to help embolize the whole gland using a unilateral approach, which is invaluable for patients with marked atherosclerosis or tortuous vascular anatomy hindering bilateral embolization. [6]

Subjects and Methods

In this prospective interventional study that started in August 2019 till July 2021; Seven patients were treated by unilateral prostatic artery embolization in Ain shams university specialized hospital as well as few hospitals in Cairo, Egypt.

Inclusion criteria were male patient 40 years old or more treated by unilateral prostatic artery embolization due to technical difficulties in catherization of the other side (marked atherosclerosis or tortuosity of the vessels) with a diagnosis of BPH with moderate to severe LUTS refractory to medical treatment for at least 6 months, unfit for surgery or refusing surgery with international prostate symptom score (IPSS)>18, quality of life score (QOL) >3, prostate volume >30 cc^3.

Exclusion criteria were prostatic malignancy, large urinary bladder diverticulae, active urinary tract infection or unregulated coagulation parameters.

No preprocedural computed tomography angiography (CTA) was done in any of the cases due to fund limitation. 3 patients only out of the 7 cases underwent intraprocedural cone beam computed tomography (CBCT) due to technical difficulties.

Ethical considerations

Informed consents were obtained from all patients before inclusion in the study. The Study was conducted according to the guidelines and stipulations of Ain Shams University ethical and scientific committee.

Procedure

Seven procedures were done via right femoral artery access under local anesthesia. The catheter was advanced to the left internal iliac artery and then its anterior division using a 5F Cobra head catheter (Tempo, Cordis) mounted over a 0.035" hydrophilic guidewire (Radiofocus, Terumo). Digital subtraction angiography (DSA) was done in left anterior oblique projection (35^o degrees) with caudal-cranial angulation (10^o degrees). This is done to accurately assess and visualize the anatomy and origin of prostatic arteries. Selective prostatic artery catheterization was achieved by using microcatheter (Progreat 2.7, Terumo) and micro guidewire (Progreat 2.7, Terumo). Manual angiography was done in frontal and same-side anterior oblique projection (35^o degrees) with caudal-cranial angulation (10^o degrees). This is done to confirm the position of catheter tip at the prostatic artery ostium, visualize the prostatic gland vascularity and to exclude any significant anastomotic channels to avoid non target embolization. Distal navigation of the microcatheter was done to bypass any anastomotic channels to avoid non-target embolization.

Embolization was done by using Embosphere (300–500 mm; Merit Medical) till near stasis then the microcatheter was advanced more distally into the prostatic artery then followed by more embolizing agent delivery. This was done in accordance with the PErFecTED technique (Proximal Embolization First, Then Embolize Distal technique) which helps to produce more prostatic tissue ischemia and infarction with better clinical improvement of lower urinary tract symptoms and lower recurrence rates (the PErFecTED technique was done in all 7 cases). Embolization was performed slowly using a 3-mL syringe, afterwards, postembolization angiography was obtained.

The same procedure was done for the right side after forming a Waltman loop to select the right iliac artery and then followed by same procedural details. Every attempt was done in these patients to catheterize both prostatic arteries yet only one side was catheterized due to marked atherosclerosis or marked tortuosity of the vessels.

After sheath removal, manual compression is applied to the puncture site for 10-15 minutes to achieve hemostasis followed by immobilization in supine position for 6 hours.

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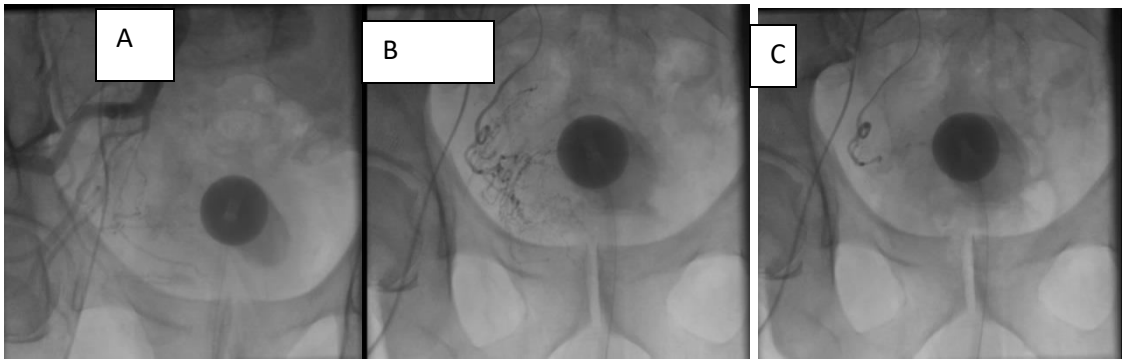

Figure (I): A) Digital subtraction angiography of the anterior division of the Right internal iliac artery (IIA) revealing common origin of the prostatic artery and superior vesical artery (Type I). B) Selective catheterization of the right prostatic artery in AP view revealing the prostatic tissue vascularity. C)Postembolization.

Figure (II): A) Digital subtraction angiography of the anterior division of the right IIA revealing independent origin the prostatic artery below superior vesical artery (Type II). B) Selective catheterization of the right prostatic artery in AP view revealing the prostatic tissue vascularity. C)Postembolization.

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Results

Unilateral prostatic artery embolization was performed on 7 patients with benign prostatic hyperplasia, with mean age of 67.7 years (range 58 - 80 years).

The mean prostatic volume measured was 80.29 ml (range 52-122 ml). The mean score of lower urinary tract symptoms were IPSS = 21.67 and QOL = 4.86 (with range of IPSS 18-29 and QOL 4-6). One patient had urinary retention and was catheterized for 4 months before procedure. (Table I).

All patients received medical treatment before the procedure for at least 6 months with little to no response.

Technical success is considered in PAE procedures when selective prostatic arterial catheterization and embolization is achieved on at least one pelvic side. All 7 cases underwent unilateral PAE due to marked tortuosity or atherosclerotic changes preventing bilateral prostatic artery catherization. Technical success rate was 100%.

The anatomical variants concerning the origin of prostatic artery that were encountered in this study are 3 prostatic arteries originated from a common origin along with superior vesical artery (type I), 2 arteries originated from the anterior division of internal iliac artery below the superior vesical artery (type II), one artery originated from obturator artery (type III) and the last one originated from the posterior division of internal iliac artery (Type V).

All procedures were done on outpatient basis, patients were kept in supine position for 6 hours after achieving hemostasis and were discharged on the same day of the PAE procedure. They were prescribed prophylactic antibiotics to guard against prostatitis and urinary tract infections, analgesics, antacids, and anti-inflammatory medications. Patients were advised to continue their medical treatment for another two weeks then were asked to stop gradually, in patients with more than one drug, the drugs are to be stopped one by one. Concerning the patient with indwelling catheter, trial of removal of catheter was only successful after 6 weeks from procedure.

There were minor adverse events for two patients; one complained of small subcutaneous tissue hematoma at puncture site which was managed conservatively by hot fomentations, anti-edematous medication, and follow-up, the other one complained of prostatitis and was managed by prolonged course of antibiotics and anti-inflammatory drugs for 2 weeks. There were no major adverse effects encountered in our study population.

The radiation exposure was measured in all 7 patients, with the mean total dose-area product (DAP) measured was 305 Gy.cm2 per procedure (range, 140–622 Gy.cm^2) given in consideration that 4 of the cases weren't exposed to the cone beam computed tomography (CBCT) due to technical limitations.

The mean procedural time was 105 minutes (starting from femoral puncture and ending with sheath removal) with a range of 70 – 135 minutes.

Follow up was done after 1, 3, 6 months by measuring prostatic volume and post voiding residual urine using ultrasound along with IPSS and QOL scores (Table I).

Statistical Data

Statistical analyses were calculated using SPSS version 28 (IBM© Corp., Armonk, NY). Quantitative data are expressed as mean, standard deviation, minimum and maximum values. Paired samples T test was used to compare continuous variables of the patients pre and 6 months post intervention including (Prostate volume, Post voiding urine volume, IPSS, QOL). P values < 0.05 were considered statistically significant.

There are significant statistical differences between Prostate volume, Post voiding urine volume, IPSS, QOL, before and 6 months after the procedure. (Table II)

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Table (I): List of Patient's variables pre and post intervention and their means and standard deviations.

	Minimum	Maximum	Mean	Std. Deviation
Age	58	80	67.71	8.036
Prostatic volume (preintervention)	52	122	80.29	26.037
Post voiding residual volume (preintervention)	47	180	91.83	55.452
IPSS (preintervention)	18	29	21.67	4.082
QOL (preintervention)	4	6	4.86	.900
Prostatic volume (1 month post intervention)	48	101	71.29	21.461
Post voiding residual volume (1 month post intervention)	44	176	83.33	54.804
IPSS (1 month post intervention)	13	23	17.67	3.266
QOL (1 month post intervention)	3	5	4.00	.816
Prostatic volume (3 months post intervention)	46	95	65.14	20.301
Post voiding residual volume (3 months post intervention)	40	160	76.00	45.822
IPSS (3 months post intervention)	13	19	15.14	1.952
QOL (3 months post intervention)	2	4	2.86	.690
Prostatic volume (6 months post intervention)	38	90	58.71	20.597
Post voiding residual volume (6 months post intervention)	33	140	64.43	41.226
IPSS (6 months post intervention)	9	15	12.57	2.070
QOL (6 months post intervention)	2	3	2.43	.535

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Table (II): Paired samples test between Prostatic volume, post voiding residual volume, IPSS and QOL both before and 6 months after intervention.

Paired Samples Test										
Paired Differences									Significance	
					95% Confidence Interval of the Difference					
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	One-Sided p	Two-Sided p
Pair 1	Prostatic Volume (preintervention) - Prostatic Volume (6 months post intervention)	21.6	9.658	3.651	12.639	30.504	5.909	6	<.001	.001
Pair 2	Post Voiding Residual Volume (preintervention) - Post Voiding Residual Volume (6 months post intervention)	28.3	15.501	6.328	12.067	44.600	4.477	5	.003	.007
Pair 3	IPSS (preintervention) - IPSS (6 months post intervention)	8.83	2.994	1.222	5.691	11.976	7.226	5	<.001	<.001
Pair 4	QOL (preintervention) - QOL (6 months post intervention)	2.43	1.134	.429	1.380	3.477	5.667	6	<.001	.001

Discussion

In our study unilateral prostatic artery embolization of 7 patients resulted in average prostatic volume reduction of 26.87% with improved international prostate symptom score and quality of life score by a mean of 9.1 points and 2.43 points respectively. One patient had an indwelling catheter for 4 months before procedure and was successfully removed after 6 weeks from procedure. The other 6 patients didn't need to insert a urinary catheter during the procedure (to help identify prostatic artery as it was done without the need for the catheter balloon as reference for the prostate size) or following the procedure (none of the patients needed catherization during the post embolization prostatic edema phase). Also, none of the cases underwent preoperative CT angiography due to funds limitations, with a technical success 100% suggesting that preoperative CTA is not mandatory, and that PAE is possible without it.

In 2008 **Carnevale et al (2010)** performed the first minimally invasive prostatic artery embolization procedure with the intention to treat lower urinary tract symptoms resulting from benign prostatic hyperplasia. The Society of Interventional Radiology (SIR) published in 2014 an initial statement on using prostatic artery embolization procedure for the treatment of benign prostatic hyperplasia, with the conclusion that PAE is a safe and effective procedure for treating BPH and recommending further clinical investigation. [8]

A randomized controlled trial was done by **Abt D et al. (2018)** compared 48 patients who underwent prostatic artery embolization and 51 patients who underwent transurethral resection of the prostate. Post procedural follow-up after 3 months for the IPSS score was not statistically significant between the two groups (-9.2 points after PAE and -10.8 points after TURP). TURP was associated with twice as many treatment related adverse effects as PAE. Blood loss, duration of hospitalization and bladder catheterization time were lower for PAE than TURP.

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In a study between 103 patients who underwent bilateral PAE and 19 who underwent unilateral PAE there was no statistically significant difference in most of the evaluated parameters after PAE between the two groups with better clinical outcome in patients bilateral PAE, however after adjustment for age it didn't reach statistical significance. [5]

The routine use of preprocedural computed tomography Angiography and intraprocedural cone beam computed tomography didn't regularly reduce procedure time, fluoroscopy time, received radiation dose or increase the rate of bilateral prostatic artery embolization with no statistically significant comparative data for the benefit of using CBCT on the previously mentioned parameters. [4]

Limitations

One of the major limitations in this study is limited number of cases along with lack of long term follow up data (>1 year), this was hindered by the COVID 19 global outbreak which severely limited the number of non-emergency procedures.

Baseline and 1-month IPSS and post voiding residual urine could not be assessed for 1 patient with indwelling catheter.

There were procedures (4 patients) that were carried out without cone-beam CT due to technical problems of the machine or unavailability in some hospitals. The lack of preoperative CTA in all cases may have made the procedures more difficult with longer procedural time, yet technical success was obtained in all cases with average mean procedural time.

Conclusion

Prostatic artery embolization is a safe and effective procedure in management of benign prostatic hyperplasia with satisfactory results even in unilateral prostatic artery embolization due to marked atherosclerosis or vessel tortuosity.

List of abbreviations

Benign prostatic hyperplasia (BPH), Lower urinary tract symptoms (LUTs), Prostatic artery embolization (PAE), International prostate system score (IPSS), Quality of Life (QOL). Computed tomography Angiography (CTA), Cone beam computed tomography (CBCT), Transurethral resection of the prostate (TURP).

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