



Selective arterial prostatic embolization (SAPE): for the treatment of lower urinary tract symptoms in the setting of benign prostatic hyperplasia: a brief review

Benign prostatic hyperplasia (BPH) is a common condition related to aging that can lead to a cluster of chronic symptoms collectively known as lower urinary tract symptoms (LUTS), including urinary frequency, urinary urgency, nocturia, hematuria, and decreased urinary stream. It is estimated that BPH affects 75% of men in the United States by age 70, with more than \$1 billion US dollars a year spent in direct health care expenditures related to BPH, exclusive of outpatient medications [1]. Treatment options for BPH are outlined out by the American Urologic Association Clinical Guidelines and include watchful waiting, medical therapy, minimally invasive therapies (including transurethral ablations), or surgical therapies including open prostatectomy or transurethral resection of the prostate (TURP) [2]. Medical therapy is often considered the first-line option for symptomatic patients; however, a large subset of patients does not respond to or cannot tolerate pharmacotherapy, in part owing to a number of side effects including sexual dysfunction [3]. TURP has remained the 'gold standard' surgical treatment for BPH for over half a century, owing to its high success rate in reducing LUTS. Over the past two decades, the TURP procedure has undergone significant technical improvements, with morbidity rates reported to be <1% [4]. However, with a general shift towards minimally invasive treatment options, the number of TURPs performed has fallen in more recent years [5]. Manuscript Click here to download Manuscript SAPE final (1).docx Embolization of the prostatic arteries has been used for many years as a technique to control severe bladder and prostate hemorrhage as well as hematuria following TURP [6-9]. A case report by DeMeritt *et al* in 2000 described a patient with BPH and refractory hematuria treated by prostatic artery embolization, who subsequently had alleviation in his LUTS and reduction in the volume of his prostate [10].

This case report introduced the idea that BPH could intentionally be treated by selective arterial prostatic embolization (SAPE). In 2008, Carnevale *et al* used SAPE as the primary treatment in two patients with BPH [11]. After 6-month follow-up, MRI demonstrated a relative prostate reduction of 47.8% in the patient who had undergone bilateral SAPE and 27.8% in the patient who had undergone unilateral SAPE. Since this initial study, there has been an enthusiastic response in the literature regarding the future role of this technique, and the Society of Interventional Radiology has encouraged further research into this intervention [12]. A growing body of literature suggests that SAPE enables reduction in prostate volume with improvements in uroflowmetry parameters, quality of life, and sexual function [13]. The largest prospective non-randomized series published to date looked at 255 patients who underwent SAPE [14]. The authors describe technical success in 250 of the patients (98%), with a clinical success rate of 82% at one month decreasing to 72% at 3 years. In the only RCT to date assessing SAPE, 57 patients were assigned to prostatic artery embolization and 57 were assigned to TURP for the treatment of BPH [15]. The authors demonstrated that all parameters: including improvement of the International Prostate Symptom Score (IPSS), quality of life (QOL), peak urinary flow, and post void residual (PVR) urine volume were improved by both treatment modalities and there was no difference at two years between the treatment arms. The paper does state there was a higher complication rate for PAE, if one controls for acute urinary retention post operatively, there would be similar complication rates for both groups. The technique for SAPE involves unilateral access of the femoral artery and subsequent catheterization of the anterior division of the internal iliac artery. Digital subtraction

Cash J Horn, Aaron M Fischman, Rahul S Patel, David N Siegel & Ardeshir Rastinehad*

Icahn School of Medicine at Mount Sinai, New York, USA

Department of Radiology, Icahn School of Medicine at Mount Sinai, New York, USA

*Author for correspondence:

Tel.: 212-241-9955

nycurology@gmail.com

angiography is used to confirm arterial anatomy and allow for superselective catheterization of the prostatic artery. A number of different embolic materials have been used, including polyvinyl alcohol particles, trisacryl gelatin microspheres, and Embozene microspheres (CeloNova BioSciences, San Antonio, TX, USA), with total stasis as the desired endpoint. Embolization is then performed on the contralateral side using the same technique [16]. Imaging follow-up after SAPE can be performed with US or MRI to document reduction in size of the prostate. Volume reduction is most evident during the first few months following the procedure. Clinical follow-up requires a PVR, uroflow and an IPSS questionnaire at regular intervals.

Compared with traditional surgical therapies for BPH, SAPE offers the advantage of being minimally invasive and does not result in the same incidence of erectile and/or ejaculatory dysfunction, requiring only conscious sedation on an outpatient basis. It has a high success rate and a low rate of complications. The most common complications have included perineal pain, nausea, and vomiting. Hematuria, urinary tract infections, and hematospermia have been described as self-limiting adverse events within the first month after the procedure [13,14]. A number of physicians have raised concern that SAPE still requires further investigation before being embraced as an appropriate treatment option for LUTS related to BPH. Importantly, LUTS is often caused by a multitude of factors in addition to BPH (including overactive bladder), and SAPE would unlikely address

these other etiologies. Additionally, PAE can be a technically challenging procedure owing to complex anatomy, and non-target embolization is a theoretical risk that could lead to significant complications. Finally, there is concern that much of the literature looking at SAPE has relied on imaging based reduction in prostate volume rather than clinical improvements in LUTS [17], and that many of the early studies failed to account for the possible placebo effect of embolization. SAPE has demonstrated promising early results as a feasible treatment option for LUTS related to BPH. Some authors have referred to the procedure as prostate artery embolization (PAE) using a similar nomenclature as with uterine artery embolization (UAE). However, the technical expertise required for the procedure is significantly greater, therefore we choose to refer to the procedure as a SAPE to set it apart from UAE [9]. Short-term data has shown a good safety profile with clinical improvement in LUTS assessed by IPSS, QoL, and urodynamic data. The general consensus among experts in the field is that the role of SAPE in the treatment algorithm for BPH will require a prospective, randomized study to determine the safety and effectiveness of PAE as well as to confirm long-term outcomes [18]. The need for long-term data is essential to further research in the field, as short-term relief of symptoms is suboptimal in the treatment of BPH given that the symptoms related to BPH are a lifelong problem [19]. A large-scale trial would also allow better characterization of appropriate patient selection for SAPE, particularly with regards to both prostate size and arterial anatomy.

REFERENCES

- Wei JT, Calhoun E, Jacobsen SJ. Urologic diseases in America project: benign prostatic hyperplasia. *J Urol.* 173, 1256-1261 (2005).
- KT McVary, CG Roehrborn, AL Avins *et al.* Update on AUA guideline on the management of benign prostatic hyperplasia. *Wei. J. Urol.* 185, 1793-1803. *J. Urol.* 187: 358-359 (2012).
- McVary KT, Roehrborn CG, Avins AL *et al.* Update on AUA guideline on the management of benign prostatic hyperplasia. *J. Urol.* 185, 1793-1803 (2011).
- Rassweiler J, Teber D, Kuntz R *et al.* Complications of transurethral resection of the prostate (TURP)--incidence, management, and prevention. *Eur. Urol.* 50, 969-979 (2006).
- Wagner TH. (2009) Re: Practice patterns in benign prostatic hyperplasia surgical therapy: the dramatic increase in minimally invasive technologies. *J Urol* 181: 2829-2830.
- Yu X, Elliott SP, Wilt TJ *et al.* Practice patterns in benign prostatic hyperplasia surgical therapy: the dramatic increase in minimally invasive technologies. *J. Urol.* 180, 241-245 (2008).
- Russinovich NA, Stauffer AE, Griggs P *et al.* Transcatheter gelfoam embolization in intractable prostatic bleeding. *Urol. Radiol.* 1, 179-181 (1979).
- Appleton DS, Sibley GN, Doyle PT. Internal iliac artery embolisation for the control of severe bladder and prostate haemorrhage. *Br. J. Urol.* 61, 45-47 (1988).
- Michel F, Dubruille T, Cercueil JP *et al.* (2002) Arterial embolization for massive hematuria following transurethral prostatectomy. *J. Urol.* 168, 2550-2551.
- Rastinehad AR, Caplin DM, Ost MC *et al.* Selective arterial prostatic embolization (SAPE) for refractory hematuria of prostatic origin. *Urology.* 71, 181-184 (2008).
- DeMerit JS, Elmasri FF, Esposito MP *et al.* Relief of benign prostatic hyperplasia-related bladder outlet obstruction after transarterial polyvinyl alcohol prostate embolization. *J. Vasc. Interv. Radiol.* 11, 767-770 (2000).
- Carnevale FC, Antunes AA, da Motta Leal Filho JM *et al.* Prostatic artery embolization as a primary treatment for benign prostatic hyperplasia: preliminary results in two patients. *Cardiovasc. Intervent. Radiol.* 33, 355-361 (2010).
- McWilliams JP, Kuo MD, Rose SC, *et al.* Society of Interventional Radiology position statement: prostate artery embolization for treatment of benign disease of the prostate. *J. Vasc. Interv. Radiol.* 25, 1349-1351 (2014).
- Jones P, Rai BP, Nair R *et al.* Current Status of Prostate Artery Embolization for Lower Urinary Tract Symptoms: Review of World Literature. *Urology.* 86, 676-681 (2015).
- Pisco JM, Rio Tinto H, Campos Pinheiro L, *et al.* Embolization of prostatic arteries

- as treatment of moderate to severe lower urinary symptoms (LUTS) secondary to benign hyperplasia: results of short- and mid-term follow-up. *Eur. Radiol.* 23, 2561-2572 (2013).
16. Gao YA, Huang Y, Zhang R *et al.* Benign prostatic hyperplasia: prostatic arterial embolization versus transurethral resection of the prostate--a prospective, randomized, and controlled clinical trial. *Radiology.* 270, 920-928 (2014).
17. Carnevale FC, Antunes AA. Prostatic artery embolization for enlarged prostates due to benign prostatic hyperplasia. How I do it. *Cardiovasc. Intervent. Radiol.* 36, 1452-1463 (2013).
18. McVary KT. Prostatic arterial embolization for LUTS/BPH-an opportunity for collaborative research or next prostatic gizmo candidate? *J. Urol.* 191: 577-578 (2014).
19. Golzarian J, Antunes AA, Bilhim T *et al.* Prostatic artery embolization to treat lower urinary tract symptoms related to benign prostatic hyperplasia and bleeding in patients with prostate cancer: proceedings from a multidisciplinary research consensus panel. *J. Vasc. Interv. Radiol.* 25: 665-674 (2014).