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Prostate Artery Embolization for Benign Prostatic Hyperplasia: Current Status

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Abstract

Prostate artery embolization has garnered much attention as a promising treatment for lower urinary tract symptoms secondary to benign prostatic hyperplasia. We aim to provide an up-to-date review of this minimally invasive technique, including discussion of potential benefits and technical challenges. Current evidence suggests it is a safe and effective option for patients with medication-refractory urinary obstructive symptoms who are poor surgical candidates or refuse surgical therapy. Larger, randomized studies with long-term follow-up data are needed for this technique to be formally established in the treatment paradigm for benign prostatic hyperplasia.

Résumé

L'embolisation des artères prostatiques soulève beaucoup d'intérêt à titre de traitement prometteur contre les symptômes du tractus urinaire inférieur consécutifs à une hyperplasie bénigne de la prostate. La présente étude propose une analyse à jour de cette technique peu effractive, en abordant notamment les avantages potentiels et les difficultés qu'elle présente sur le plan technique. Selon les données probantes actuelles, il s'agit d'une option thérapeutique efficace et sécuritaire pour les patients qui présentent des symptômes d'obstruction urinaire réfractaires aux médicaments et qui sont de pauvres candidats à une chirurgie ou refusent un traitement chirurgical. Des études aléatoires à vaste échelle axée sur la collecte de données de suivi à long terme doivent toutefois être réalisées avant que cette technique ne soit officiellement intégrée au paradigme de traitement de l'hyperplasie bénigne de la prostate.

Key Words: Embolization; Interventional radiology; Lower urinary tract symptoms; Prostatic hyperplasia; Transurethral resection of prostate

Prostate artery embolization (PAE) is becoming an increasingly well-recognized therapeutic modality in the management of lower urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH). Although the procedure has not yet been widely adopted, a growing body of evidence suggests it represents an innovative, effective, and safe alternative to transurethral resection of the prostate (TURP) and open prostatectomy as well as minimally invasive surgical therapies such as Holmium Laser Enucleation of the Prostate and photoselective vaporization of the prostate. Thus, it has garnered much interest in both the interventional radiologic and urologic communities. This article provides an up-to-date review of PAE in the treatment of LUTS secondary to BPH.

Background

LUTS typically include incomplete bladder emptying, frequency, intermittency, urgency, weak stream, straining, and nocturia. BPH represents the most common cause of LUTS, with more than 50% of men 60-69 years of age and as many as 90% 70-89 years of age experiencing such symptoms [1]. BPH symptoms are quantified by the International Prostate Symptom Score (IPSS), which assigns a severity score of 0-5 to each of the 7 LUTS symptoms. A total score of 0-7 is considered mild, 8-19 is moderate, and 20-35 is severe [2]. An additional eighth question deals with patient-perceived quality of life related to urinary symptoms, and is assigned a score of 0 (delighted) to 6 (terrible).

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Existing Treatment Paradigm

The goal of treatment is to facilitate quality of life and to avoid the potential sequelae of bladder outflow obstruction, including acute urinary retention and recurrent urinary tract infection. Pharmacotherapy with alpha-blockers or 5-alpha-reductase inhibitors is usually the first line option for symptomatic patients. Patients who cannot tolerate pharmacotherapy, who develop complications of BPH, or whose disease is severe or refractory to treatment are considered for surgical intervention.

TURP remains the gold standard surgical therapy for BPH, with reported IPSS reduction of up to 70% [3,4]. However, as many as 20% of patients can have significant complications including sexual dysfunction, perioperative bleeding requiring blood transfusion, and incontinence [3,4]. Open prostatectomy has traditionally been reserved for prostates larger than 80-100 cm^3, but carries with it significant morbidity and requires extended hospitalization. Several other less invasive techniques have been popularized in the past few years, including intraprostatic stents, transurethral needle ablation, transurethral microwave therapy, Holmium Laser Enucleation of the Prostate and photoselective vaporization of the prostate. However, none of these newer techniques have been shown to be superior to TURP from a cost-benefit standpoint, and none of them have supportive long-term efficacy data [5,6].

PAE

History and Expanding Research

Embolization of internal iliac artery branches has been successfully used to manage severe prostatic hemorrhage secondary to prostate cancer or BPH for over 30 years [7−10]. However, it was not until 2000 that the first case documenting therapeutic effect of PAE on BPH was published [9]. The premise behind PAE is simple: distal occlusion of the arteries supplying the prostate results in ischemic necrosis and reduction in gland volume [11]. The resultant effect is improvement in the objective and subjective parameters of voiding. PAE began to be studied for primary control of LUTS related to BPH after feasibility and safety from trials in dogs and pigs were established [12−14].

The first intentional treatment of BPH with PAE in humans was performed by Carnevale et al [15] in 2008, wherein the procedure achieved the return of spontaneous urination in 2 catheter-dependent patients. Multiple nonrandomized trials have since been published, from various institutions and multiple countries, all of which have affirmed the efficacy and the safety of the procedure. An extensive search of English language online databases (Medline and PubMed) was performed for articles from January 2000 to October 2015. A comprehensive set of search terms including "prostate," "embolization," "lower urinary tract symptoms," "benign prostatic enlargement," and "benign prostatic hyperplasia" were used. In total, 11 studies (randomized and nonrandomized trials) on PAE for LUTS were identified with published findings [16−27]. See Table 1 for baseline characteristics of human PAE studies and Table 2 for a summary of outcomes of PAE studies published to date.

Summing all the studies included in this review, a total of 741 patients have undergone PAE and have been reported in the literature. Most of these studies have been single centre and nonrandomized. All 11 studies demonstrated consistent and significant IPSS reduction at 1 year post-PAE, with IPSS improvement ranging from 12-21 points. Quality of life improvement is also consistent, with bother score reduction ranging from 2.4-2.9 points, which generally equates to improvement from unhappy to mostly satisfied. Urinary flow rate improvement has been more heterogeneous, ranging from 32%-227%.

The largest study of PAE, with the longest follow-up, was published by Pisco et al [17] in 2013. It reported on 255 patients with a history of symptomatic BPH, refractory to pharmacologic treatment for at least 6 months, who underwent PAE as an alternative to surgery. Technical success

Table 1
Patient characteristics and technical details of included studies

Author	Mean patient age (range) (y)	Mean prostate size/volume (range) (mL)	Embolic particle type	Embolic particle size (μm)	Technical success (defined as bilateral embolization)
Antunes [16]	68.5 (59-78)	69.7 (43.5-92)	Trisacryl gelatin microspheres (Embospheres)	300-500	N/A
Pisco [17]	65.5 (45-85)	83.5 (24-269)	Nonspherical PVA	100-200	82%
Bagla [19]	65.2 (48-81)	93.9 (25.9-274)	Polyzene F-coated hydrogel (Embozene)	100-400	96%
Kurbatov [20]	66.4	129.3	Trisacryl gelatin microspheres (Embospheres)	300-500	100%
Grosso [21]	75.9 (51-90)	N/A	Trisacryl gelatin microspheres (Embospheres)	300-500	75%
Somani [22]	64 (54-74)	94.9	Nonspherical PVA	N/A	90%
Assis [23]	64.8 (53-77)	135.1 (90.3-252)	Trisacryl gelatin microspheres (Embospheres)	300-500	94%
Wang [24]	71.5 (56-85)	96.5 (50-168)	Nonspherical PVA	100	95%
Gao [25]	67.7	64.7	Nonspherical PVA	355-500	84%
Carnevale [26]	62.0 (46-75)	64.6 (34-97)	Trisacryl gelatin microspheres (Embospheres)	300-500	93%
Li [27]	74.5 (65-85)	110.0 (82-165)	Trisacryl gelatin microspheres (Embospheres)	50-100	86%

N/A = not available; PVA = polyvinyl alcohol.
Manufacturer information: Embospheres: Merit Medical, South Jordan, UT, USA; Embozene: CeloNova BioSciences, San Antonio, TX, USA.