

**Prostatic Artery Embolization (The
PErFecTED Technique) versus TURP for
treating Benign Prostatic Hyperplasia (BPH)**

Thesis

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Introduction

Lower Urinary Tract Symptoms (LUTS) are a group of symptoms consisting of incomplete bladder emptying, frequency, intermittency, urgency, weak stream, straining, and nocturia.

It was agreed to quantify them using the International Prostate Symptom Score (IPSS) that assign a score from 0 to 5 for each one of these seven symptoms giving a total score ranging from 0-35 for them, considering a score of 0-7 mild LUTS, from 8-19 moderate LUTS and from 20-35 to be severe LUTS. A final question was added to this score concerning the Quality of life (QOL) bothersome score ranging from 0-6, where 0 is delighted and 6 being terrible. (1)

The most common cause of LUTS in the aging male is Benign Prostatic Hyperplasia (BPH), accounting for more than 50% of men aged 60–69 years and as many as 90% of men aged 70–89 years. (2)

Patients with mild LUTS are commonly reassured having them treated with watchful waiting or lifestyle modification, while medical therapy is targeting those who complain of moderate LUTS, negatively affecting their QOL with no absolute surgical indication so they can commit for medical therapy for a long period of their life. (3)(4)

There are two main categories of pharmacotherapy targeting BPH, the first group is α -blockers that are used for relieving symptoms but sometimes associated with side effects such as orthostatic hypotension, headache, shortness of breath and retrograde ejaculation. The second group is 5 α -reductase inhibitors that are able to affect disease progression by decreasing mass effect (up to 20%-30%) but are also associated with erectile dysfunction and lowered libido. (1)(5)

Patients who cannot tolerate these drugs, whose disease is refractory to treatment, who develop complications of BPH while receiving medical therapy, whose symptoms affect their QOL negatively or who have absolute indications for surgery which are recurrent urinary retention, recurrent UTIs, renal insufficiency, bladder calculi, and recurrent gross hematuria are considered for surgical therapy. (1)

Transurethral resection of the prostate (TURP) is the gold standard surgical treatment for BPH reducing the patient complaint of LUTS on IPSS by up to 70%. Although it has been reported with much complications as many as 20% including Transurethral resection syndrome (dilutional hyponatremia), perioperative bleeding that may require blood transfusion, incontinence and sometimes bladder neck contracture, yet the rate of these complications is greatly reducing with the

advancement in equipment and technology with the morbidity of TURP to be less than 1% and a mortality rate of 0%-0.25%. (6)

Introduction of the Bipolar system Transurethral resection in saline (B-TURP) system reduced the relative risks of transurethral resection syndrome (TUR Syndrome), blood transfusion and also reducing the need for readmission after surgery. (7)

Prostatic Artery Embolization (PAE) was first described in 1979 for treating intractable hematuria that is prostatic in origin by lang et al. PAE is now emerging as a new promising minimally invasive technique for treating LUTS due to BPH. (8)(9)(10)

Using PAE in treating LUTS due to BPH, DeMeritt et al. were the first to report on the relief of BPH-related bladder outlet obstruction after transarterial polyvinyl alcohol prostate embolization in 2000. (11)

The original method used in PAE in which they embolize distal first then embolize proximal showed a reduction of prostatic volume by about 30%, improve IPSS and quality of life (QoL) questionnaire scores, increase urinary flow rate, and even can eliminate the need for an indwelling catheter in patients complaining of urinary retention. (12)(13)

A new technique for PAE was described by Carnevale et al in 2014 where they embolize Proximal first then embolize distal,

the PErFecTED Technique. This technique showed greater prostatic infarction rates suggesting its superiority over the original technique used before. (14)

PAE was shown to be a safe procedure with low morbidity in carefully selected patients. (15)

Anatomy

Gross and Zonal Anatomy:

The prostate is an ovoid gland positioned just inferior to the bladder. The prostate is palpable approximately 4 cm from the anus on digital rectal examination. (16)

The prostate measures approximately 4 x 3 x 2 cm, weighing roughly 15 to 20 g. The median volume measured by Magnetic Resonance Imaging (MRI) in a group of 420 healthy volunteers aged from 21 to 25 years was 11.5 mL (range: 1.6 – 20.6). (17)

The prostate is composed of a base, an apex, anterior, posterior, and inferio-lateral surfaces.

The base of the prostate is at the bladder-prostate junction and the narrowed apex is the most inferior portion of the prostate gland, reaching the urogenital diaphragm and is continuous with the striated urethral sphincter. (16)

The prostatic urethra traverses its way through the base to the apex as it enters the middle of the base of the prostate near the anterior surface, traversing its way to emerge out of apex. The inferolateral surfaces are cradeled by levator ani. The ejaculatory ducts traverses their way posteriorly through the prostate to open in the prostatic urethra. (18)(Figure 1)

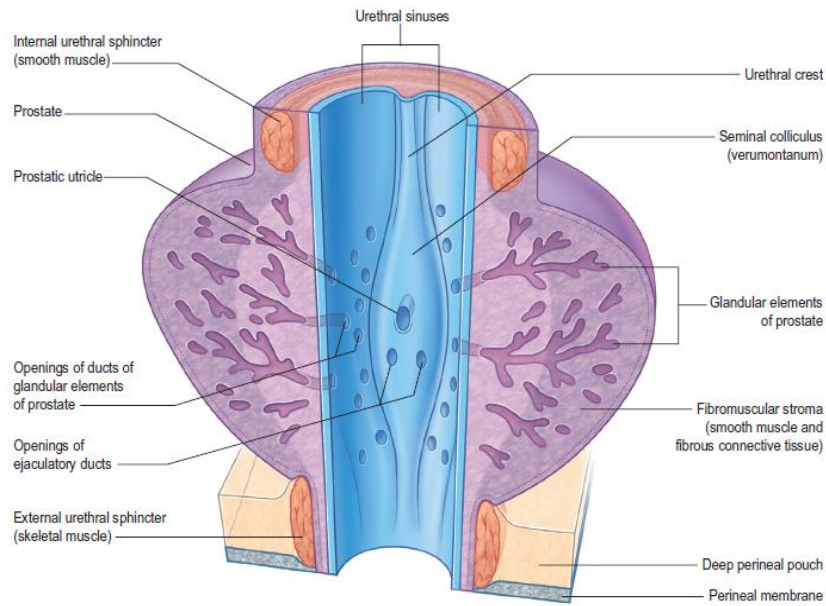


Figure 1: The prostatic part of the male urethra. The raised part of the urethral crest is the seminal colliculus, known clinically as the verumontanum.

(De Marzo AM, Platz EA, Sutcliffe S, Xu J, Grönberg H, Drake CG, et al. Inflammation in prostate carcinogenesis. Vol. 7, *Nature Reviews Cancer*. Nature Publishing Group; 2007. p. 256–69)

The prostatic capsule in the human prostate is composed of smooth muscle with an outer layer covering of collagen. There are two anatomic defects in the prostatic capsule; at the apex (anterior and anterolaterally) and at the site of entry of the ejaculatory ducts. (19)

In 1911, Oswald Lowsley published his anatomic findings on human embryos at different stages of fetal development. Based on urethral ductile budding, Lowsley concluded that there were 5 lobes of the prostate (anterior, posterior, 2 lateral, and 1 middle), with the anterior regressing after birth. Lowsley's findings, however, could not be confirmed in the adult prostate studied with ductile injection of India Ink or resin by the 1934

investigations of I. E. Leduc. Instead, Leduc concluded that the prostate was best divided into 2 lateral and 1 middle lobe. (20)

In a series of articles starting at the late 1960s and spanning the 1970s and 1980s, John McNeal pioneered a new understanding of the prostate based on zones instead of lobes, which became known as the zonal anatomy of the prostate and remains the main model of understanding the prostate anatomy until now. McNeal described 4 distinct zones of the prostate namely, the peripheral zone (PZ), the central zone (CZ), the transition zone (TZ), and the anterior fibromuscular stroma (AFMS). (17)

The peripheral zone of the prostate is the largest zone. Seventy percent of the glandular tissue of the prostate is comprised of the peripheral zone. The peripheral zone makes up the posterior and lateral aspects of the prostate gland. The ducts of the peripheral zone drain into the prostatic sinus along the entire length of the post-sphincteric prostatic urethra. Seventy percent of prostate cancers are found in the peripheral zone. (16)

Peripheral zone tumors of 0.2 mL or larger may be detected by digital rectal examination (DRE). Although the sensitivity and specificity of DRE is limited, an abnormal DRE is associated with an increased risk of a higher Gleason score and should therefore be considered an indication for prostate biopsy even if Prostatic Specific Antigen (PSA) is normal. (18)

The central zone is a smaller zone (25% of the normal glandular prostate) arises from ducts clustered in a small area on the convexity of the verumontanum, immediately surrounding the ejaculatory duct orifices. These ducts branch proximally and laterally toward the prostatic base. This zone is relatively immune to cancer but can be susceptible to tumor infiltration from adjacent zones. In autopsy and surgical specimen studies, central zone cancers account for up to 10% of prostate cancer. Although uncommon, cancers that do arise in this zone may be more aggressive. (18)

The transition zone comprises 5% to 10% of the glandular tissue of the normal prostate. The transition zone is separated from the rest of the glandular compartments of the prostate by a distinct fibromuscular band. Benign prostatic hyperplasia most commonly occurs in the transition zone. (16)

The Tranzitional zone is easily recognizable on ultrasound examination, as it is diffusely hypoechoic relative to the Peripheral zone. Tranzitional zone cancer is the site of origin of up to 25% of prostate cancer. Cancers from this zone show much less capsular penetration and seminal vesicle invasion than Peripheral zone cancers of comparable volume, as the Tranzitional zone boundary provides a barrier to cancer spread through the Peripheral zone. (18)(Figure 2, 3, 4)

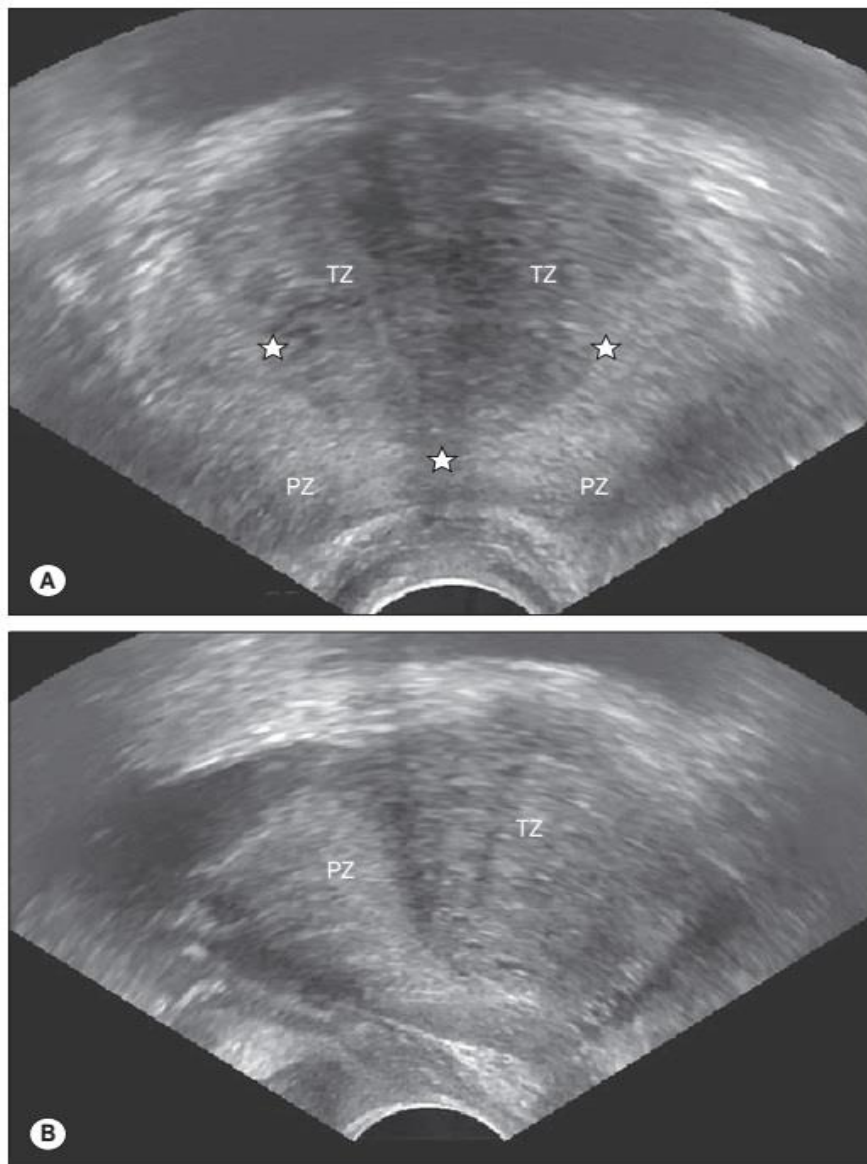


Figure 2: Ultrasound of the prostate. A, An axial view showing the hypoechoic transition zone and the more echogenic peripheral zone. Their interface is the surgical capsule. B, A sagittal view showing the hypoechoic transitional zone and the more echogenic peripheral zone.

(Susan S. Gray's anatomy : the anatomical basis of clinical practice. In: Gray's anatomy : the anatomical basis of clinical practice. 41st ed. Elsevier Limited; 2016. p. 1255–71.)

Anterior Fibromuscular Stroma

The anterior fibromuscular stroma produces the characteristic convexity of the anterior prostatic surface. It is a thick, non-glandular region that accounts for one-third of the bulk of the prostate. It is continuous with detrusor muscle proximally and the external urethral sphincter distally. (18)

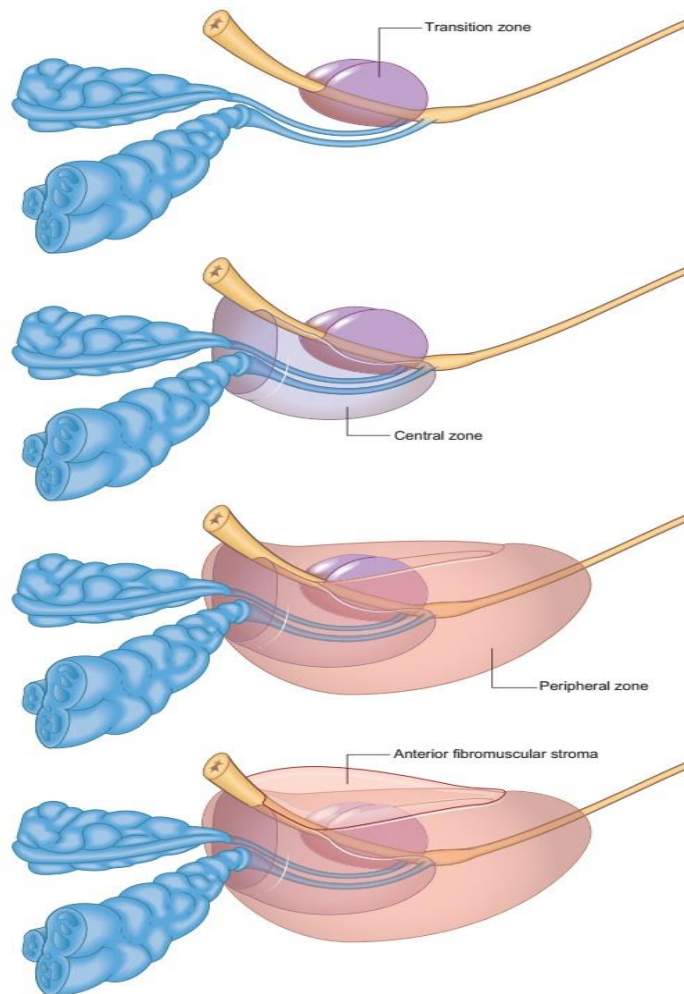


Figure 3: The zonal anatomy of the prostate
(Wein AJ, Kavoussi LR, Partin AW, Peters CA. *Campbell-Walsh Urology*
11th Edition. Elsevier. 2015;2(21):489–515)

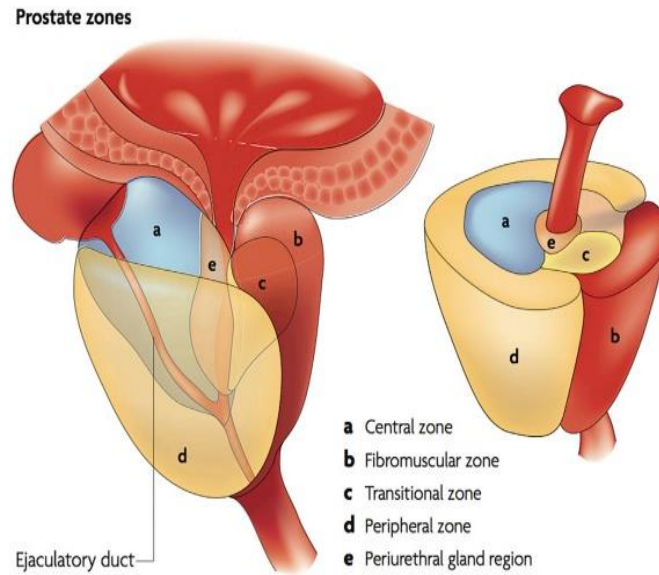


Figure 4: Zonal anatomy of the prostate

(De Marzo AM, Platz EA, Sutcliffe S, Xu J, Grönberg H, Drake CG, et al. Inflammation in prostate carcinogenesis. Vol. 7, Nature Reviews Cancer. Nature Publishing Group; 2007. p. 256–69)

Arterial supply with Radiological consideration:

The arterial supply of the prostate is highly variable. In approximately 60% of pelvic sides there is only 1 Prostatic artery (PA), whereas in up to 40% of pelvic sides 2 independent prostatic vascular pedicles may be found.

PAs are small-sized arteries with diameters usually between 1 and 2 mm which does not depend on prostate volume, but on the number of independent PAs: patients with just 1 PA have larger arteries (around 2 mm) than those with 2 PAs (around 1 mm). (17)(23)(24)