INTRODUCTION

Benign prostatic hyperplasia (BPH) becomes increasingly common as men age. Men with clinically significant lower urinary tract symptoms (LUTS) suggestive of BPH who do not find adequate relief with medical treatment may benefit from transurethral resection or ablation to enlarge the urethral channel by reducing the amount of prostate tissue around the urethra ***(McVary et al., 2016).***

Transurethral resection of the prostate (TURP) is still considered the reference ‘gold standard’ surgical procedure for low urinary tract symptoms (LUTS) due to benign prostatic hyperplasia (BPH). The high success rate of TURP, proven by substantial and sustained improvements of symptom scores, urinary flow rate and other functional parameters, is still associated with significant morbidity, including perioperative or postoperative bleeding, The most important is transurethral resection (TUR) syndrome, prolonged hospital stay, and even urinary incontinence, retrograde ejaculation, and erectile dysfunction ***(Elshal, 2014).***

As a consequence, a large number of new minimally invasive therapeutic alternatives have been tested in the last 30 years, including (but not being limited to) laser enucleation, resection or vaporization of the prostate, bipolar resection and vaporization, transurethral microwave therapy (TUMT), transurethral needle ablation (TUNA), and prostatic stents ***(Elshal, 2014).***

Advantages of bipolar technique over monopolar TURP

Better hemostatic effect of the bipolar system allowed less intraoperative and postoperative bleeding, better vision obtained due to the use of normal saline as an irrigant and due to better intraoperative hemostasis, higher resection speed during bipolar TURP which allows shorter resection time and higher resection ratio which in turn decreased the reoperation rate, less risk of dilutional hyponatremia due to use of normal saline, which minimized the time limit risk factor and hence allowed more comfortable and precise resection of most of the adenoma, the current doesn’t pass through the patient as it travels from the active electrode through the irrigation fluid to a negative return electrode, so less tissue damage from dispersed heat and It can be used safely in patient with cardiac pacemaker.

Bipolar electrosurgical technology for transurethral resection in saline systems has been described as an alternative techniques to monopolar system in surgical treatment of BPH.

Plasma vaporization is characterized by minimal heat generation. The bipolar electrode generates a thin layer of highly ionized particles, allowing it to glide over the tissue. After the generation of an initial electrical pulse, a constant plasma field is created, allowing it to vaporize a limited layer of prostate cells, without affecting the underlying tissue .As a consequence of this technique, which realizes concomitant vaporization and coagulation, the bleeding is reduced significantly ***(Autorino, 2015).***

AIM OF THE STUDY

The objectives of this study are to present the technical principles behind bipolar system and to thoroughly analyze the impact of the this method on the patient outcomes, mainly residual prostatic tissue size, and complication rates, making a direct comparison between TURis and PKVP.

ANATOMY OF THE PROSTATE

The normal prostate weighs 18-22 gm; measures 3 cm in length, 4 cm in width, and 2 cm in depth and is traversed by the prostatic urethra. Although ovoid, the prostate is referred to as having anterior, posterior, and lateral surfaces, with a narrowed apex inferiorly and a broad base superiorly that is continuous with the base of the bladder ***(James, 2017).***

Gross Anatomy

General Considerations:

The prostate is a compound tubuloalveolar gland whose base abuts the bladder neck and whose apex merges with the membranous urethra to rest on the urogenital diaphragm. The intact adult gland resembles a blunted cone, weighs approximately 18 to 20 gm.

The urethra enters the prostate near the middle of its base and exits the gland on its ventral surface above and in front of its apical portion. The ejaculatory ducts enter the base on its posterior aspect and run in an oblique fashion to emerge and terminate adjacent to the verumontanum. The capsule of the prostate gland is an inseparable condensation of stromal elements that is incomplete at the apex; it does not represent a true capsule. Fibrous septa emanate from the capsule, pierce the underlying parenchyma, and divide it into multiple lobules. These glandular units drain into branched tubules, which lead into 20 to 30 prostatic ducts. Most of these ducts empty their contents into the prostatic urethra adjacent or distal to the verumontanum ***(Woodburne, 2016).***

Lobes and Zones:

The prostate has been divided into five lobes: two lateral lobes, a median lobe, a posterior lobe, and an anterior lobe.

Mc Neal classification: By the Trans-rectal ultrasound, the prostate shows zones:

1- ***Transitional zone*****:** (5-10%) surrounds the prostatic urethra.

2- ***Central zone:*** *(25%)* cone shaped circumferentially and thought to be of wolffian origin.

3- ***Peripheral zone:*** (70%) covers the posterior and lateral aspects of the gland. Its ducts drain into the prostatic sinus along the entire length of the prostatic urethra.

4- ***Anterior fibromuscular stroma zone:***extends from the bladder neck to the stiated sphincter.

5- ***Preprostatic sphincter zone:*** is composed of elastin, collagen, and smooth and striated muscle fibres.

Clinically, the prostate have two lateral lobes, separated by a central sulcus that is palpable on rectal examination, and a middle lobe, which may project into the bladder in older men.

These lobes do not correspond to histologically defined structures in the normal prostate but are usually related to pathologic enlargement of the transition zone laterally and the periurethral glands centrally ***(Mc Neal, 2016).***

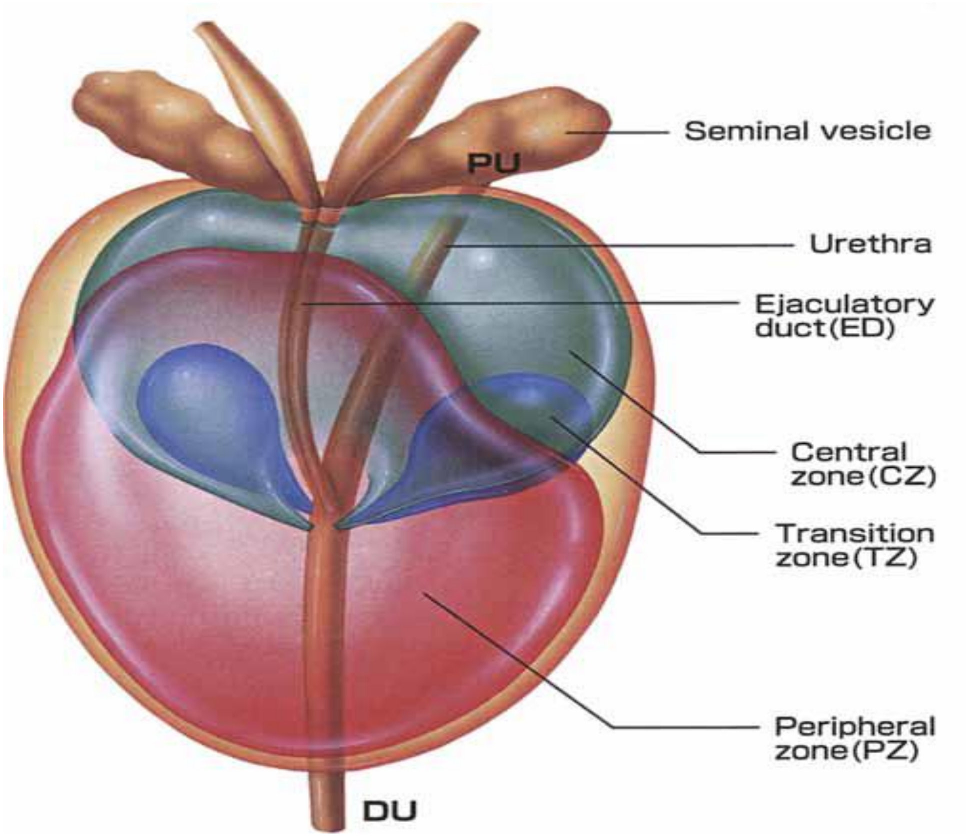

Figure (1): Three-dimensional structure of the prostate viewed from the right posterolateral angle and drawn based on the model by McNeal. The urethra, which runs through the midline, is divided into proximal *(PU)* anddistal *(DU)* halves of equal length. The *PU* is tilted ventrally and is surrounded by a sleeve of smooth muscle fibers called the preprostatic sphincter. The distal end of the *PU* receives ducts derived from the transition zone *(TZ)* just proximal to the angulation. The central zone *(CZ)* ducts drain into the *DU* immediately surrounding the ejaculatoryduct *(ED)* orifices. The ducts of the peripheral zone *(PZ)* open into the *DU* from the base of the verumontanum to the prost ate apex ***(McNeal, 2016).***

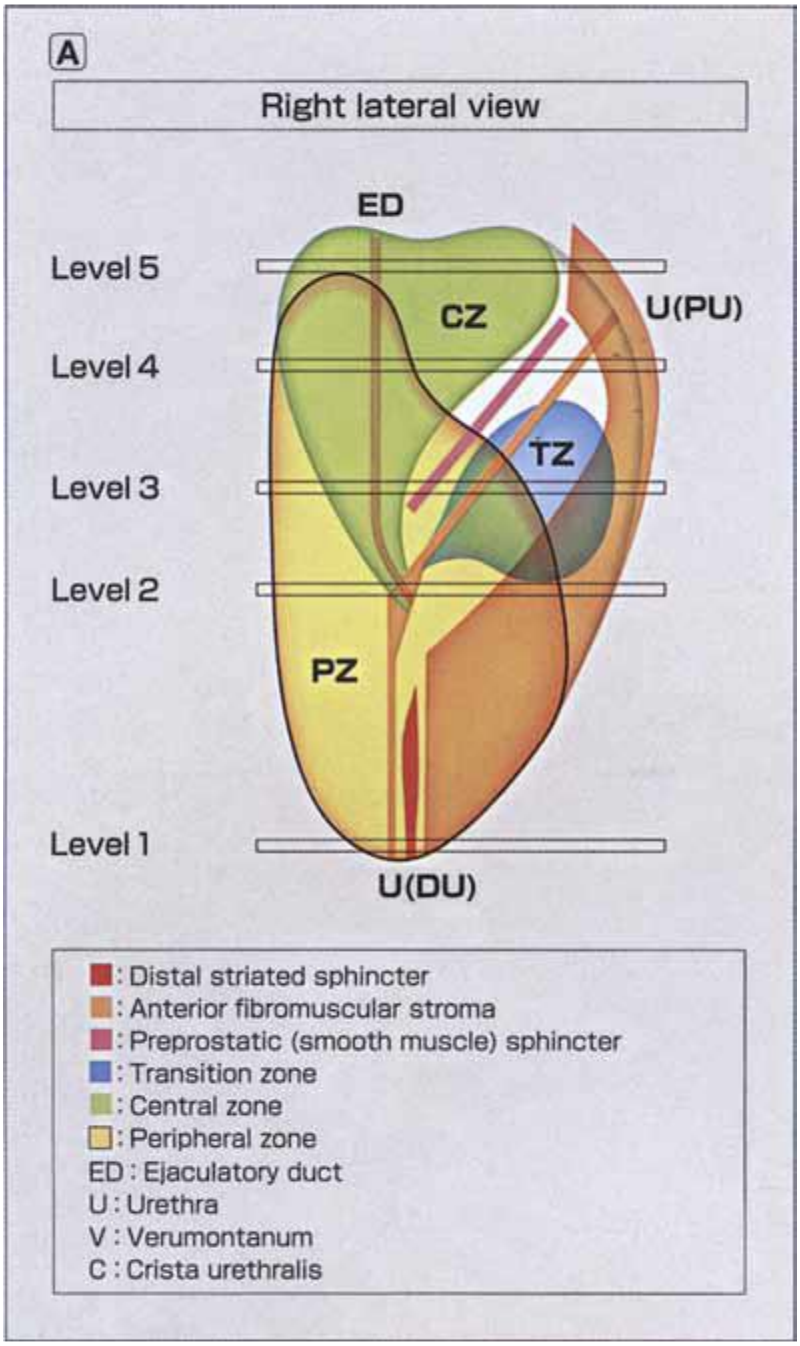

Figure (2): Structure of the prostate and approximate location of the central, transition, and peripheral zones. Restructured basedon the model of McNeal ***(McNeal, 2016).***

Capsule and Fascia:

The prostate has a tough capsule of fibrous tissue and muscular elements completely enveloping the prostate and is densely adherent to it. This capsule is actually a glandular prostatic tissue that is connected to the acini and inseparable from the parenchyma. This is surrounded by a periprostatic fascia ***(Walsh et al., 2013).***

Contiguous structures:

The prostate is inferior to the bladder and anterior to the rectum. The perineal anatomy is a complex of muscles and tendons that comprise the pelvic floor. Beginning from the skin of the perineum, the superficial (Camper's) and deep (Colle's) fascia. The latter is attached to the ischiopubic rami and the border of the urogenital diaphragm and is continuous with Scarpa's fascia. The most superficial pelvic musculature is the ischiocavernosus, the bulbocavernosus, the superficial transverse perineal muscles, and the external anal sphincter. These muscles are united in the midline as a central tendon (perineal body) and function as a single muscle. This central tendon is attached to the bulb of the rectum by fibrous bands of muscle known as the rectus urethralis. Beneath this layer of muscles is the deep perineal compartment which is predominantly the urogenital diaphragm which is attached to the inferior rami of the ischia and pubis ***(Weyrauch, 2015).***

Vascular anatomy:

The prostatic blood supply comes predominantly from the internal iliac artery and is a series of lateral pedicles, the most prominent and constant of which is the pedicle at the base of the prostate (superior prostatic artery) Additional branches may also exist most usually at the apex of the prostate. The superior prostatic artery enters just below the bladder neck and forms two branches, one to the capsule and the other to the urethra. As patients age, the latter becomes more prominent with prostatic enlargement. Other sites of origin for the prostatic artery are the internal pudendal, the superior vesical, or the obturator artery ***(Brendler, 2015).***

The neurovascular bundle can be located along the posterior lateral prostate at the base of the prostate beneath the anterior layer of Denonvillier's fascia. More distally, the neurovascular bundle crosses the apex of the prostate and enters the pelvic diaphragm posterior laterally to the membranous urethra. The venous drainage of the prostate is via the anterior venous plexus (Santorini) which is found on the anterior and lateral prostate. This plexus receives blood from the dorsal vein of the penis and empties into the hypogastric vein.

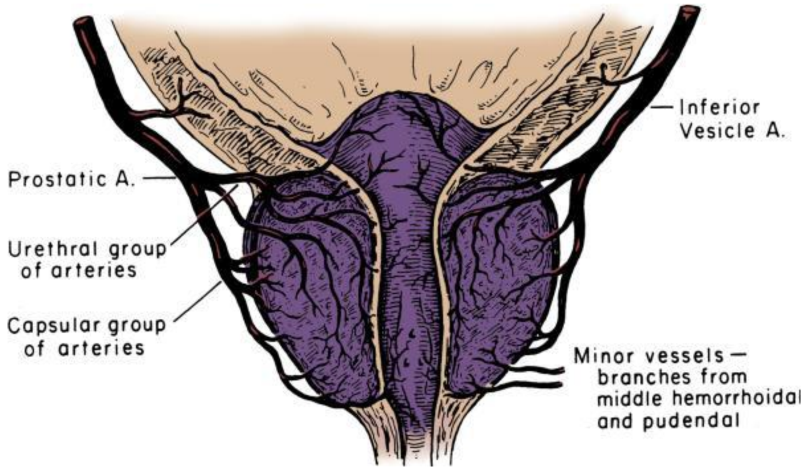

Figure (3): Arterial supply of the prostate ***(Adapted from Flocks RH: The arterial distribution within the prostate gland: Its role in transurethral prostatic resection (J Urol 2015; 37:524-548).***

Lymphatic Anatomy:

The lymphatic drainage of the prostate is predominantly along the path of the prostatic artery with the primary nodal drop site being the obturator nodes. Other potential sites of nodal metastases include the external iliac and presacral nodes.

Neuroanatomy:

The prostate has sympathetic, parasympathetic, and somatic innervation. The sympathetic innervation is from L1 and L2 via the superior hypogastric plexus. The parasympathetic and somatic innervation is from S2,3,4 via the inferior hypogastric plexus and pudendal nerves respectively ***(Burnett, 2015).***

Endoscopic Anatomy

As the endoscope is passed proximally through the membranous urethra, the distal margin or the apex of the prostate is identified by the presence of the *verumontanum,* also called *colliculus seminalis.* Mucosal folds of varying prominence can also be identified. In the proximal membranous urethra two folds of mucosa (the inframontanal folds) course laterally and distally from the verumontanum and merge into the urethral wall. Extending proximally from the verumonatanum, the urethral crest is a longitudinal ridge on the posterior floor within the prostatic urethra. On either side of this ridge lies the area of prostatic sinus, which contains the orifices of the prostatic ducts from the lateral lobes ***(Bagley, 2015).***

The verumontanum represents the elevation of urethral mucosa by the ejaculatory and utricle which is a very important landmark for due to neurovascular bundle and external sphincter. The utricle itself is only a few millimetres long, running posteriorly within the substance of the prostate. It has been labelled the *uterus masculinus* since it is a remnant of the paramesonephric, or mullerian ducts, in male and is homologues with the uterus and upper portion of the vagina in female. The prostatic portion of the urethra runs proximally from the verumonatanum to the bladder neck through the substance of the prostate gland. It is located more anteriorly than posteriorly within the gland. The lumen is indented by the lateral lobes of the prostate and is subjected to obstruction in the presence of prostatic hypertrophy ***(Bagley, 2015).***

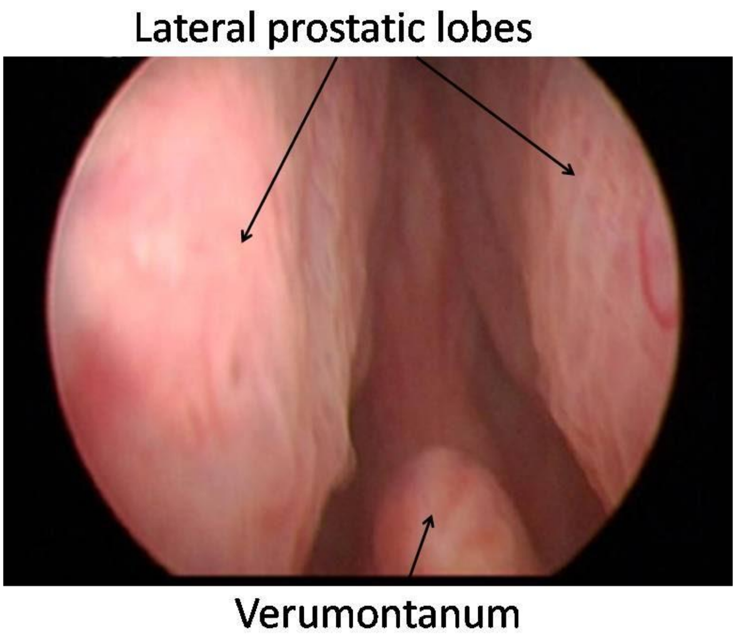

Figure (4): The two lateral lobes of the prostate and the verumontanum ***(Bagley, 2015).***

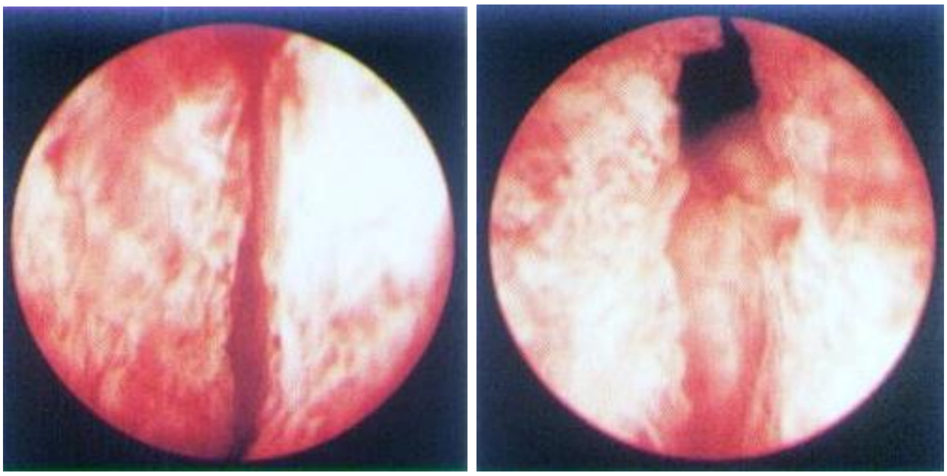

Figure (5): A-The lateral prostatic lobes are touching one another, B-The lateral prostatic lobes are separated by passage of the tip of the endoscope, C-Small median lobe & bladder neck are seen in this view. ***(Bagley, 2015).***

BENIGN PROSTATIC HYPERPLASIA

Definition of BPH:

- Benign prostatic hyperplasia (BPH) refers to a regional nodular growth of varying combinations of glandular and stromal proliferation that occurs in almost all men who have testes and who live long enough.
- Histopathologically BPH is characterized by an increased number of epithelial which gives glandular component cells and stromal cells which gives fibrous componenet in the periurethral area of the prostate.
- Macroscopic BPH refers to organ enlargement due to the cellular changes.
- Clinically BPH refers to the lower urinary tract symptoms thought due to benign prostatic obstruction.

(Berry et al., 2014)

Incidence & Epidemiology:

BPH is the most common benign tumour in men, No convincing evidence exists regarding a positive correlation for any factors other than age and the presence of testes.

Autopsy data indicates that anatomic (microscopic) evidence of BPH is seen in about:

- 25% of men age 40 to 50 year.
- 50% of men age 50 to 60 year.
- 65% of men age 60 to 70 year.
- 85% of men age 70 to 80 year.
- 90% of men age 80 to 90 year.

(Verhamme et al., 2012)

It has been classically stated that from 25 to 50 percent of individuals with microscopic and macroscopic evidence of BPH will progress to clinically manifested BPH.

The prevalence of clinical BPH in an individual community in men ages 55 to 74 years may vary from 5% to 30%.

Some studies have suggested a genetic predisposition and some have noted racial differences ***(McConnell et al., 2013).***

Aetiology:

The aetiology of BPH is not completely understood, but it seems to be multifactorial and endocrine controlled. The prostate is composed of both stromal and epithelial elements, and each, either alone or in combination, can give rise to hyperplastic nodules and the symptoms associated with BPH.

Each element may be targeted in medical management schemes.

Observations and clinical studies in men have clearly demonstrated that BPH is under endocrine control. Castration results in the regression of established BPH and improvement in urinary symptoms. Additional investigations have demonstrated a positive correlation between levels of free testosterone and oestrogen and the volume of BPH.

The latter may suggest that the association between aging and BPH might result from the increased oestrogen levels of aging causing induction of the androgen receptor, which thereby sensitizes the prostate to free testosterone. However, no studies to date have been able to demonstrate elevated oestrogen receptor levels in human BPH ***(McConnell et al., 2013).***