



**Sudan University of Science and Technology**  
**College of Graduate Studies**



## **Characterization of Benign Prostatic Hyperplasia using Ultrasonography**

**الصوتية فوق الموجات باستخدام الحميد البرستاتا توصيف تضخم**

A thesis Submitted for Partial Fulfillments of the Requirements  
of M.Sc. Degree in Medical Diagnostic Ultrasound

By:

**Babiker Ahmed Mohammed**

Supervisor:

**Dr. Babiker Abd El wahab Awad Allah**

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الاية



سورة الشعراء (78-81)

# Dedication

*To my father:*

*Who always supported me in every Endeavor.*

*To my mother:*

*Who is the Reason I am here all, and me who I am today.*

*To my wife and my kids:*

*If I denoted to you everything in the world is not enough to  
give you your right.*

*To my brother and sister:*

*For their valuable supports.*

# Acknowledgment

First of all I thank Allah the almighty for helping me to complete this research.

I thank **Dr Babiker Abdel Wahab Awad Allahmy** supervisor for her help and guidance.

My Thank extend to anyone who help me to complete this study,with his full patience cooperation.

I would like to thank also radiology staff in college of medical radiological science for their cooperation.

Finally I would like thank my friend teacher and colleagues.

## **Abstract**

This study was a descriptive cross sectional study which aimed to evaluate the benign prostatic hyperplasia using ultrasonography, carried out in Omdurman Sharg Elnil and Alailfonen Hospitals June 2018 to February 2019.

There were 60 males patients were scanned by ultrasound, all had patients age abover 38 years, Any patient had normal prostate and prostatic cancer was excluded from this study.

All these patients were scanned trans abdominal ultrasound using mindary DP10 ultrasound machines to evaluate the prostate volume, out lines, internal echogenicity of prostate and any other diseases associated with BPH like (classification, cyst,others).

Data was collected using data collected sheets and analyzed using the collecting data program. Study found that the most affected age by benign prostatic hyperplasia 60 to 70 years respectively (71.46)the prostate volume with mean 55,6 and stander deviation 24.08., there was a linear correlation between age, occupation and prostatic volume.

The study concluded that the normal prostate usually include homogenous echo pattern, regular out line, with or without presence of classification, cyst, diverticulum, and residual urine may be found or not.

Study recommended that ultrasound scanning should be done routinely for any patient with age above forty years to exclude BPH, because is sheep and safety.

## ملخص البحث

هذه الدراسة دراسة مقطعية وصفية التي تهدف إلى تقييم تضخم البروستاتا الحميد في عدد من السكان السودانيين، اجريت هذه الدراسة في مستشفى في الفتره ما بين يونيو 2018 الي فبراير 2019.

كان هناك 60 من الذكور تم فحصهما عن طريق الموجات فوق الصوتية، وكانت أعمارهم من 40 عاما، حيث تم استبعاد هذه الدراسة كل مريض يحتوي علي بروستات سليمة.

كل هؤلاء المرضى فحصو بالموجات فوق الصوتيه عن طريق البطن باستخدام مساحات سيمنس واي ساوتيه لتقييم حجم البروستاتا، والحواف الخارجيه للغده، والمظهر الداخلي للبروستاتا وأي أمراض أخرى مرتبطة بتضخم البروستات مثل (تصنيف، والكيس، رتج).

وقد تم جمع البيانات باستخدام اوراق البيانات التي تم جمعها وتحليلها باستخدام برنامج التحليل الخطي التمييزي. ووجدت الدراسة أن أكثر الفئات العمرية تأثرا بتضخم البروستات تتراوح مابين 60-70 سنة على التوالي (41.9%) ، وتراوح حجم البروستاتا (71.46)م الانحراف 24.08، حيث وجدت الدراسة ان هناك ارتباط خطي بين الفئة العمرية وحجم البروستاتا.

ووجدت الدراسة ان البروستات الطبيعية تتميز عادة بتجانس المظهر الداخلي، وان تكون الحواف الخارجيه منتظمه، مع وجود او عدم وجود تصنيف، والكيس، رتج، والبول المتبقي يمكن ان يتواجد أم لا.

وأوصت الدراسة أن كل رجل عمره أكثر من 40 سنة يجب فحصه بالموجات فوق الصوتية ينبغي أن يتم بشكل روتيني لمعرفة وجود تضخم غدة البروستات ، وذلك لأنها امنه ورخيصه.

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## Abbreviations

| <b>Abbreviation</b> | <b>Meaning</b>                |
|---------------------|-------------------------------|
| TUPS                | Transperineal ultrasonography |
| BMI                 | Body mass index               |
| BNH                 | Benign nodular hyperplasia    |
| BPH                 | Benign prostatic hyperplasia  |
| CA                  | Cancer                        |
| KG                  | Kilogram                      |
| KSA                 | Kingdom of Saudi Arabia       |
| MI                  | Milliliter                    |
| NG                  | Nanogram                      |
| PSA                 | Prostatic specific antigen    |
| TRUS                | Transrectal ultrasound        |
| US                  | Ultrasound                    |

# **Chapter one**

## Chapter one

### 1-1-introduction

Prostate is a compound tubuloalveolar exocrine of the male reproductive system, the prostate gland is a chestnut-size organ located in the pelvic posterior to symphysis pubic and pubic arch anterior to the rectum and just beneath the urinary Bladder. it encircles the proximal part of urethra. Function of the prostate is to secrete slightly alkaline fluid which has a characteristic of milky or white in appearance. The secretion usually constitutes 20% to 30% of volume of semen along with spermatozoa and seminal vesicle fluid. In medical practice most of prostate abnormalities are diagnosed by measuring their volume range between 0,250 ml at the birth to the 1000 ml sized at the puberty, after puberty the prostate volume will continuously grow as the age increases for most of the male's life.

. Benign prostatic hyperplasia (BPH) is a medical term for prostate gland enlargement; it is a non-cancerous enlargement of the gland. The presence or absence of prostate gland enlargement is not related to the development of prostate cancer. (Agrawal, V.K and Gupta, R.K.1971)

More recently the voiding dysfunction that ensues from prostate gland enlargement and has been generically termed as prostatism. The median lobe of the gland enlarges upward and encroaches within the sphincter vesicae, located at the neck of the bladder. The leakage of urine into the prostatic urethra causes an intense reflex desire to micturate. The enlargement of the median and lateral lobes of the gland produces elongation and lateral compression and distortion of the urethra so that the patient experiences difficulty in passing urine and the stream is weak. Backpressure effect on the ureters and both kidneys are a common

complication(Betty Bates1993). The enlargement of uvula vesicae( owing to the enlarged median lobe) results in the formation of a pouch of stagnant urine behind the urethral orifice within the bladder .the stagnant urine frequently become infected, and the inflamed bladder( cystitis) adds to the patients symptoms. The traditional theory is that as the prostate enlarges the surrounding capsule prevents it from readily expanding, and this subsequently results in urethral compression. The bladder wall become thickening, trabeculated, and irritable when it is forced to hypertrophy and increased its own contractile force. This increased sensitivity (detrusor instability), even with small volume of urine in the bladder, is believed to cause ensuing urinary frequency bladder may gradually weaken and lose the ability to empty completely, thus leading to increased residual urine volume and sometimes acute or chronic urinary retention.( Carol M. Rumack 2005)

. In the past, chronic end stage often lead to renal failure and uremia. While this complication is much less common now, chronic (BOO) secondary to BPH may lead to urinary retention, renal insufficiency, recurrent UTIs, gross hematuria, and bladder calculi. Ultrasound and Intravenous Urography (IVU) are useful for helping determine bladder and prostate size and the degree of hydronephrosis (if any) in patients with urinary retention or signs of renal insufficiency .

BPH is a proliferative process of the cellular elements of the prostate. Cellular accumulation and gland enlargement may be due to epithelial and stromal proliferation, impaired preprogrammed cell death (apoptosis) or both.

From birth to young adulthood, the prostate grows from about the size of a pea to about the size of a walnut; most men experience a second

period of prostate growth in their mid to late 40s, at this time, cells in the central portion of the gland - where the prostate surrounds the urethra - begin to produce more rapidly, result in prostate gland enlargement, as tissues in this area enlarge, they often compress the urethra and partially block the urine flow. Though nodular prostatic hyperplasia has been suggested by some precursor for development of prostatic cancer, it is considered unlikely. Most prostatic cancers develop in the periphery of the gland. Any concomitant occurrence of the two diseases may be considered as aging process. Approximately 15-20% of nodular hyperplastic prostates harbour carcinoma .( Chummy S. Sinnatamby1995) BPH affects half of all men over the age of 60 years. By the age of 70, about 80% of men have an enlarged prostate. Histological evidence of prostatic enlargement occurs in up to 90% of men by age 80 year In the United States of America (USA) as many as 14 million men have symptoms related to this benign enlargement. Worldwide, approximately 30 million men have symptoms related to this benign enlargement .

Many people feel uncomfortable talking about the prostate, since the gland plays a role in both sex and urination. Still, prostate enlargement is as a common a part of aging as a gray hair. (Harsh Mohan 2000)

## **1.2 Problem of the study:**

Enlargement of prostate gland (BPH) more than(35mg), May lead to many problem in urinary tract recently and its argued decision of treatment (drugs or surgery) have been considered as ultimate problem for the current study.

### **1.3 Objectives:**

#### **1.3.1 General objectives:**

Characterize Benign Prostate Hyperplasia in Sudan using ultra sound

#### **1-3-2 Specific Objectives:**

- To measure volume of prostate gland.
- To assess the shape, echogenicity and echo texture .
- To determine the most common age group affect.
- To determine other finding in urinary tract associated with BPH.
- To correlate between volume.in BPH patient with age.

### **1.4 Overview of the study**

The following thesis will be consists of five chapters ,Chapter one which include introduction, problem and study, objectives and overview of the study. While Chapter two will include a anatomy, physiology, pathology and previous studies. Chapter three deals with the methodology, where it provides an outline of material and methods used to acquire the data in this study as well as the method of analysis approach. While the results were presented in chapter four, and finally Chapter five include discussion of results, conclusion and recommendation followed by references and appendices.



**Chapter Tow**  
**Literature Review**

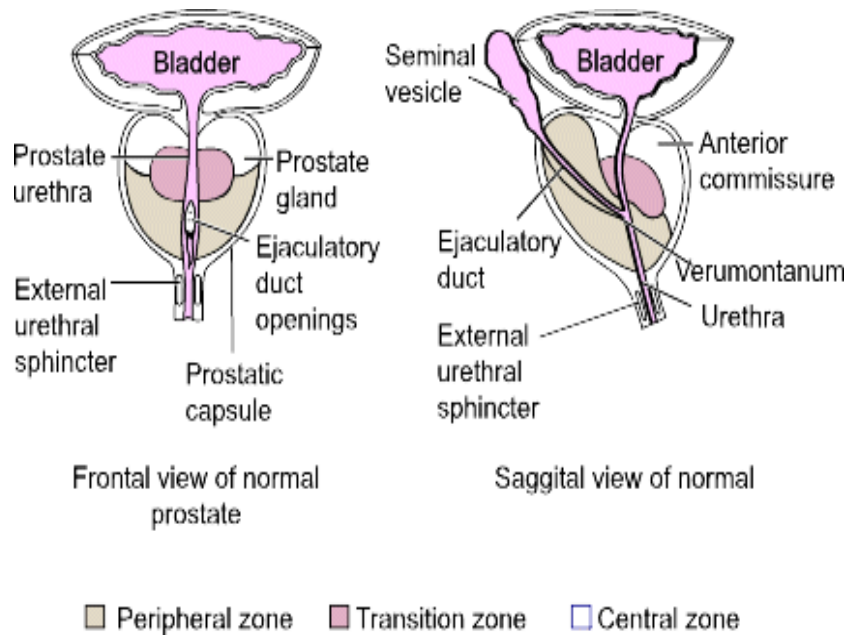
## **Chapter tow**

### **Literature review**

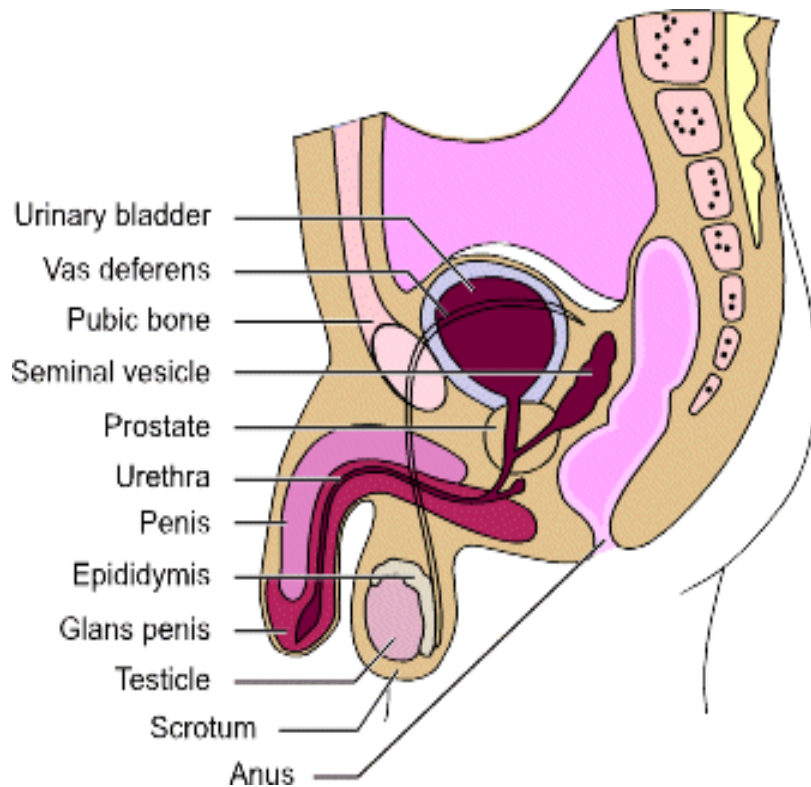
#### **2-1 Anatomy of Prostate:**

The prostate is a pyramidal fibro muscular gland which surrounds the prostatic urethra from the bladder base to the membranous urethra. It has no true fibrous capsule, but is enclosed by visceral fascia containing neurovascular tissue. The muscular tissue within the prostate is mainly smooth muscle.

The prostate lies at a low level in the lesser pelvis, behind the inferior border of the symphysis pubis and pubic arch and anterior to rectourethralis and the rectal anpufla, through which it may be palpated. It presents a base or vesical aspect superiorly, an apex inferiorly, and posterior, anterior and two inferolateral surfaces, The prostatic base measures about 4 cm transversely. The gland is 2 cm in anteroposterior and 3 cm in its vertical diameters, and weight about 8 g in youth, but almost invariably enlarges with the development of BPH.



**Figure (2-1).Shows frontal and sagittal planes of prostate**



**Figure (2-2). Shows male reproductive system**

Superiorly the base is largely contiguous with the neck of the bladder. The apex is inferior, surrounding the junction of the prostatic and

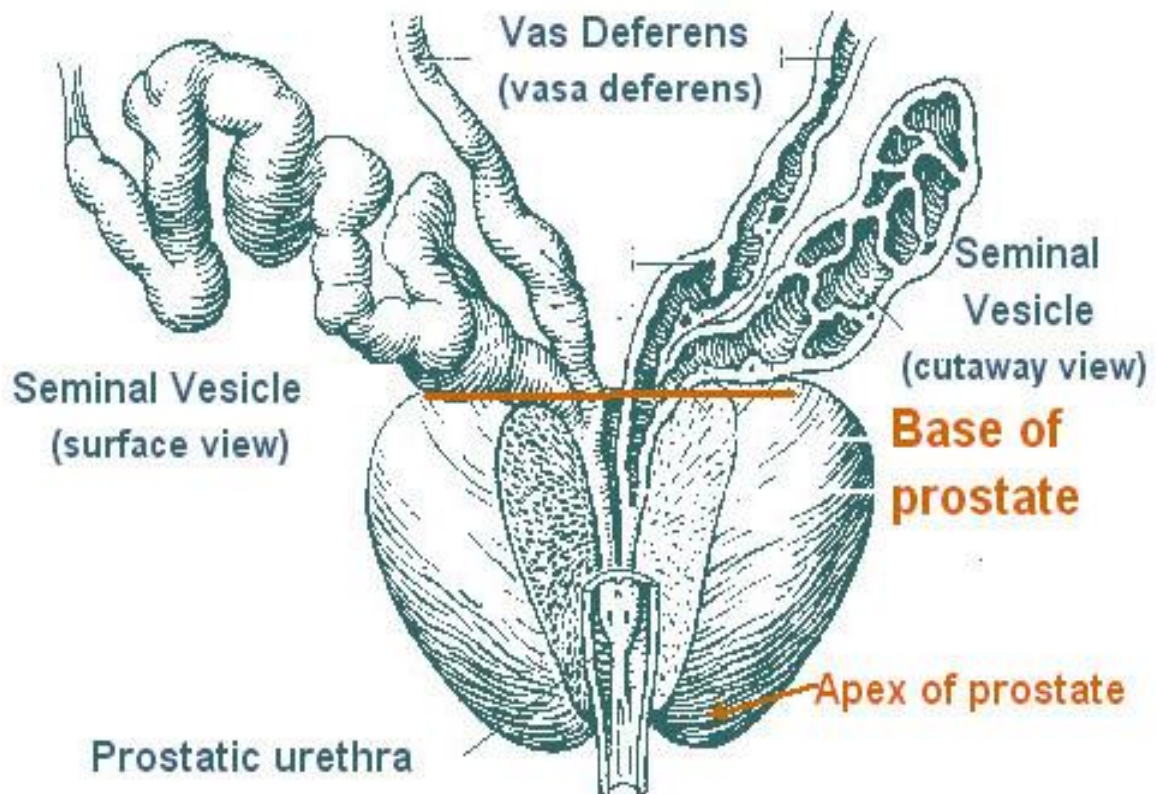
membranous parts of the posterior urethra. The apical posterior relation of the prostate and external urethral sphincter is rectourethralis.

The anterior surface lies in the arch of the pubis, separated from it by the dorsal venous complex (Santorini's plexus) and loosely attached adipose tissue.

The anterior and lateral aspects of the prostate are covered by a layer of fascia derived from the endopelvic fascia on each side, called the lateral prostatic fascia. This is adherent medially to the prostate, continues posteriorly over the lateral aspect of the prostate, neurovascular bundles and rectum (lateral rectal fascia) and passes distally over the urethra

The inferolateral surfaces are related to the muscles of the pelvic sidewall: the anterior fibers of levator ani embrace the prostate in the pubourethral sling or pubourethralis. These muscles are separated from the prostate by a thin layer of connective tissue.

The posterior surface of the prostate is transversely flat and vertically convex. It is separated from prerectal fat in the prerectal space. and rectum by Denonvillier's fascia, The prostate is traversed by the urethra and ejaculatory ducts, and contains the prostatic utricle. The urethra enters the prostate near its anterior border and usually passes between its anterior and middle thirds. The ejaculatory ducts pass anteroinferiorly through its posterior region to open into the prostatic urethra



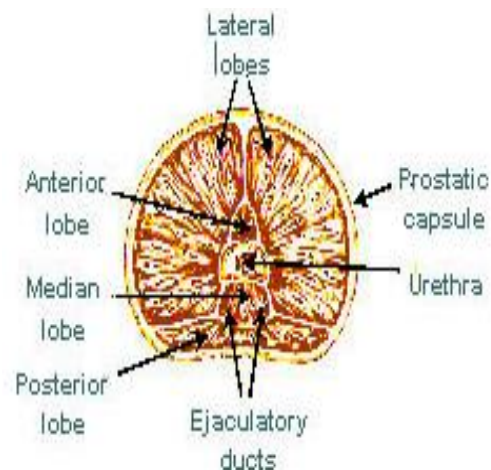
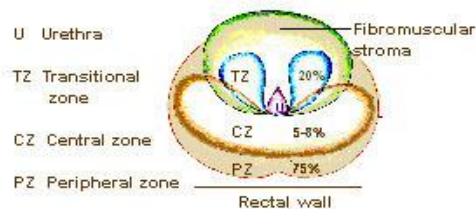
**Figure (2-3). Shows the parts of the prostate**

### **2-1-1 ZONALANATOMY OF THE PROSTATE**

The prostate gland was initially thought to be divided into five anatomical lobes, but it is now recognized that five lobes can only be distinguished in the fetal gland prior to 20 weeks' gestation. Between then and the onset of BPH, only three lobes are recognizable, two lateral and a median lobe. From an anatomical, and particularly from a morbid anatomical perspective, the glandular tissue may be subdivided into three distinct zones, peripheral (70% by volume), central (25% by volume), and transitional (5% by volume). Non glandular tissue (fibromuscular stroma) fills up the space between the peripheral zones anterior to the preprostatic urethra. The central zone surrounds the ejaculatory ducts, posterior to the preprostatic urethra, and is more or less conical in shape with its apex at the verumontanum. The transitional zone lies around the distal part of the

preprostatic urethra just proximal to the apex of the central zone and the ejaculatory ducts. Its ducts enter the prostatic urethra just below the preprostatic sphincter and just above the ducts of the peripheral zone. The peripheral zone is cup-shaped and encloses the central transitional zone and the preprostatic urethra except anteriorly, where the space is filled by the anterior fibromuscular stroma. Simple mucus-secreting glands lie in the tissue around the preprostatic urethra, above the transitional zone and surrounded by the preprostatic sphincter. These simple glands are similar to those in the female urethra and unlike the glands of the prostate.

The zonal anatomy of the prostate is clinically important because most carcinomas arise in the peripheral zone, whereas BPH affects the transitional zone. which may grow to form the bulk of the prostate



**Figure (2-4). Shows prostatic lobes**

**Figure (2-5) zones of the prostate Zones**

## 2-1-2 VASCULAR SUPPLY AND LYMPHATIC Drainage

### 2-1-2-1 Arteries

The prostate is supplied by branches from the inferior vesical, internal pudendal and middle rectal arteries. And the inferior vesical artery often arises from the internal iliac artery with the middle rectal artery.

### **2-1-2-2 Veins**

The veins form the prostatic venous plexus ,which is between the capsule of the prostate and fibrous sheath.

The prostatic plexus receives the deep dorsal vein of penis and numerous vesical veins and drains into the internal iliac veins.

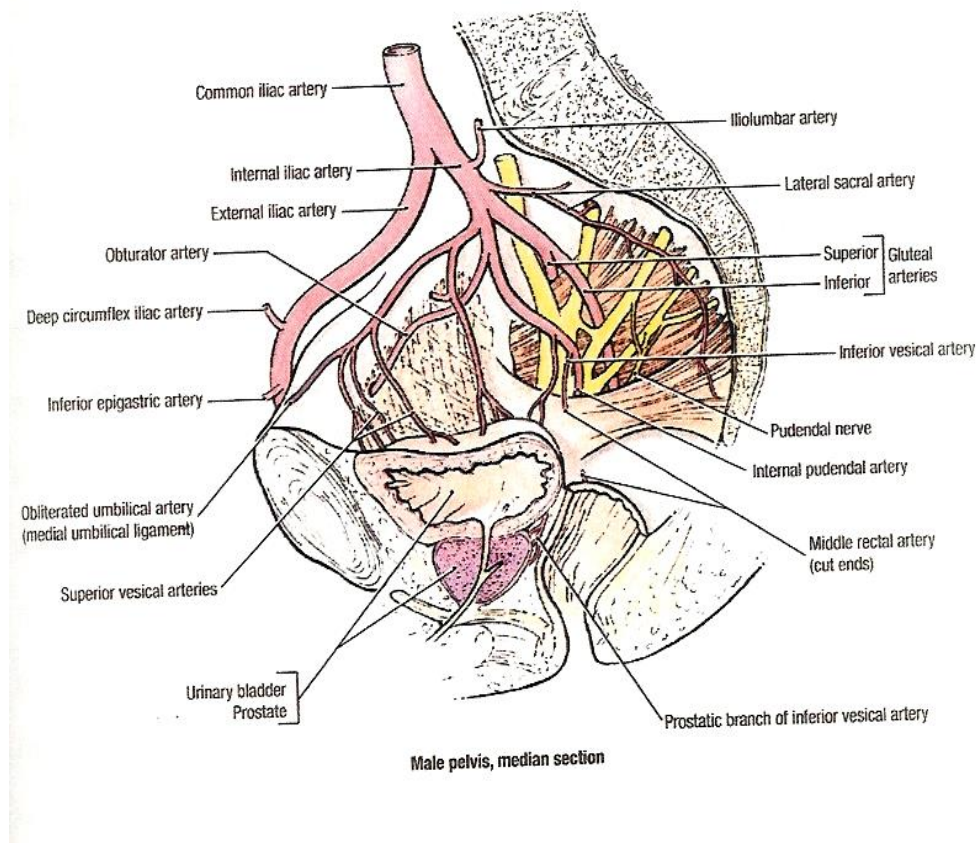
### **2-1-2-3 Lymphatic drainage**

Collecting vessels from the vas deferens drain into the external iliac nodes, while those from the seminal vesicle drain to the intemal and external iliac nodes. Prostatic vessels end mainly in internal iliac.

### **2-1-2-4 INNERVATION**

The prostate receives an abundant nerve supply from the inferior hypogastnc (pelvic) plexus.

The sympathetic nerve simulate the smooth muscle of the prostate during ejaculation.



**Fig: (2-6). Shows blood Supply of Prostate**

### **2-1-3MICROSTRUCTURE**

The glandular tissue consists of numerous follicles with frequent internal papillae. Follicles open into elongated canals which join to form 12—20 main ducts. The follicles are separated by loose connective tissue, supported by extensions of the fibrous capsule and muscular stroma and enclosed in a delicate capillary plexus. Follicular epithelium is variable but predominantly columnar, and either single-layered or pseudostratified.

Prostatic ducts open mainly into the prostatic sinuses in the floor of the prostatic urethra. They have a bilayered epithelium. the luminal layer columnar and the basal Layer is populated by small cuboidal cel. Small colloid amyloid bodies (corpora amylicea) are frequent in the follicles. Prostatic and seminal vesicular secretions form the bulk of seminal fluid.



Prostatic secretions are slightly acid, and contain acid phosphatase, amylase, prostate specific antigen, fibrinolysin and zinc. Numerous neuroendocrine cells, containing neuron-specific enolase, chromogranin and serotonin, are present in the glandular epithelium: their numbers decline after middle age and their function is unknown.

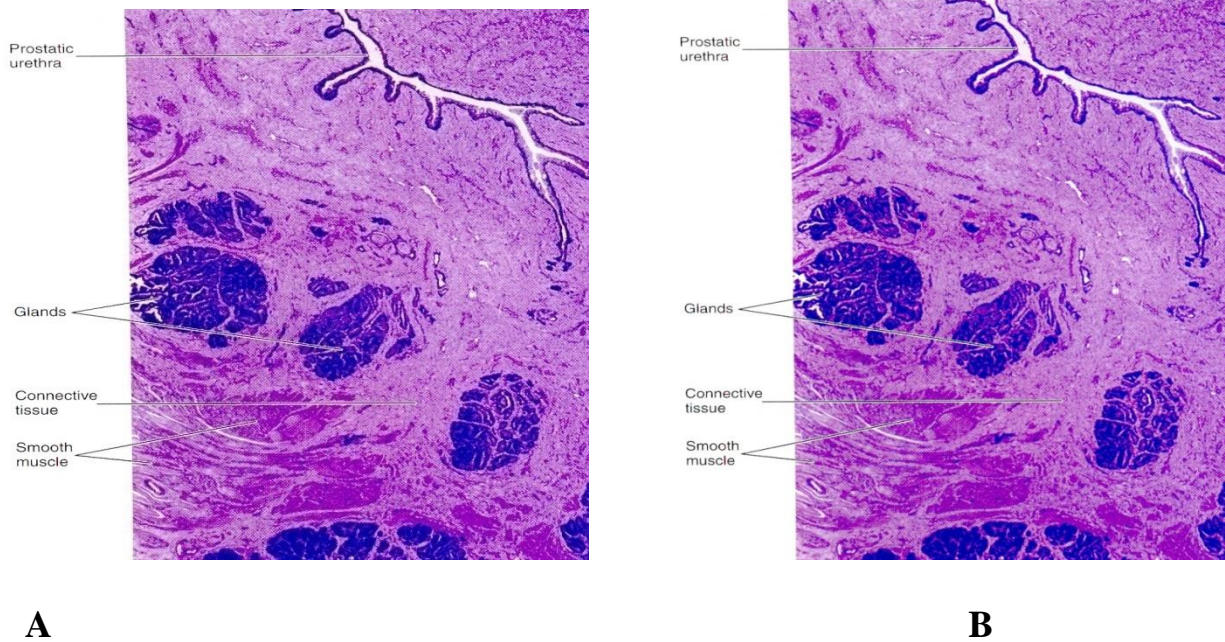


Fig: (2-7) (A) Histological section shows glands of the prostate surrounded by connective tissue and smooth muscle. (B) Histological section of the central region of the prostate showing the prostate urethra and tubuloalveolar glands surrounding by connective tissue and smooth muscles (Susan Standring2008).

## 2-2 Physiology of Prostate:

The prostate secretes a milky, slightly acidic fluid that contains several substances. Citric acid in prostatic fluid is used by sperm for ATP production via the Krebs cycle. Several proteolytic enzymes, such as prostate-specific antigen (PSA), pepsinogen, lysozyme, amylase, and hyaluronidase, eventually break down the clotting proteins from the

seminal vesicles. The function of the acid phosphatase secreted by the prostate is unknown. Seminalplasmin in prostatic fluid is an antibiotic that can destroy bacteria. Prostatic secretions make up about 25% of the volume of semen and contribute to sperm motility and viability.

### **2-2-1 Bulbourethral Glands**

During sexual arousal, the bulbourethral glands secrete an alkaline fluid into the urethra that protects the passing sperm by neutralizing acids from urine in the urethra. They also secrete mucus that lubricates the end of the penis and the lining of the urethra, decreasing the number of sperm damaged during ejaculation.

### **2-2-2 Semen**

Semen is a mixture of sperm and seminal fluid, a liquid that consists of the secretions of the seminiferous tubules, seminal vesicles, prostate, and bulbourethral glands. The volume of semen in a typical ejaculation is 2.5–5 milliliter (mL), with 50–150 million sperm per mL. When the number falls below 20 million/mL, the male is likely to be infertile.

Despite the slight acidity of prostatic fluid, semen has a slightly alkaline pH of 7.2–7.7 due to the higher pH and larger volume of fluid from the seminal vesicles. The prostatic secretion gives semen a milky appearance, and fluids from the seminal vesicles and bulbourethral glands give it a sticky consistency. (Gerard J. Tortora and Bryan Derrickson (2009)).

## **2-3 Pathology of the prostate:**

### **2-3-1 Inflammatory lesions:**

Apart from infection, the vas deferens and seminal vesicles are seldom the site of pathological changes. In gonorrhoea and urinary tract infections,

the organisms may cause suppuration in the seminal vesicles or prostate and spread along the vas to involve the epididymis. A cute prostatitis may also follow surgical instrumentation of the urethra or of the prostate itself. Chlamydial infections are also common but usually milder. (Text book of pathology 2002)

**(I) chronic prostatitis:**

May results from an acute infections and a number of other causes. The prostate initially enlarged and tender but many eventually become fibrosed and shrunken. Urethral obstruction may occur and the lesions may be mistaken clinically for prostate carcinoma. (Text book of pathology 2002)

**(II) Tuberculosis:**

Tuberculosis of the prostate shows characteristic glaucomatous ceseating lesions and may involve the whole gland. Tuberculosis may extend in either direction along the vas, depending on whether the initial site of infection of the genital tract was by haematogenous involvement of the epididymis, or by a setenism from the kidney to the urinary bladder and then to the prostate and vas deference. (Essential pathology 2000)

**(III) Granulomatous prostatitis:**

Is a rare condition in which an inflammatory infiltrate including giant cells, is present in relation to prostate ducts and glands. It my be a reaction to retained secretion (compare granulomatous orchitis). Histologically it may mimic tuberculosis. (Essential pathology 2000)

#### **(IV) Allergic (eosinophilic) prostatitis:**

With focal necrosis and heavy infiltration with eosinophils has been associated with allergic conditions, particularly asthma. Eosinophilic prostate may also occur because of parasitic infestation, e. g. schistosoma haematobium. (Essential pathology 2000)

#### **2-3-2 Benign Nodular Hyperplasia (BNH) (or benign prostatic hyperplasia (BPH):**

This is not a neoplastic process but represents an over growth of prostatic glandular tissue and smooth muscle and is comparable to conditions such as nodular goiter and cystic hyperplasia of the breast, It is very common and the incidence with age by the age of 80 over 75% of the males are affected to some degree although only some 5% have significant symptoms.

The cause is obscure but hormonal factors must be important:

- BNH does not occur in eunuchs or castrated men.
- BNH is not regarded as premalignant.

The process starts in the periurethral prostatic glands and the growth occurs mainly on each side of the urethra (in the so-called lateral lobes), although often there is a localized hyperplasia of the tissue just behind the urethra to form a rounded mass which projects into the bladder (the so-called Median lobe).

The hyperplastic tissue is usually firm, white and nodular but it may sometimes show areas of inflammation, abscess formation or infarction. Microscopically there is an increase in both the glandular elements and the stroma. The glands are usually arranged in well defined lobules and the acini are lined by tall columnar cells beneath which there is a basal cell layer the hyperplastic epithelium may extend into the Lumina of the

acini forming small papillary projections. Some of the acini may be dilated and small retention cysts can form. Tiny concentric concretions known as corpora amyloidea, formed from inspissated secretion, are commonly found, and deposition of oxalates and phosphates may produce prostatic calculi. The connective tissue stroma usually contains a substantial proportion of smooth muscle fibers. Fibromuscular hyperplasia is most prominent in the earlier stages of the process but in some cases it may be predominant, forming nodules in which glandular elements are scant. (Verhamme KM, Dieleman JP, Bleumink GS, et al. 2002).

### **2-3-3 Clinical Features:**

Prostatic hyperplasia is the most important cause of urinary obstruction and infection in older men. Although the prostatic urethra is distorted by BPH it is rarely significantly stenosed and the effects on bladder function result from a complex disturbance of the bladder sphincter mechanism by the protruding prostate rather than by simple obstruction. Accordingly, the symptoms of prostatism are more diverse than those of simple obstruction and the severity of the symptom does not correlate closely with prostatic size. There may be acute retention of urine or chronic partial obstruction sometimes with "overflow incontinence". Acute obstruction may be precipitated by infection or acute congestion of the gland caused by ingestion of alcohol or as part of the venous congestion of cardiac failure. Chronic obstruction leads to hypertrophy and dilatation of the bladder, followed in time by hydronephrosis and hydronephrosis. If unrelieved chronic renal failure may result. Urinary tract infection due to *Escherichia coli* mixed bacterial flora is frequently superadded ascending spread of infection resulting in pyelonephritis. (Verhamme KM, Dieleman JP, Bleumink GS, et al. 2002).

### **2-3-4 Carcinoma of the Prostate:**

This now one of the commonest cancer of an internal organ in males in the developed countries, its mortality rate being exceeded only by carcinomas of the bronchus, stomach and large intestine. Carcinoma of the prostate has its principle incidence later in life than most other cancer and its increasing incidence over the last 20 years is mainly attributable to the increased number of elderly men in the population.

There are marked racial and geographical variations in incidence; however American Negroes have the highest incidence in the world considerably greater than white Americans and greater than black Africans. There is a very low incidence in Chinese and Japanese.

The tumor usually arises on the posterior aspect and at the periphery of the gland out with the common lesions prostatic carcinoma and BNH frequently coexist but, as already stated, there is virtually no evidence that BNH is casually related to the development of malignancy.

The large majority of the prostatic carcinomas are adenocarcinomas. (Rietbergen JBW, Schroder FH:1988;37,515-532).

### **Appearance of Normal prostate shape:**

It appears like an inverted pyramid and lies posterior to the bladder. It is base superior to it is apex, and inferior to the urinary bladder in screen, with smooth outlines. The urethra passes through the center of the prostate before traversing to the penis.

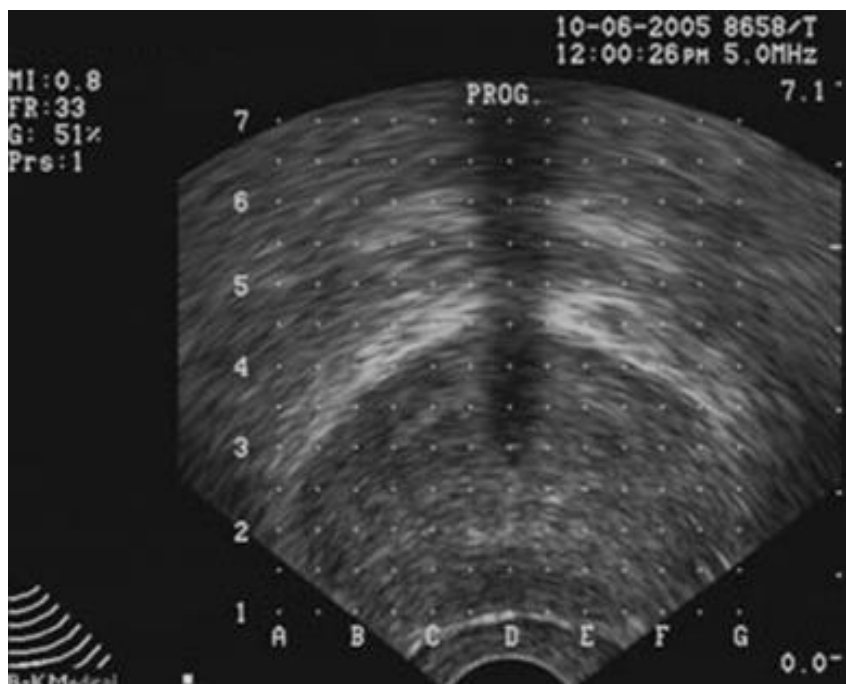
### **Normal Size and volume of the prostate:**

The transverse measurement of the gland is approximately 4cm; the anteroposterior dimension measures 3cm, and the cephalocaudal

(Thickness) dimension measures 3.8cm. A recent American Family Physician document reports:“the normal prostate volume is 20 to 30 mL”.

#### **2.4 Ultrasound appearance of normal prostate:**

By using a trans rectal scanning, the seminal vesicles are paired, relatively hypo echoic multi septated structures cephalad to the base of the prostate. The anterior urethra and it is surrounded smooth muscle and glandular area appears relatively hypo echoic and can be quite prominent measured 2cm in diameter. Because the sphincter is muscular, it frequency is very hypo echoic especially in young man. Often Corpora amylacea seen as an echogenic foci. Typically, the peripheral zone is more uniform in texture and slightly more echogenic than the transitional zone. The peripheral zone echogenisity is the standard for echogenisity in the prostate and is define to be isochenic. Echogenisity in other areas of the gland is compared to that of the peripheral zone.( Diagnostic Imaging Ultrasound. First Edition).



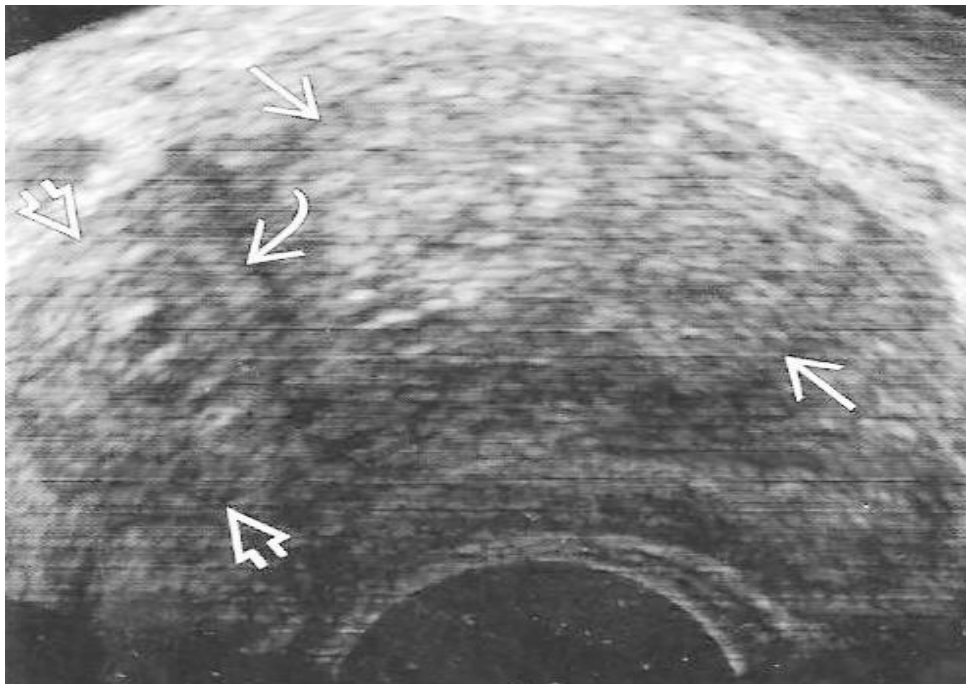
**Figure (2.8) Shows a transrectal ultrasound image of normal prostate**

#### **2.4.1 Sonographic appearance in acute prostatitis:**

Ultrasound features of acute prostatitis include hypo echoic swollen gland with increase in vascularity with or without cystic areas suggestive of abscess, but most cases of acute prostatitis sonographically have normal appearance.

#### **2-4-2 Sonographic appearance of chronic prostatitis:**

Sonographic findings of chronic prostatitis include focal masses of varying echogenicity, ejaculatory duct calcifications, capsular thickening or irregularity, irregular periurethral glandular area, dilatated periprostatic veins and distended seminal vesicles.



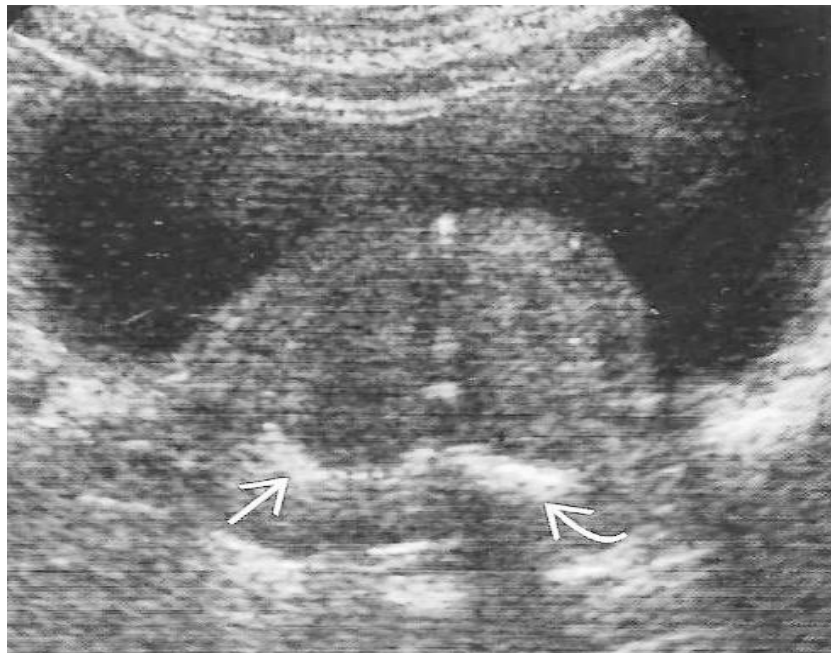
**Figure(2-9). Shows a trans rectal ultrasound image of chronic prostatitis**



### **2-4-3 Sonographic appearance of BPH:**

Sonographic appearance of BPH variable, depending on histopathologic changes. Diffusely enlarged transitional zone; inhomogeneous nodular texture; occasional finding of calcification and cystic change (80%).

Isoechoic hyperplastic nodules with halo may appear in peripheral zone mimicking carcinoma (20%). Delineation between peripheral zone and central zone becomes more obvious, some times out line by corpora amylacea along surgical capsule. Hyperplastic nodules may undergo cystic degeneration forming rigged cystic masses.



**Figure(2-10). Shows a trans abdominal ultrasound image of BPH**

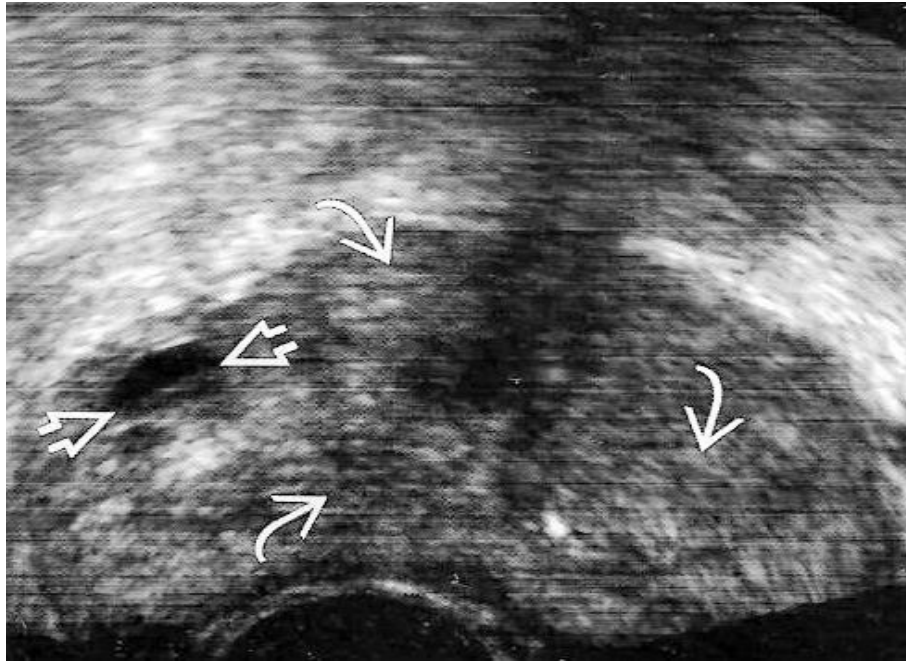
### **2-4-4 Sonographic appearance of prostate carcinoma:**

In ultrasound prostatic Ca appears as hypo echoic (60 – 70%), hyper echoic (1-5%), Iso echoic (30-40%) or diffuses lesions, depends on amount of stromal fibrosis. Most peripheral isoechoic lesions close to capsule cause asymmetry contour and bulging of lateral border. Isoechoic

tumors identified by indirect signs: Areas of attenuation, glandular asymmetry and capsular distortion.

Large diffuse tumors tend to be more echogenic.

Benign nodules related to prostatitis, BPH, atrophy and infarction can mimic prostatic Ca(Diagnostic Imaging Ultrasound. First Edition).



**Figure (2-11). Shows a trans rectal ultrasound image of Ca prostate**

### **2-5 Prostate specific antigens (PSA):**

Is a protein produced by the cells of the prostate gland. PSA is present in small quantities in the serum of normal men, and is often elevated in the presence of prostate cancer and in other prostate disorders. A blood test to measure PSA is considered the most effective test currently available for the early detection of prostate cancer, but this effectiveness has also been questioned. Rising levels of PSA over time are associated with both localized and metastatic prostate cancer (Ca Prostate)

### **2.5.1 PSA density:**

PSA production by benign tissue (normal and hyperplastic) is less than production by cancer. If there is an excess PSA level above that which is predicted from gland volume as measured by U/S, then there is an increased chance of cancer. PSA density is determined by (PSA/volume).

Restricting biopsy in the PSA 4 to 10 ng/ml groups to those with PSA density greater than 0.12 will detect about 80% of those with cancer in this group and avoid many biopsies. This suggests that the PSA level is consistent with the prediction from gland volume and not excessive and hence, biopsy would be avoided with about 80% confidence that cancer is not present. Others have suggested PSA density ranging from 0.05 to 0.15, remember that in all cases, a proportion of cancers will be missed and these men need continued surveillance. (Littrup P Kane RA, Mellen CJ, et. 2000)

### **2.5.2 Age-specific PSA:**

PSA normally increase with age. It has been suggested that by using different threshold PSA levels at different ages, it may be possible to make PSA more sensitive in younger men, and less sensitive in older men. Suggested ranges are: 40 to 49 years-0.0 to 2.5 ng/ml; 50 to 59 years-0.0 to 3.5 ng/ml; 60 to 69 years-0.0 to 4.5 ng/ml; 70 to 79 years-0.0 to 6.5 ng/ml. although PSA does increase with age, the chance is very slight. Most of the increase with age is due to the larger prostates due to BPH found in older men. Hence, age-specific PSA is really a surrogate the age specific to be useful.

### **2-5-3 PSA velocity:**

PSA levels in men with cancer usually rise more rapidly than with BPH. The rate of rise over time is termed velocity. If three PSA tests are done over 2 years and the rate of rise exceeds 0.75 ng/ml/year, then this rapid change (velocity) is claimed to distinguish subjects with CA from those with BPH with a specificity of 99%. Many labs do not wait for two years and offer biopsy if there is an unexplained rise in the 4 to 10 ng/ml group of greater than 1 ng/ml between two tests less than a year apart.

### **2-5-4 PSA test results:**

PSA test results report the level of PSA detected in the blood. The test results are usually reported as nanograms of PSA per milliliter (ng/mL) of blood. In the past, most doctors considered PSA values below 4.0 ng/mL as normal. However, recent research found prostate cancer in men with PSA levels below 4.0 ng/mL.

Many doctors are now using the following ranges with some variation:

- 0 to 2.5 ng/mL is low.
- 2.6 to 10 ng/mL is slightly to moderately elevated.
- 10 to 19.9 ng/mL is moderately elevated.
- 20 ng/mL or more is significantly elevated.

There is no specific normal or abnormal PSA level. The higher a man's PSA level, the more likely it is that cancer is present. But because various factors (such as age) can cause PSA levels to fluctuate, one abnormal PSA test does not necessarily indicate a need for other diagnostic tests. When PSA levels continue to rise over time, other tests may be needed. It should be noted that it is common for normal PSA ranges to vary somewhat from laboratory to laboratory. (D'Amico, AV, Chen, MH, Roehl, KA, Catalona, WJ: Pre 2004)

## **2-6 Previous studies:**

-Study appears in 2007 in AL-ZAEM ALAZHARI university which done by AMER AHMAD ELHADJ.

Methodology:

Transabdominal u/s scanning done to patient with enlarged prostate for measuring their prostate dimension and volume.

Result:

1/ u/s is a good diagnostic tool in diagnosis of the prostate pathogenesis.

2/ there is significant proportional relation between patient age and prostate gland size, the prostate gland size is apparently increased with increasing age.

-study done by M.ELSAMANI et al (2005)

Sonographic finding of prostate in Saudi population.

ultrasound is the tool of choice in detection of abnormal prostatic finding and BPH. Home found that the incidence of BPH increase direct proportional with age.

-study done by MATHIAS OELKE et al(2007) diagnostic accuracy of non invasive taste to evaluate bladder out let obstruction in men, detrusor wall thickness, uroflometry, post void residual urine. And prostatic volume, the all investigated index tests different significantly between obstructed and non obstructive men.

- study done by BABIKER 2009 in Sudan university.

Role of u/s versus total and free prostatic specific antigen in diagnosis of benign and malignant tumor of prostatic gland.

## Result:

-BPH is the homogenous echo texture, regular out line, with presence of u/s finding or not.

-age and sexual activity are risk factor for prostatic disorder.

-study done by Ngken Hoo et al (ISBN978-61804-122-7) in UTM university for technology of malaysia .

## Methodology:

prostatic volume measurement using transabdominal ultrasound scanning.

## result:

the prostate is larger for man with larger body size.

# **Chapter three**

## **Materials and Methods**

## Chapter Three

### Materials and Methods

#### 3-1: Materials

##### 3-1-1 Subjects:

This is a descriptive prospective study, carried out in order to state the abnormal measurement of prostate gland(**BPH**) in Khartoum state

This study was conducted indifferent hospital and health centers in Khartoum state

Cross section study will include 50 male subjects from 35 to 90 years old will select to undergo the transabdomial ultrasound scanning.

The subject were randomly selected with deferent status age, social status, occupation and prostatic volume to find the correlation of this parameters to BPH

Prostate ultrasonographic scanning protocols over all ultrasonographic scanning will conducted by using mindray machine

The subjects well first instructed to fully fill their urinary bladder by consuming water 30 minutes before the measurement .this was to ensure that the anatomy of prostate could be well imaged and observed the measurement will conduct by placing the transducer on the superficial of the lower abdominal area with subjects laid in supine position during scanning.

##### 3-1-2 Machine used:

Ultrasound machines mindray DP50 made in china , DP110 made in china all of which has major machine tow probes ;with full us



department facilities, and ultrasound gel is applied in transducer to prevent the attenuation or artifact. The device well set to a 2D The device well set to a 2D and convex probe with the frequency of 3,5MHz to 5 MHz will use for imaging from longitudinal and transverse planes and convex probe with the frequency of 3,5MHz to 5 MHz will use for imaging from longitudinal and transverse planes.



**Figure(3-1). Shows machine use for data collection**

### **3-2 Methods:**

#### **3-2-1 Technique used:**

The study conduct by(TAUS),The patient lies supine and should have full bladder,500 ml of water ,one hour before the scan if possible is recommended ,the probe is angled approximately 30 degrees caudal using the bladder as window .slight compression to ensure the inferior portion of the prostate is not obscure by the shadow artifact from the base of the bladder. Transabdominal ultrasound can assess the volume of the prostate .the patient lies supine with amount of gel is poured on the anterior part

of the pubic region. Segital and transverse scanning is then preformed to assess the entire prostate in many planes.

### **3-2-2 Measurement of the prostate volume**

Was taken by measuring transverse and depth diameter in transverse plane, in segital plane taken longitudinal diameter.

Volume of prostate = transverse diameter depth diameter length diameter

Diameter multiply 0,52.

Normal volume of prostate = 20 cm<sup>3</sup>

### **3-2-3 Data collection method (data sheet)**

The data of this thesis is collected by using special data collection sheet, which contains ten variables, divided into two parts personal data, and sonographic findings. These data were collected in the following ways

The personal data consists of four variables: patient's index, age occupation, and marital status. The patient's age and marital status were picked up from the patient by direct questions to him (after taking permission). The sonographic finding data includes six variables which are: the length, width, depth, volume, echogenicity, texture presence of mass and site of mass of the prostate gland. These variables are taken also by the sonologist from the US machine while they were doing the scan, also after the patient has been informed and agree of it.

### **3-2-4 Data analysis**

The data was analyzed using Statistical Packaged for Social Studies (SPSS) version 20. Using frequency tables and bar graphs to inter present the variables used in the data collected. Also a correlation tests and

scatters plots to find out the definite relationships between the( BPH) volumes and the other variables under study..

### **3-2-5 Data storage:**

Data was stored in personal computer, and data sheets were kept safely and responsibly.

### **3-2-6 Ethical consideration**

Verbal permissions were taken from the patients before doing scans, and they were informed about the study, and accept it. Also the patients get sure that their details will not be exposed. Before that verbal permissions were also taken from the head mangers of the hospitals, and health centers where the study is conducted.

# **Chapter four**

## **Results**

## Chapter four

### Results

This study was carried out on( 50) patient of BPH were examine with the following result according to the age, occupation, social status (single / married,), prostatic volume(depth ,width, length), and ultrasound finding.

**Table (4.1) frequency distribution of age\years:**

| Age\ years | Frequency | Percent | Valid Percent | Cumulative Percent |
|------------|-----------|---------|---------------|--------------------|
| 38-48      | 3         | 6.0     | 6.0           | 6.0                |
| 49-59      | 12        | 24.0    | 24.0          | 30.0               |
| 60-70      | 17        | 34.0    | 34.0          | 64.0               |
| 71-81      | 14        | 28.0    | 28.0          | 92.0               |
| 82-90      | 4         | 8.0     | 8.0           | 100.0              |
| Total      | 50        | 100.0   | 100.0         |                    |

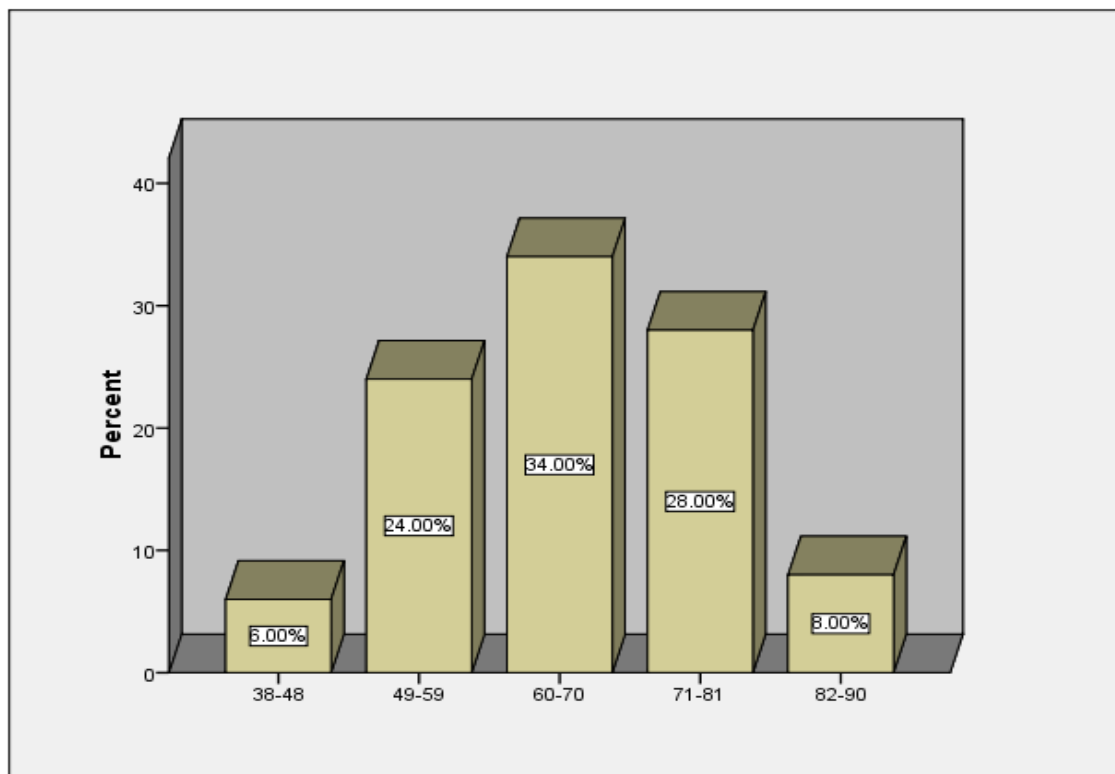
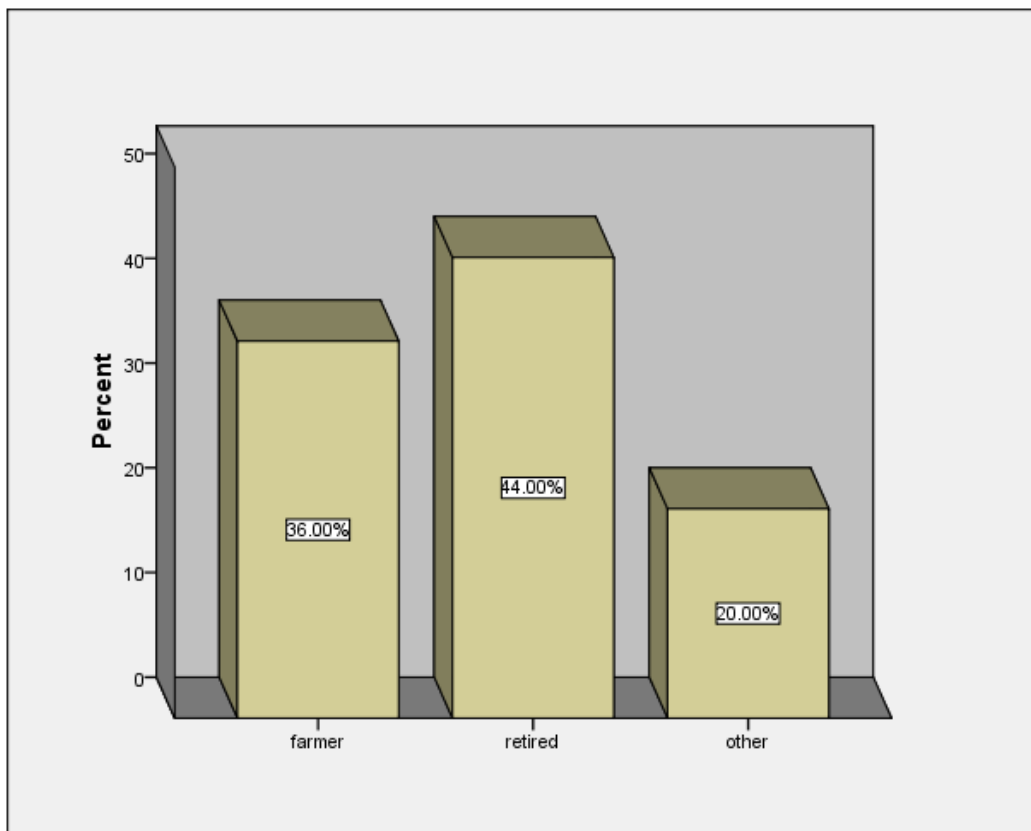


Figure (4.1) frequency distribution of age

**Table (4.2) frequency distribution of occupations:**

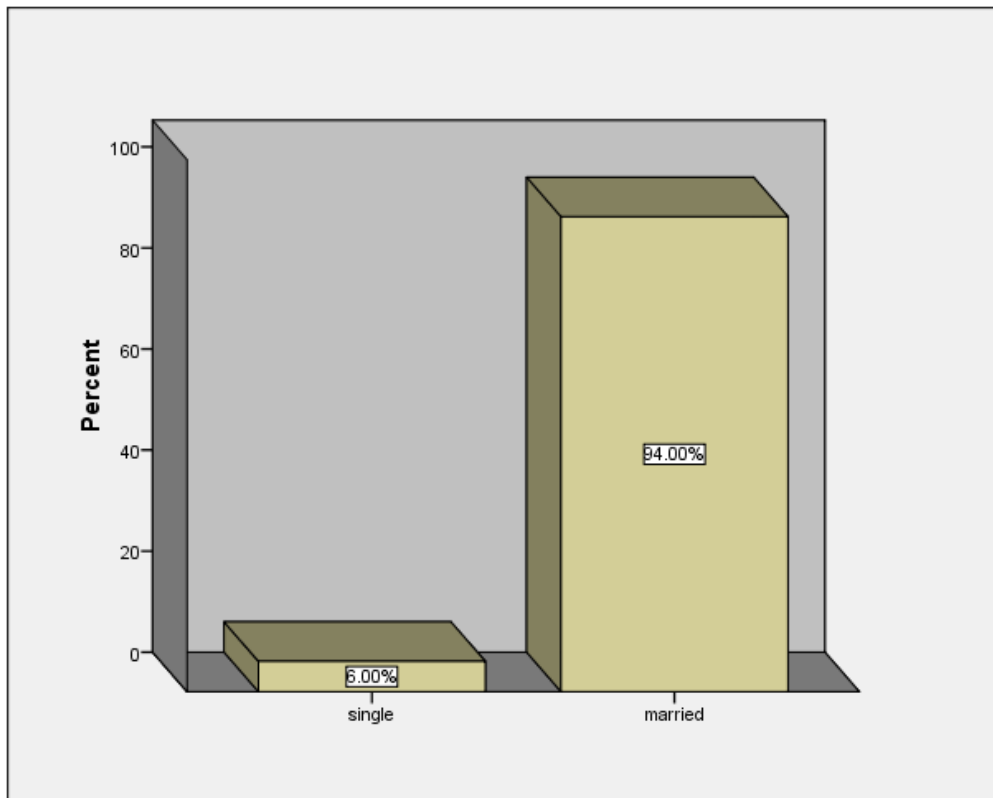
| <b>Occupation</b> | <b>Frequency</b> | <b>Percent</b> | <b>Valid Percent</b> | <b>Cumulative Percent</b> |
|-------------------|------------------|----------------|----------------------|---------------------------|
| Farmer            | 18               | 36.0           | 36.0                 | 36.0                      |
| Retired           | 22               | 44.0           | 44.0                 | 80.0                      |
| Other             | 10               | 20.0           | 20.0                 | 100.0                     |
| Total             | 50               | 100.0          | 100.0                |                           |



**Figure (4.2) frequency distribution of occupations**

**Table (4.3) frequency distribution of marital status:**

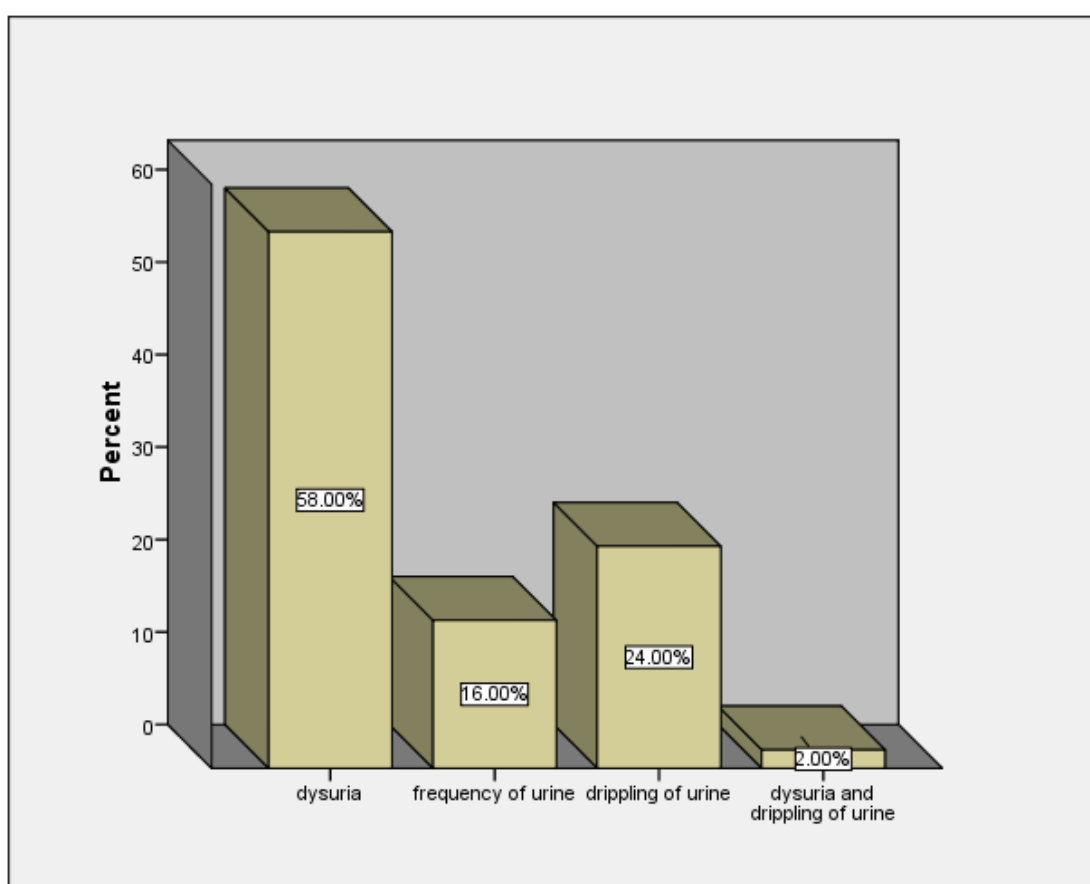
| <b>Marital status</b> | <b>Frequency</b> | <b>Percent</b> | <b>Valid Percent</b> | <b>Cumulative Percent</b> |
|-----------------------|------------------|----------------|----------------------|---------------------------|
| Single                | 3                | 6.0            | 6.0                  | 6.0                       |
| Married               | 47               | 94.0           | 94.0                 | 100.0                     |
| Total                 | 50               | 100.0          | 100.0                |                           |



**Figure (4.3) frequency distribution of marital status**

**Table (4.4) frequency distribution of complains:**

| <b>Complains</b>              | <b>Frequency</b> | <b>Percent</b> | <b>Valid Percent</b> | <b>Cumulative Percent</b> |
|-------------------------------|------------------|----------------|----------------------|---------------------------|
| Dysuria                       | 29               | 58.0           | 58.0                 | 58.0                      |
| Frequency of urine            | 8                | 16.0           | 16.0                 | 74.0                      |
| Dripping of urine             | 12               | 24.0           | 24.0                 | 98.0                      |
| Dysuria and dripping of urine | 1                | 2.0            | 2.0                  | 100.0                     |
| Total                         | 50               | 100.0          | 100.0                |                           |



**Figure (4.4) frequency distribution of complains**



**Table (4.5) Descriptive statistic for age, length, width and thickness of prostate (minimum, maximum , mean  $\pm$  Std. Deviation):**

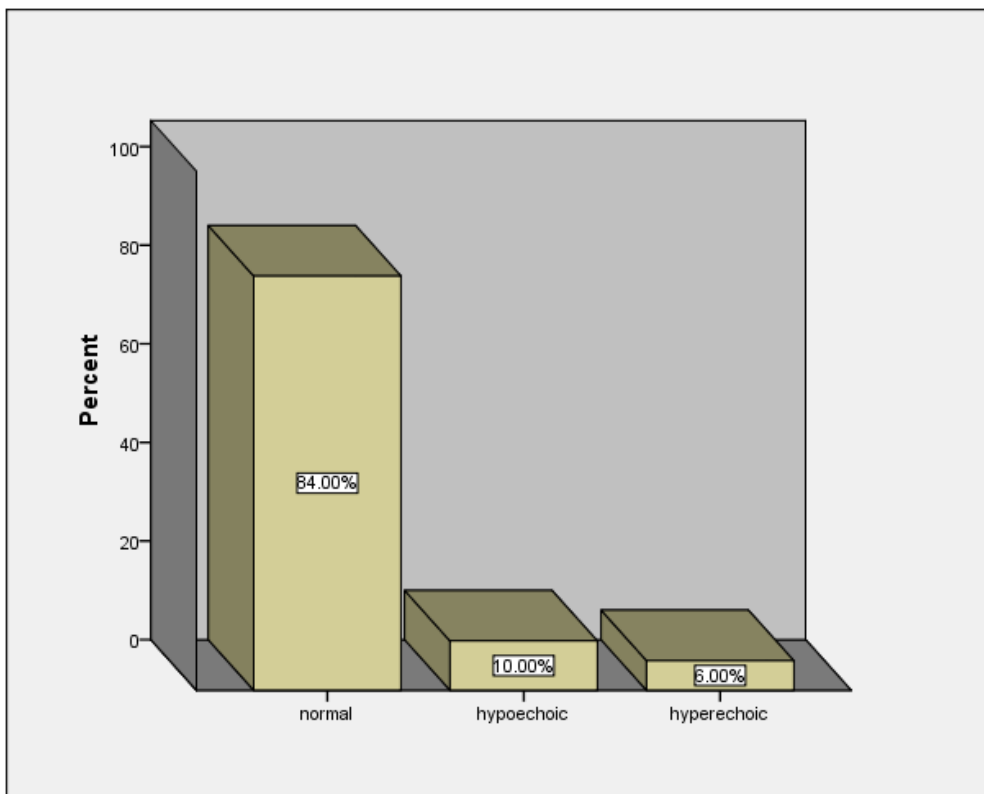
| <b>Descriptive</b> | <b>N</b> | <b>Minimum</b> | <b>Maximum</b> | <b>Mean</b> | <b>Std. Deviation</b> |
|--------------------|----------|----------------|----------------|-------------|-----------------------|
| Age                | 50       | 38             | 90             | 65.74       | 11.36                 |
| Length             | 50       | 4.31           | 7.40           | 5.56        | .73                   |
| Width              | 50       | 3.51           | 6.14           | 4.72        | .66                   |
| Thickness          | 50       | 3.47           | 6.92           | 5.0862      | .68                   |
| Volume             | 50       | 37.01          | 145.42         | 71.46       | 24.08                 |
| Valid N (listwise) | 50       |                |                |             |                       |

**Table (4.6) frequency distribution of shape changes:**

| <b>Shape changes</b> | <b>Frequency</b> | <b>Percent</b> | <b>Valid Percent</b> | <b>Cumulative Percent</b> |
|----------------------|------------------|----------------|----------------------|---------------------------|
| No                   | 38               | 76.0           | 76.0                 | 76.0                      |
| Yes                  | 12               | 24.0           | 24.0                 | 100.0                     |
| Total                | 50               | 100.0          | 100.0                |                           |

**Table (4.7) frequency distribution of echogenicity :**

| <b>Echogenicity</b> | <b>Frequency</b> | <b>Percent</b> | <b>Valid Percent</b> | <b>Cumulative Percent</b> |
|---------------------|------------------|----------------|----------------------|---------------------------|
| Normal              | 42               | 84.0           | 84.0                 | 84.0                      |
| Hypoechoic          | 5                | 10.0           | 10.0                 | 94.0                      |
| Hyperechoic         | 3                | 6.0            | 6.0                  | 100.0                     |
| Total               | 50               | 100.0          | 100.0                |                           |



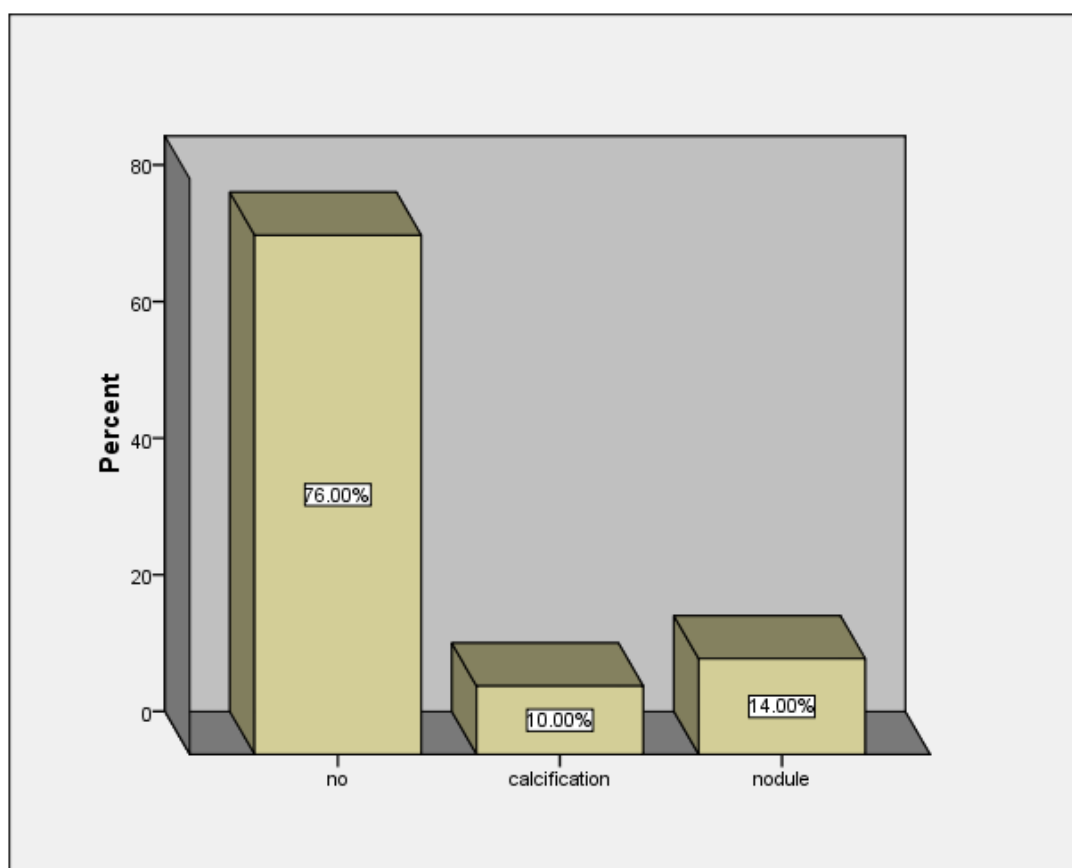
**Figure (4.5) frequency distribution of echogenicity**

**Table (4.8) frequency distribution of echo texture:**

| <b>Texture</b> | <b>Frequency</b> | <b>Percent</b> | <b>Valid Percent</b> | <b>Cumulative Percent</b> |
|----------------|------------------|----------------|----------------------|---------------------------|
| Homogeneous    | 47               | 94.0           | 94.0                 | 94.0                      |
| Heterogeneous  | 3                | 6.0            | 6.0                  | 100.0                     |
| Total          | 50               | 100.0          | 100.0                |                           |

**Table (4.9) frequency distribution of presence of nodules and calcification (mass):**

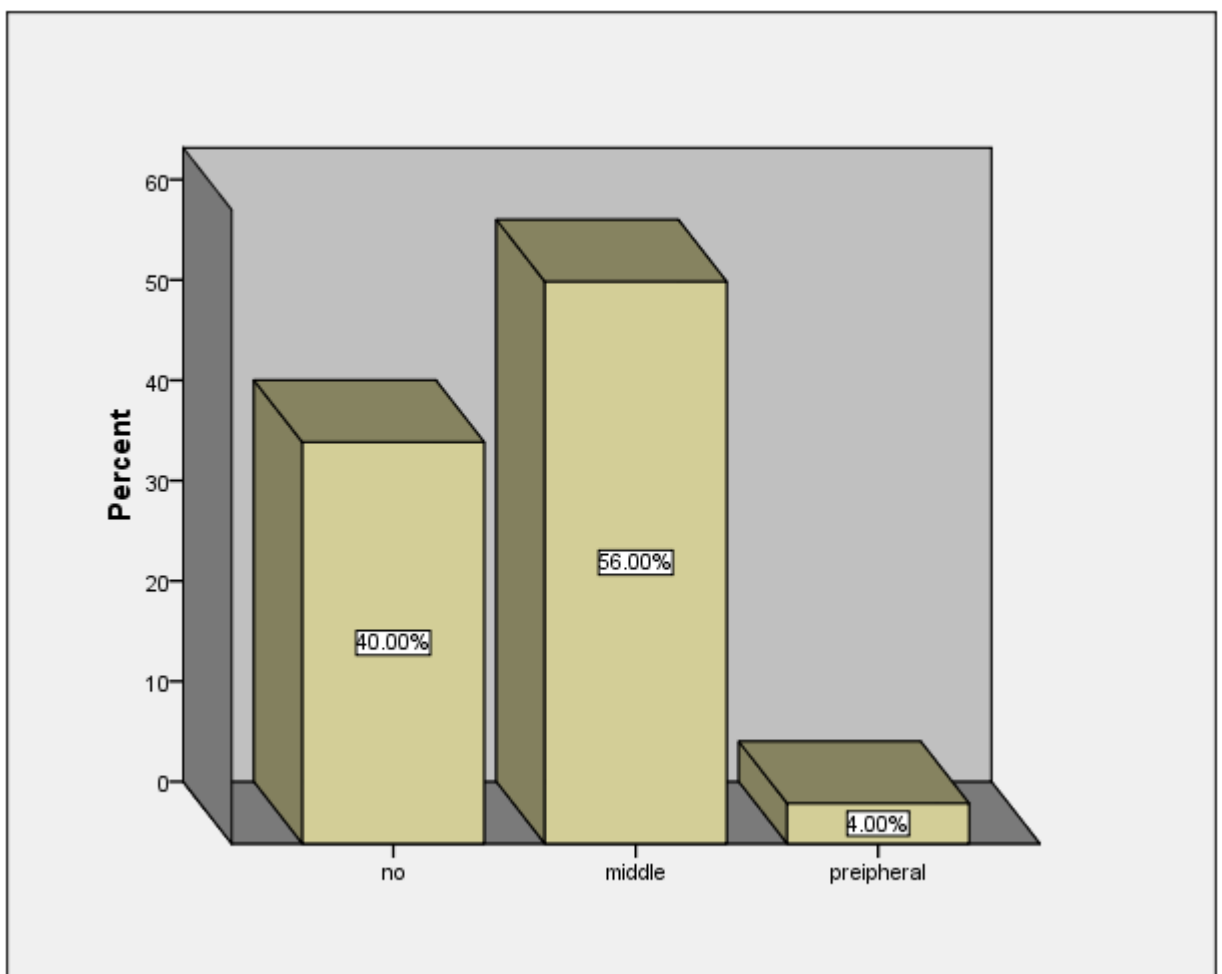
| <b>Findings</b> | <b>Frequency</b> | <b>Percent</b> | <b>Valid Percent</b> | <b>Cumulative Percent</b> |
|-----------------|------------------|----------------|----------------------|---------------------------|
| No              | 38               | 76.0           | 76.0                 | 76.0                      |
| Calcification   | 5                | 10.0           | 10.0                 | 86.0                      |
| Nodule          | 7                | 14.0           | 14.0                 | 100.0                     |
| Total           | 50               | 100.0          | 100.0                |                           |



**Figure (4.6) frequency distribution of presence of nodules and calcification**

**Table (4.10) frequency distribution of site of mass:**

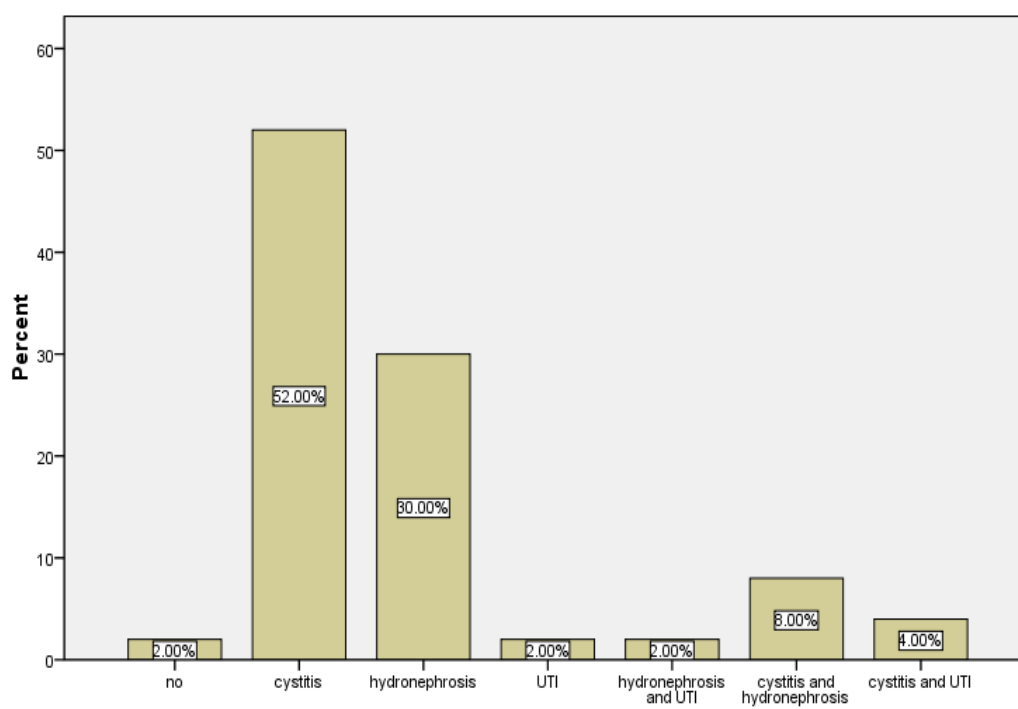
| Site       | Frequency | Percent | Valid Percent | Cumulative Percent |
|------------|-----------|---------|---------------|--------------------|
| No         | 20        | 40.0    | 40.0          | 40.0               |
| Middle     | 28        | 56.0    | 56.0          | 96.0               |
| Peripheral | 2         | 4.0     | 4.0           | 100.0              |
| Total      | 50        | 100.0   | 100.0         |                    |



**Figure (4.7) frequency distribution of site of mass**

**Table (4.11 ) frequency distribution of complications:**

| Complications               | Frequency | Percent | Valid Percent | Cumulative Percent |
|-----------------------------|-----------|---------|---------------|--------------------|
| No                          | 1         | 2.0     | 2.0           | 2.0                |
| Cystitis                    | 26        | 52.0    | 52.0          | 54.0               |
| Hydronephrosis              | 15        | 30.0    | 30.0          | 84.0               |
| UTI                         | 1         | 2.0     | 2.0           | 86.0               |
| Hydronephrosis and UTI      | 1         | 2.0     | 2.0           | 88.0               |
| Cystitis and hydronephrosis | 4         | 8.0     | 8.0           | 96.0               |
| Cystitis and UTI            | 2         | 4.0     | 4.0           | 100.0              |
| Total                       | 50        | 100.0   | 100.0         |                    |



**Figure (4.8) frequency distribution of complications**

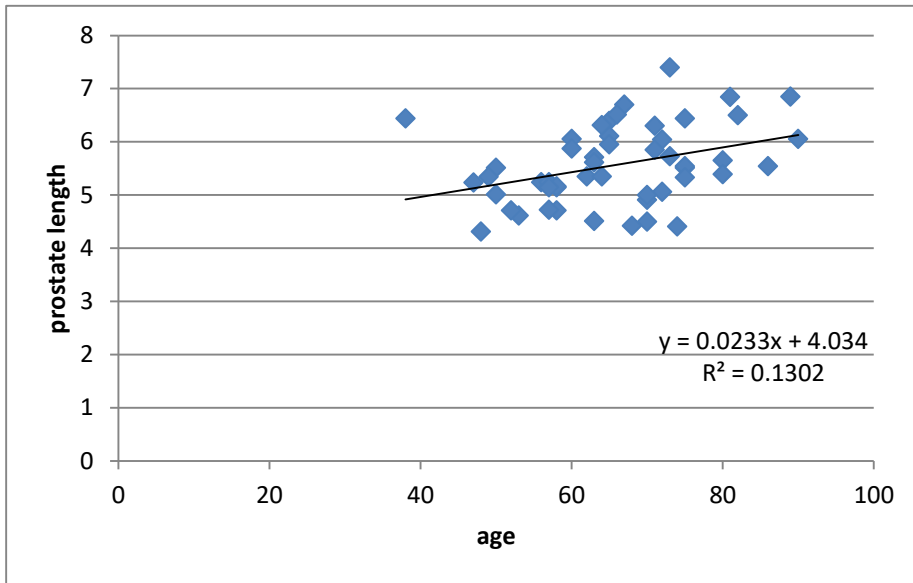


Figure (4.9) scatterplot shows linear relationship between age and prostate length

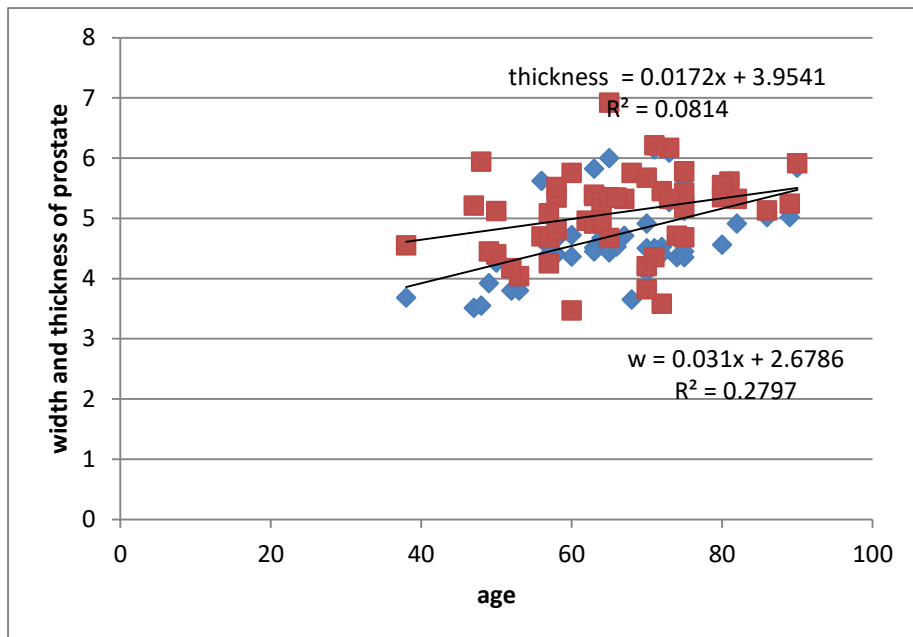


Figure (4.10) scatterplot shows linear relationship between age and prostate width, thickness

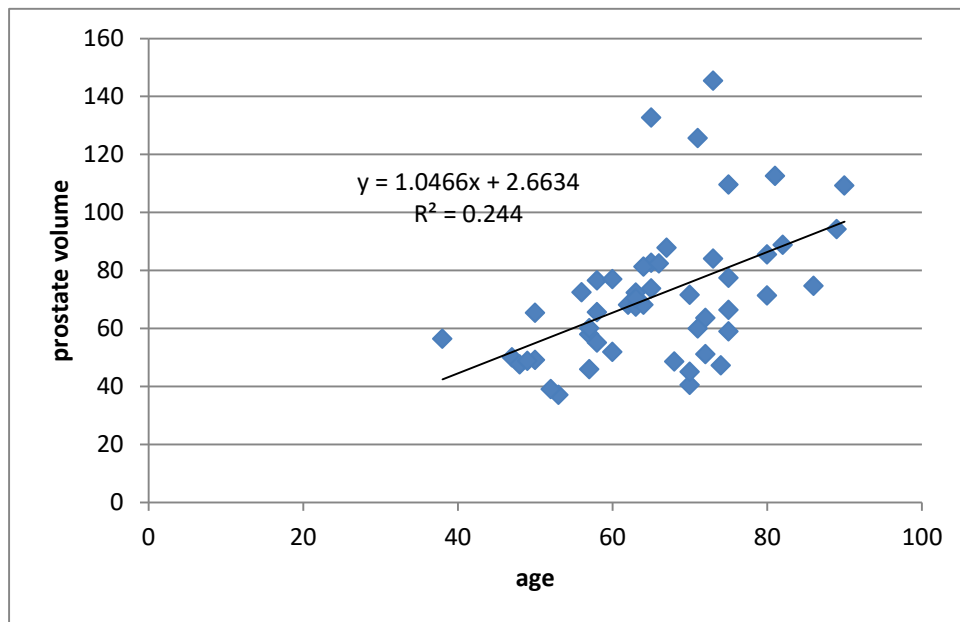


Figure (4.11) scatterplot shows linear relationship between age and prostate volume

**Table (4.15) correlation between prostate measurements and age:**

|           |                     | Age    | Length | Width  | Thickness | Volume |
|-----------|---------------------|--------|--------|--------|-----------|--------|
| Age       | Pearson Correlation | 1      | .361*  | .529** | .285*     | .494** |
|           | Sig. (2-tailed)     |        | .010   | .000   | .045      | .000   |
|           | N                   | 50     | 50     | 50     | 50        | 50     |
| Length    | Pearson Correlation | .361*  | 1      | .486** | .301*     | .746** |
|           | Sig. (2-tailed)     | .010   |        | .000   | .034      | .000   |
|           | N                   | 50     | 50     | 50     | 50        | 50     |
| Width     | Pearson Correlation | .529** | .486** | 1      | .440**    | .829** |
|           | Sig. (2-tailed)     | .000   | .000   |        | .001      | .000   |
|           | N                   | 50     | 50     | 50     | 50        | 50     |
| Thickness | Pearson Correlation | .285*  | .301*  | .440** | 1         | .736** |
|           | Sig. (2-tailed)     | .045   | .034   | .001   |           | .000   |
|           | N                   | 50     | 50     | 50     | 50        | 50     |
| Volume    | Pearson Correlation | .494** | .746** | .829** | .736**    | 1      |
|           | Sig. (2-tailed)     | .000   | .000   | .000   | .000      |        |
|           | N                   | 50     | 50     | 50     | 50        | 50     |

\*. Correlation is significant at the 0.05 level (2-tailed).

\*\* . Correlation is significant at the 0.01 level (2-tailed).

**Table (4.16) compares mean prostate volume and shape changes:**

| <b>Shape changes</b> | <b>Mean</b> | <b>N</b> | <b>Std. Deviation</b> | <b>P value</b> |
|----------------------|-------------|----------|-----------------------|----------------|
| No                   | 65.7290     | 38       | 19.28177              | 0.002          |
| Yes                  | 89.6239     | 12       | 29.32140              |                |
| Total                | 71.4638     | 50       | 24.08340              |                |

**Table (4.17) compares mean prostate volume and presence of mass:**

| <b>Volume</b>           |             |          |                       | <b>P value</b> |
|-------------------------|-------------|----------|-----------------------|----------------|
| <b>Presence of mass</b> | <b>Mean</b> | <b>N</b> | <b>Std. Deviation</b> |                |
| No                      | 63.47       | 38       | 15.26026              | 0.000          |
| Calcification           | 75.86       | 5        | 25.77570              |                |
| Nodule                  | 111.70      | 7        | 23.41767              |                |
| Total                   | 71.4638     | 50       | 24.08340              |                |



# **Chapter Five**

## **Discussion, Conclusion and Recommendations**

## Chapter Five

### Discussion, Conclusion and Recommendations

#### 5-1 Discussion:

The result of this study showed that the mean the patient age average was 60 – 70 years, age most affected by BPH therefore the increasing of age is a risk factor for prostatic disorders ranged from 38 – 90 years in table (4.1).

The result dictated that the age of patient mostly present with increase prostate volume, expected this relationship was apparent in table (4.14) (4.15) which displayed relation between the prostate volume and patient age, the result conclude that when the age increase the prostatic volume increase which had direct linear relationship or significant correlation between age and BPH. this study was agree with {Amer Ahmad Alhadj (2007) and M.Elsamani et al (2005)}

-Table (4.2) showed distribution of patient occupation during the study farmer 18(36%) ,retired 22(44%), others 10(20%)

-Table (4.3) showed frequency distribution number of marital status (married. Single) and BPH, the mean is the marring 47(94%) single3(6%)

Table (4.4) showed distribution of patient clinical signs which 29 patient (58%) dysuria while 8 patient(16%) complain of frequency of urine and 13 patient (26%) have dripping of urine

-Table (4.5) which found mean of Depth (AP) (5.08) with stander deviation .73

Width (thickness) (4.72)) with stander deviation(.66).

Length (5.56) with stander deviation..73

Volume (71.46) with stander deviation 24.08.

Study found that (4. 5) the depth, width, volume had significant correlation between them and normal and BPH.

Table (4.6) showed distribution of patient prostate shape change

38(76%)no change in shape which12of patient (24%) presence change in shape As shown in table (4.7) there are 42 patients (84%) out of 50 cases are normal echogenicity. While 5 patient (10%) hypo echoic texture, and there were 3 patient (6%) of these patients hyper echoic texture

Table (4.8) showed ultrasound finding in prostatic texture 47 of patient (94%) with homogenous echo pattern while of 3 patient (6%) with heterogeneous echo pattern.

Table (4.9) showed other finding associated with BPH.

-BPH without other finding 38 of patient (76%).

-BPH with classification 5 of patient (10%).

-BPH with nodules7 of patient (14%).

Table (4.11) showed the complication of BPH, 26 patient(52%) with cystitis. 15 patient (30%) hydronephrosis ,one patient (2%) nocomplication.one patient (2%) UTI. , one patient (2%) UTI and hydronephrosis,4 patient(8%) . cystitis and hydronephrosis ,2 patient (4%) UTI and cystitis

All this means that ultrasound finding in case of BPH usually include homogenous echo texture, regular out line, with or without presence of classification, cyst, Babekir 2009, Mathias oelke et al (2007) and M.Elsamani et al (2005) agree with my study.

## **5-2 Conclusion:**

The ultrasound is the effective image modality in detection of prostatic disorder, and able to differentiate BPH from other disease but there is other modality to confirm the diagnosis.

The study found that there is significant correlation between age, depth, width, volume, shape and texture, with BPH, and no statistically correlation between BPH and other factor.

The BPH usually characterized by homogenous echo pattern, regular outline, with or without presence of calcification, cyst, diverticulum, and residual urine may be found or not.

### **5-3 Recommendation:**

From the result of the study the researcher won't like to recommend the following:

- health center and clinics must be provided height quality ultrasound machine with color Doppler.

- is important use elastography to give final diagnosis if this BPH or Ca to prevent the patient from biopsy.

- TRUS sonography has high sensitivity and specificity in visualization of prostate volume.

- post residual scan for elder patient is important.

- clear and specific instruction must be given to patient to be full bladder for good evaluate the prostate.

- PSA recommended in case of BPH.

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