



بسم الله الرحمن الرحيم

**Sudan University of Science and Technology**

**College of graduate studies**



## **A Study of Benign Prostatic Hyper Plasia by Ultrasonography**

دراسة حجم تضخم غدة البروستاتا باستخدام التصوير بالموجات فوق الصوتية

**A Thesis submitted For Partial Fulfillment of Requirement of the Master in  
Radiological Diagnostic Imaging**

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**2017-2018**

## الآية

بسم الله الرحمن الرحيم

قال تعالى (فَتَنبَسَمُ ضَاغًا مِنْ قَوْلِهَا وَقَالَ رَبِّ أَوْزِعْنِي أَنْ أَشْكُرَ نِعْمَتَكَ الَّتِي أَنْعَمْتَ عَلَيَّ وَعَلَىٰ وَالِدَيَّ وَأَنْ أَعْمَلَ صَالِحًا تَرْضَاهُ وَأَدْخِلْنِي بِرَحْمَتِكَ فِي عِبَادِكَ الصَّالِحِينَ) .

صدق الله العظيم  
سورة النمل: الآية (١٩)

## **Dedication**

To the beloved father.

To my dear mother who always supported me.

To my brothers and sisters.

## **Acknowledgment**

All thanks and praise to Allah who gave hearth, patience and strength to accomplish this work.

I would like to send my regards and thanks to my supervisor Dr. Mona Ahmed and all staff at collage of Medical Radiological Science for chance that have provided to gain knowledge and experience.

Thanks also go to all patients for their cooperation.

I thank all staff at east Nile hospital special Dr. Ibrahim Alimam and Dr. Rose John.

I thank everyone who contributed to success this work.

## **Abstract**

This study was carried out to study the size of prostate gland enlargement in adult patients age 50 years and over, using ultrasound. A curved heights frequency transducer is used, two views are taken Sagittal and axial to provide acceptable range of enlargement prostate gland volume. A prospective selection of fifty symptomatic males was recruited and measurement of the maximum length, height and width of their prostate gland were obtained and the volume was calculated. Subjects were selected, if they had complaints related to the urinary system or signs of urinary tract disease. The mean measurement of the three parameters length, width, and height are 5.32, 4.7 and 5.73cm respectively. The mean prostate volume obtained from the above parameters was 65cm with stander deviation (17.03). The result are discussed in details, from the data obtained Finally, Prostate volume measurement was calculated by (measured height  $\times$  length in Sagittal plane  $\times$  width in the axial plane and multiply by 0.52) calculation done by machine. The findings show that prostate volume increases linearly with age and child number .

## ملخص الدراسة

تهدف هذه الدراسة لقياس حجم تضخم غدة البروستاتا لدى المرضى الرجال البالغين من عمر ٥٠ فما فوق وذلك باستخدام الموجات الصوتية.

استخدمت فى هذه الدراسة تقنية التصوير بالموجات فوق الصوتية فى منطقة العانة وذلك بتسليط الموجات اسفل البطن . وتم اختيار محول طاقة ذو تردد عالى لآخذ مقاطع ثنائية الابعاد وذلك للحصول على قياسات معيارية مقبولة لحجم تضخم البروستاتا.

تم اختيار عينة من ٥٠ فرد امن المرضى الرجال البالغين وتاس الابعاد القصوى الثلاث لتضخم حجم غدة البروستاتا وهى الطول والعرض والارتفاع . وتم القياس باخذ مقطعين للبروستاتا مقطع طول اخر عرض لقياسا لابعاد الثلاث.

وجد ان متوسط قياس تلك الابعاد هو سم للطول ٥,٣٢ سم للارتفاع ٥,٧٣ سم، و ٤,٧ سم للعرض ،وان متوسط حجم البروستاتا طبقا لهذه الابعاد، وباستخدام معادلة الاجسام البيضاوية الشكل بضرب هذه الابعاد المذكورة ف الثابت ٠,٥٢٩ هو ٦٥ سم.

اثبتت الدراسة انتضخم حجم البروستاتا يزيد طبقا لزيادة بعض العوامل كزيادة عمر الفرد. كما ان هنالك عوامل قد تؤثر بطريقة غير مباشرة فى زيادة حجم تضخم البروستاتا كالحالة الاجتماعية للفرد.

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## Abbreviations

BPH	Benign prostatic hyperplasia
LUTS	lower urinary tract symptoms
TRUS	Trans Rectal Ultrasonography
TAUS	TransAbdomindUltrasonography
CT	computed tomography
MRI	magnetic resonance imaging
PSA	Prostate Specific Antigen
PZ	PZ Peripheral Zone
BCG	Bacillus Calmette-Guerin
US	ULTRA SOUND
SV	seminal vesicle
PVR	post void residual urine
BPE	benign prostatic enlargement
BWT	Body weight

## Chapter One

### 1.1. Introduction:

Benign prostatic hyperplasia (BPH) is highly prevalent in Elderly men and affects approximately 50% of all men between 60 and 70 years old. (Yoo, 2012). Twenty-five percent to 50% of those with BPH have lower urinary tract symptoms (LUTS), such as flow impedance and sensations of incomplete emptying, related to bladder obstruction. Furthermore, BPH is associated with additional complications such as acute urinary retention, hematuria, Urinary tract infection and urinary stones. The prostate gland is divided into 3 zones: peripheral, transition, central. The majority of prostate tumors (approximately 75%) are found in the peripheral zone. As men age, the transition zone begins to enlarge, until it becomes the largest area of the prostate. This is called benign prostatic hyperplasia (BPH). When the transition zone enlarges, it pushes the peripheral zone of the prostate toward the rectum. The gland cells within the prostate produce a thin fluid rich in proteins and minerals that maintain and nourish sperm. The prostate is oval shaped with a rounded tip. It is approximately 4 cm wide and 3 cm thick. The actual size of the prostate varies from man to man. It can range from the size of a walnut to a small apple. In addition to featuring and monitoring many diseases, the prostate size is valuable in dose-distribution calculation and simulations and in human modeling. Medical imaging is often indicated in the workup of patients with lower urinary tract symptoms, including benign prostatic hyperplasia, with prostate volume assessment commonly performed. (Shier, 1998).

Knowledge of normal prostatic anatomy is paramount to understanding the pathological condition of the gland observe on ultrasound imaging. Through transverse and sagittal histological sections of normal prostates, model ultrasound images of prostate and per prostatic tissues were constructed .Various shades of gray were assigned to these structures depending upon the histological composition. We found that ultrasonic characteristics of the normal Prostate and its surrounding tissues could be predicated accurately by knowledge of the histology of these structures.(Abu-Yousef, 1982).

Prostate volumes can be obtained from multiple modalities including Tran's rectal ultrasound (TRUS) and Tran's abdominal ultrasound (TAUS), computed tomography (CT), and magnetic resonance imaging (MRI). (Futterer 2009).

Prostate measurement differences and errors are common in relation to different imaging modalities as well as inter- and intra-operator variability. The prostate volume calculated using the standard ellipsoid formula, volume width x height x length x pi / 6. (Eri, 2002).

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

All most men over 50 experience some symptoms related to BPH, a condition where the prostate increase in size, gradually pinching the urethra, leading to a host of frequent need urinate, difficulty to fully emptying the urinary bladder so this may lead to many sever complication early diagnosis of BPH may delay this complication .

## **1.3. Objectives:**

### **1.3.1. General objective**

The general objective of this research to study benign prostatic hyperplasia by ultra sound.

### **1.3.2. Specific Objectives**

- To measure the volume of prostate in patient with BPH.
- To get the volume of prostate
- To correlate prostate volume with age.
- To correlate prostate volume with child's number.

### **1.4. Over view of study:**

This study consists of five chapters. Chapter one contains introduction, problem, objectives and overview of the study. Chapter two deals with literature review including theory behind the study and previous work conducted in field of research. Chapter three contains methodology of the study (material and methods). Chapter four contains results. Chapter Five consist of discussion conclusion and recommendation in addition to reference and appendix.

# **Chapter Two**

## **Literature Review**

## Chapter Two

### 2.1. Theoretical background

#### 2.1.1. Anatomy:

##### 2.1.1.1. Embryology and development of the prostate gland:

During the third month of gestation, the prostate gland develops from epithelial invaginations from the posterior urogenital sinus. In order for this process to occur normally, the presence of 5 alpha dihydrotestosterone is required. This molecule is synthesized from fetal testosterone by the action of 5- alpha reductase and is localized in the urogenital sinus and external genitalia of humans. Deficiencies of 5- alpha reductase will cause a rudimentary or undetectable prostate in addition to severe abnormalities of the external genitalia, although the epididymides, vasa deferentia, and seminal vesicles remain normal. During the prepubertal period, the constitution of the human prostate remains relatively identical; however, it undergoes morphologic changes into the adult phenotype with the beginning of puberty. Ultimately, the < gland enlarges to reach the average adult weight of approximately 20 g by 25—30 years of age. (**Hammerer, 1995**).

The prostate gland is small muscular rounded organ, about 4cm (1.6 in) in diameter. That surrounds the urethra at it leaves urinary bladder. Prostate gland lying immediately below the bladder. The part of the prostate above and between the ejaculatory ducts is sometimes described as the “median lobe”. (Robert, 2000).



### 2.1.1.2. Structure:

The prostate gland is small muscular rounded organ, about 4cm (1.6 in) in diameter. That surrounds the urethra at it leaves urinary bladder. Prostate gland lying immediately below the bladder. The part of the prostate above and between the ejaculatory ducts is sometimes described as the “median lobe”. (Robert, 2000).

The prostate gland is covered in a layer of connective tissue called the prostatic capsule. Prostate gland made up of different type of cells gland cells that produce the fluid portion of semen, muscle cells that control urine flow and ejaculation and fibrous cells that provide the supportive structure of the gland.

#### 2.1.1.2.1 .Structures around the prostate:

Seminal vesicles found on both side of the prostate, vas deferens to carry sperm from testicles to seminal vesicles, nerve bundles found on both side of the prostate and muscles to control urination.(Martini ,2012).

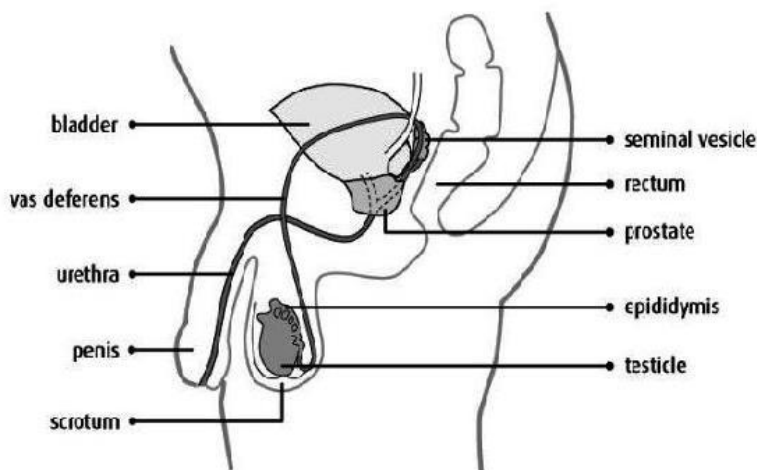


Figure (2-1) Male reproductive system (Martini, 2012)

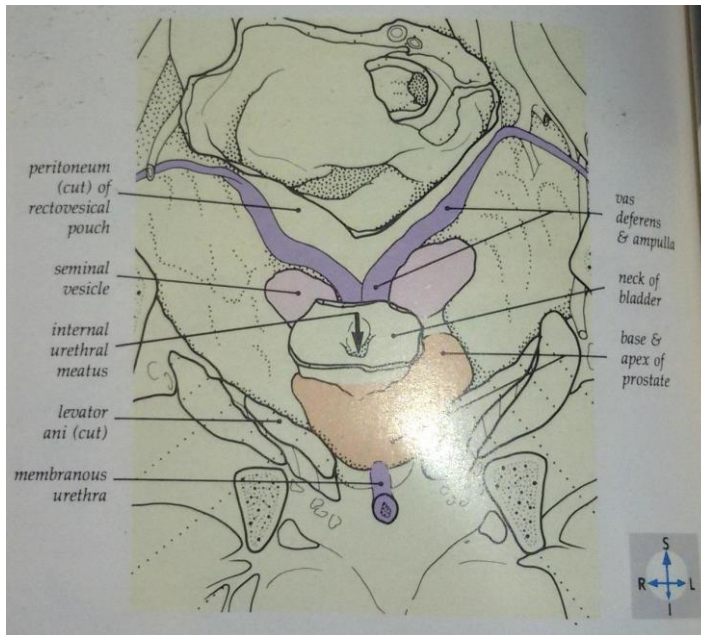


Figure (2-2) Coronal section of the pelvic walls and floor, prostate, the seminal vesicles and the vasa deferentia, (Fredric H 2000)

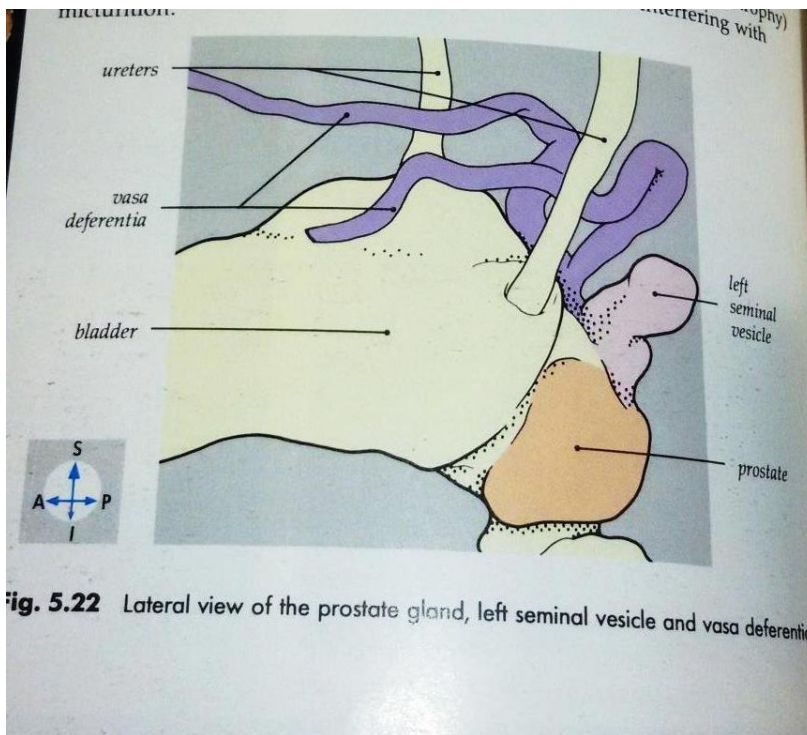


Figure (2-3) lateral view of the prostate, gland, left seminal vesicle and vasa deferentia (Fredric H 2000).

### 2.1.1.3. Zone of the prostate:

Prostate gland divided in to 3 zones.

**2.1.1.3.1. Peripheral zone:** is the area at prostate that is closest to the rectum, it is largest zone of the prostate gland. The majority of the prostate tumors are found in the peripheral zone. (Shier, 1998)

**2.1.1.3.2. Transition zone:** is the middle area of the prostate, it surround the urethra as it passes through the prostate this zone makes up about 20percent of the prostate gland until age of 40years old. As men age the transition zone begins to enlarge, when this zone enlarges it pushes the peripheral zone of the prostate toward the rectum. (Shier, 1998)

**2.1.1.3.3 .The central zone:** the central zone is front of the transitional zone is the part of the prostate that is farthest from rectum. (Shier, 1998)

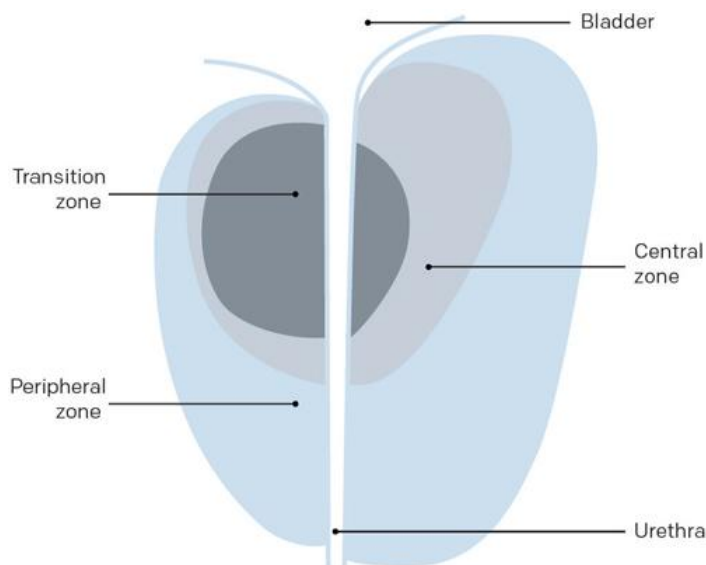


Figure 2.4: Prostate zone. (Shier, 1998)

### **2.1.2 .Function of the prostate gland:**

The main function of the prostate is to produce the fluid portion of semen. The gland cells within the prostate produce thin fluid rich in proteins and minerals that maintain and nourish sperm. This fluid is made continuously. The excess passes from the body in the urine when a man is sexually aroused, the prostate produce large amount of this fluid it then mixes with sperm and is ejaculated as semen. The prostate also play part in controlling the flow of urine. The urethra runs from the bladder through the prostate and out through the penis. The muscle fibers of the prostate are wrapped around the urethra and under involuntary nervous system control. These fibers contract to slow and stop the flow of urine (Schenk, (2008).

#### **2.1.2.1 .Secretions:**

Prostatic secretions vary among species. They are generally composed of simple sugar and are often slightly acidic. In prostatic the protein content is less than 1%. And include proteolytic enzymes , (Prostatic acid phosphatase ,beta – microseminoprotein, and PSA).The secretions also contains zinc. (Komisar, 2009).

#### **2.1.2.2. Male sexual response:**

During male ejaculation, sperm is transmitted from the ducts deferens into the male urethra via the ejaculatory duct, which lie within the prostate gland.

#### **2.1.2.3. Regulation:**

The primary, the prostate male hormones (testosterones), which are responsible for male sex characteristics .the main hormone is testosterone,

which produced mainly by the testicles. Some male hormones are produced in small amounts by the adrenal glands. However, it is dihydrotestosterone that regulates the prostate. (Schenk, (2008).

### **2.1.3. Prostate pathology:**

#### **2.1.3.1. Benign Prostatic Hyperplasia (BPH):**

Nodular prostatic hyperplasia (also termed benign prostatic hyperplasia or BPH) is a common condition as men age. Perhaps a fourth of men have some degree of hyperplasia by the fifth decade of life. By the eighth decade, over 90% of males will have prostatic hyperplasia. However, in only a minority of cases (about 10%) will this hyperplasia be symptomatic and severe enough to require surgical or medical therapy (Bushman, 2009).

The mechanism for hyperplasia may be related to accumulation of dihydrotestosterone in the prostate, which then binds to nuclear hormone receptors which then trigger growth. The effect of drugs which act to inhibit the enzyme 5-alpha reductase, which converts testosterone to dihydrotestosterone within cells. This blocks the growth-promoting androgenic effect and diminishes prostatic enlargement. Such drugs include finasteride and dutasteride. Drug therapy must be continued to remain effective. (Andriole, 2004).

The normal prostate weighs 20 to 30 gm, but most prostates with nodular hyperplasia can weigh from 50 to 100 gm. Hyperplasia begins in the region of the verumontanum, in the inner zone of the prostate, and extends to involve lateral lobes. This enlargement impinges upon the prostatic urethra, leading to the difficulty on urination with hesitancy that is typical for this condition. Dysuria, dribbling, and nocturia are also frequent. The urinary

tract obstruction leads to urinary retention and risk for infection. In severe, prolonged cases, hydroureter with hydronephrosis and renal failure can ensue. (Wasserman, 2006).

Sonographically BPH is demonstrated as an enlarged prostate (>40g); the inner gland is hypoechoic and inhomogeneous compared to the PZ; multiple hyperechoic nodules are often present in the inner gland; nodules frequently undergo cystic degeneration and calculi form along the surgical capsule. A post transurethral resection prostate appears thin with a preserved PZ and a scant or absent inner gland. The urethra is widened into a funnel shape with the widest portion at the bladder base.(Eri, et al 2001).

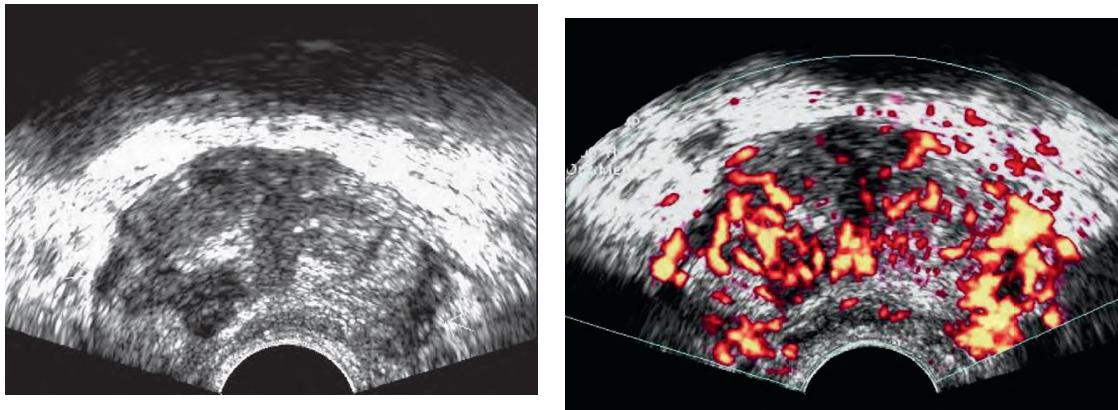


Fig (2.5) A, B, C show Benign prostatic hypertrophy in an 83 year old. The patient has a bladder outlet obstruction secondary to the BPH and required a urethral stent. (Devin 2005).A- Longitudinal transvesical bladder and

prostate scan. The more anterior portion of the enlarged prostate (arrow) is shown encroaching on the bladder lumen. The highly echogenic urethral stent degrades remainder of the prostate image. B- Transverse transvesical bladder and prostate scan. The enlarged prostate gland is shown projecting into the bladder lumen. A long portion of the echogenic urethral stent is demonstrated. C- Axial TRUS scan demonstrates an enlarged gland that is wider posteriorly than the sector the image. The hypoechoic boundary (arrows) between the inner gland and peripheral zone is well demonstrated. The urethral stent is readily identified. (Devin 2005).

### **2.1.3. 2. Prostatitis:**

The majority of cases of acute prostatitis are due to ascending infections caused by E coli. Catheterizations, cystoscopies and urethral dilatations also frequently result in acute prostatitis. Chronic prostatitis may follow the acute form but in the majority of cases no causative organism is identified and no previous acute state has been noted. Clinically, both acute and chronic forms are associated with low back pain, dysuria, frequency and urgency. Sometimes the prostate is enlarged and tender. Fever may be noted with the acute form. Frequently chronic prostatitis is asymptomatic and results in repeated urinary tract infections by constant seeding of the bacteria. Sonographically prostatitis appears as a moderately enlarged gland with focal hypoechoic or hyperechoic areas, with poor margination, in the peripheral prostate. This appears sonographically similar to prostatic malignancy. The prostate may also appear normal. Color and power Doppler imaging demonstrates marked hyper-vascularity. Prostatic calculi may be small, large, single or in clusters and are characteristically seen near the urethra. A thickened, irregular prostatic capsule is common. (Eri et al , 2001).



A

B

Fig (2.6) shows prostatitis A- Biopsy-proven non acute inflammation. Multiple geographic hypoechoic areas on both sides B- Power Doppler ultrasound demonstrates increased vascularity in area of inflammation.

### **2.1.3.3 .Granulomatous prostatitis:**

Can form hypo echoic masses that feel and look like cancer. Men with bladder cancer are a special group if they have been treated with BCG instillation. Reflux of BCG into the prostate can cause inflammatory granulomatous masses that mimic prostate cancer or metastatic bladder cancer and require biopsy for clarification.(Eri et al 2001).



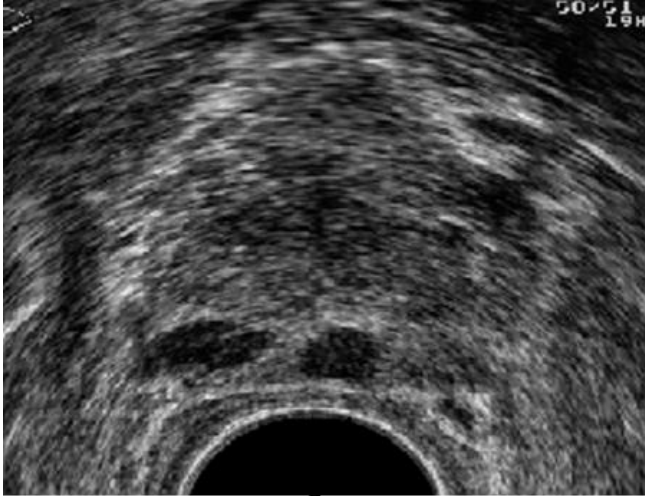


Fig (2.7) TRUS of a patient with granulomatous prostatitis shows multifocal hypoechoic lesions in the peripheral zone mimicking prostatic cancer. (Clements et al., 1993).

#### **2.1.3.4. Prostatic Abscess:**

Acute prostatitis may be complicated by a prostate abscess. Aspiration of the abscess guided by TRUS, combined with appropriate antibiotics, is an effective treatment. Sonographically the abscess appears as a mixed lesion within the parenchyma. Color and power Doppler imaging demonstrates the surrounding prostatic parenchyma as markedly hyper-vascular and the abscess as avascular. (Eri, et al 2001).

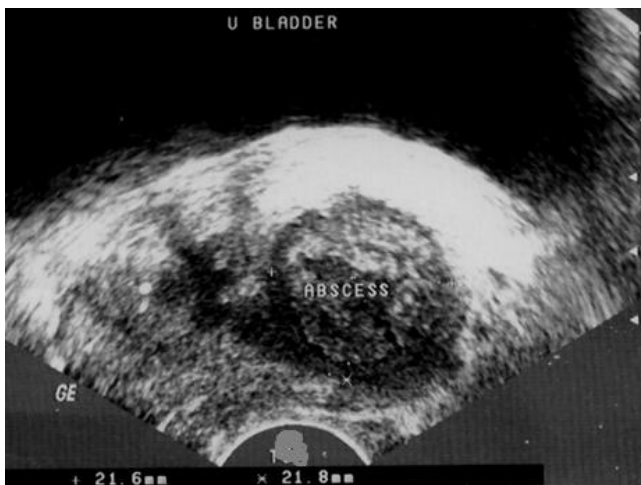


Fig (2.8) TRUS of a case of prostatic abscess with a relatively thick wall and echogenic fluid. (Sohlberg et al., 1991).

#### **2.1.3.5 .Prostatic Cysts:**

Cysts of the prostate are confusing abnormalities because they are uncommon and their origin is uncertain. Small cysts are asymptomatic while large cysts may present with symptoms of urinary tract irritation, obstruction or hypo fertility. The cysts may be complicated by infection, and stone formation. They may be turned malignant in about 3% of cases (Litirup et al., 1988).

The cysts are usually unilocular, sharply defined, thin walled and anechoic. They vary size from 0.5 cm to 3.0 cm in diameters .Prostatic cysts are either midline prostatic cysts like utricle cyst and Mullerian duct cyst or lateral prostatic cysts as cysts of the ejaculatory ducts or acquired cysts which are associated with prostate cancer, PBH, and prostatic abscess (Patel et al., 2002).

Utricle cysts are dilatation of the prostatic utricle which may be congenital (mega utricle) or acquired due to obstruction of its orifice by inflammation (utriclocele). The utricle cysts are small intra prostatic midline cysts. Mullerian duct cysts are remnants of Mullerian duct.(Donkol, 2010).

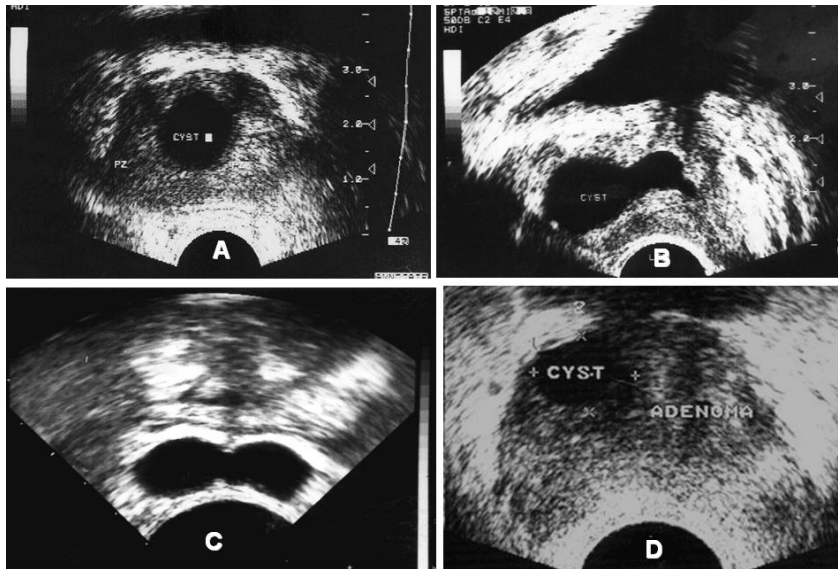


Fig. (2.9 )TRUS of different prostatic cysts. A BC D (A) Axial TRUS of a utricule cyst; the cyst is midline and intraprostatic. (B) Sagittal TRUS of Mullerian duct cyst; the cyst is midline is midline With supraprostatic extension. (C) Axial TRUS of bilateral seminal vesicles cysts in a patient with obstructive azospermia. (D) Axial TRUS shows an acquired intraprostatic cyst in the in the right part of adenoma of benign prostatic hypertrophy. (Patel et al., 2002).

### 2.1.3.6 .Prostatic Cancer:

Prostate cancer is the most common cancer among men and second only to lung cancer as a cause of death, the incidence has steadily increased over the past 35 years. The risk appears to increase rapidly after 50 years of age. African-American men have an increased incidence compared to white men. There is also a higher incidence in men with a strong personal family history of the disease. The most common form is an adenocarcinoma. Local invasion involves the seminal vesicles and pelvic side walls. Metastatic spread is via the lymphatics and bloodstream, frequently involving the axial skeleton. Serum acid phosphatase and PSA levels are elevated with advanced prostatic cancer. Location of Cancer 70% is in the peripheral zone;

20% in the transition zone and 10% in the central zone. Sonographically 70% of cancers are seen as hypoechoic lesions in the peripheral zone. Unfortunately these sonographic appearances are also similar to prostatitis, fibrosis and infarction. 30% are isoechoic, blend with the surrounding gland and can only be detected by appreciating glandular asymmetry, capsular bulging and areas of attenuation. The occasional cancer is hyperechoic. (Eri et al 2001).

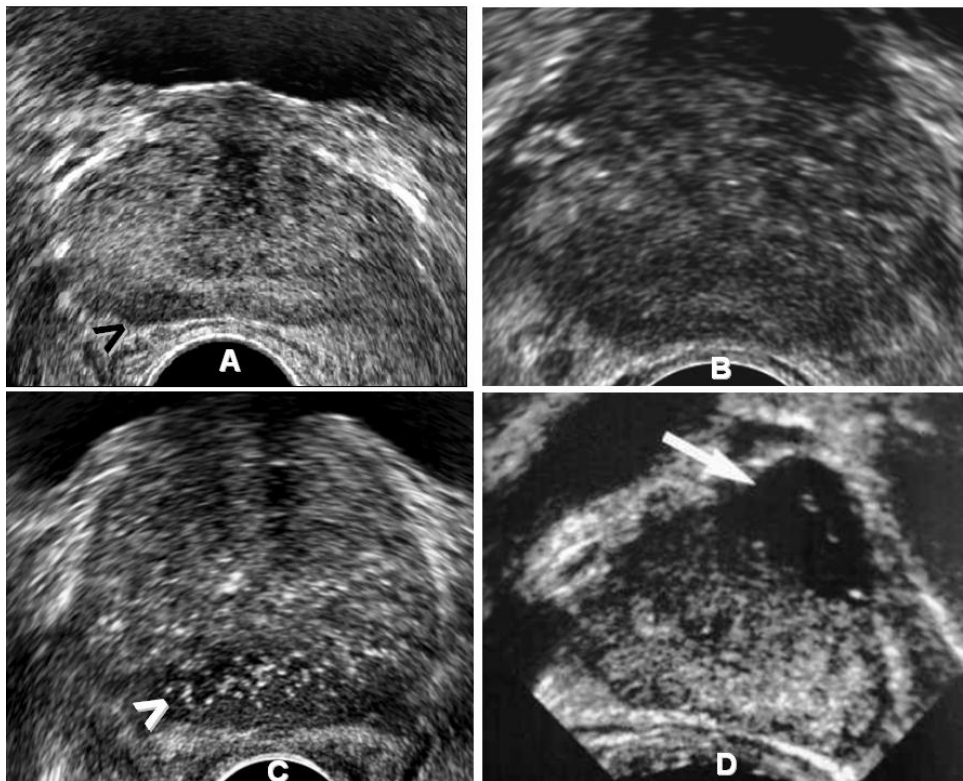


Fig. (2.10) TRUS of four different patients with prostate cancer. The carcinoma appears as focal hypo echoic area (arrow head) in the right PZ (A), diffuse hypoechogenicity of the whole gland (B), focal hyperechoic area (arrow head) in the posterior PZ (C) and focal hypoechoic area (arrow) in the central gland (D) (Shinohara et al., 1989).

#### **2.1.4. Physics and equipment of ultrasound:**

Ultrasound is sound waves with frequencies higher than the upper audible limit of human hearing. Ultrasound is no different from 'normal' (audible) sound in its physical properties, except in that humans cannot hear it. This limit varies from person to person and is approximately 20 kilohertz (20,000 hertz) in healthy young adults. Ultrasound devices operate with frequencies from 20 kHz up to several gigahertz. Ultrasound is used in many different fields. Ultrasonic devices are used to detect objects and measure distances. Ultrasound imaging or sonography is often used in medicine. In the nondestructive testing of products and structures, ultrasound is used to detect invisible flaws. Industrially, ultrasound is used for cleaning, mixing, and to accelerate chemical processes. Animals such as bats and porpoises use ultrasound for locating prey and obstacles. Scientist are also studying ultrasound using graphene diaphragms as a method of communication. (Novelline, (1997).

Ultrasound scanners consist of a console containing a computer and electronics, a video display screen and a transducer that is used to do the scanning. The transducer is a small hand-held device that resembles a microphone, attached to the scanner by a cord. Some exams may use different transducers (with different capabilities) during a single exam. The transducer sends out high-frequency sound waves (that the human ear cannot hear) into the body and then listens for the returning echoes from the tissues in the body. The principles are similar to sonar used by boats and submarines. The ultrasound image is immediately visible on a video display screen that looks like a computer or television monitor. The image is created based on the amplitude (loudness), frequency (pitch) and time it takes for the

ultrasound signal to return from the area within the patient that is being examined to the transducer (the device placed on the patient's skin to send and receive the returning sound waves), as well as the type of body structure and composition of body tissue through which the sound travels. <https://www.radiologyinfo.org>.

### **2.1.5. Techniques and approaches of prostatic ultra sonography:**

Ultra sonography is firmly established diagnostic tool in prostatic imaging. Recent development in US technology has led to significant improvements in image quality, consistency and resolution. Additionally, dynamic scanners, color flow imaging and real time imaging have allowed appreciation of blood flow, reduced examination time and improved quality of the image. These advances combined with the portability, relative low cost and lack of risks of iodinated contrast media and irradiation have made US one of the most useful modality in evaluation of the prostate. Many approaches can be used to image the prostate as trans-abdominal, trans-urethral, trans-perineal and trans-rectal US. The common two approaches are trans-abdominal and trans-rectal ultrasound. (Benson et al (1992)).

#### **2.1.5.1. Trans-abdominal ultrasound:**

Trans abdominal US of the prostate is nearly universally available and provides excellent anatomic information using the urine-filled bladder as an acoustic window. Prostate size, weight, shape and intra vesicle extent can be determined. Caudal angulations of the transducer to accommodate the pubic bone is often required. The normal prostate appears as a homogenous, round or ovoid structure with uniform low level echoes. The intra glandular zonal anatomy cannot be visualized. The relation between the prostate,

bladder and seminal vesicles can be demonstrated. (Benson MC, Whang IS, Pantuck A, Ring K, Kaplan SA, Olsson CA, et al (1992).

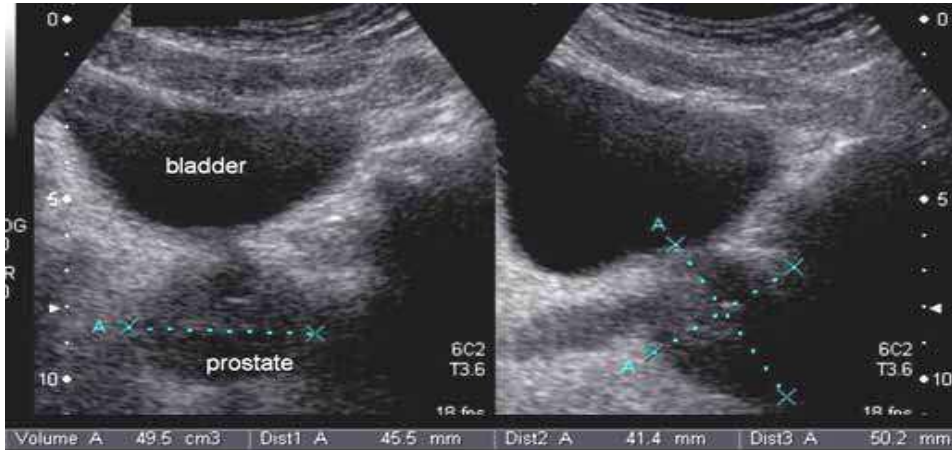


Fig. (2.11) Trans abdominal US of a moderately enlarged prostate in axial and Sagittal planes. .(Benson MC, et al 1992).

#### **2.1.5.2. Tran rectal ultrasound (TRUS):**

In 1963, Takahashi and Ouchi were the first to describe the use of TRUS to evaluate the prostate. The first clinically applicable images of the prostate obtained with TRUS were described in 1967, they used a 3.5 MHz transducer, which at that time was considered to be state of the art, to obtain images that were clinically meaningful. As US technology has become more refined, the use of TRUS in the evaluation of prostatic disease has increased. By the mid-1980. It had become a standard diagnostic instrument of the urologists and radiologists.

Most investigators today prefer equipment using hand-held transducers which are available in frequencies ranging from 3.5 MHz up to 10 MHz with the optimum frequency being around 7.0 MHz. Trans-rectal probes is available in different Sizes and shapes with diameters ranging from 1.2 to 2 cm.

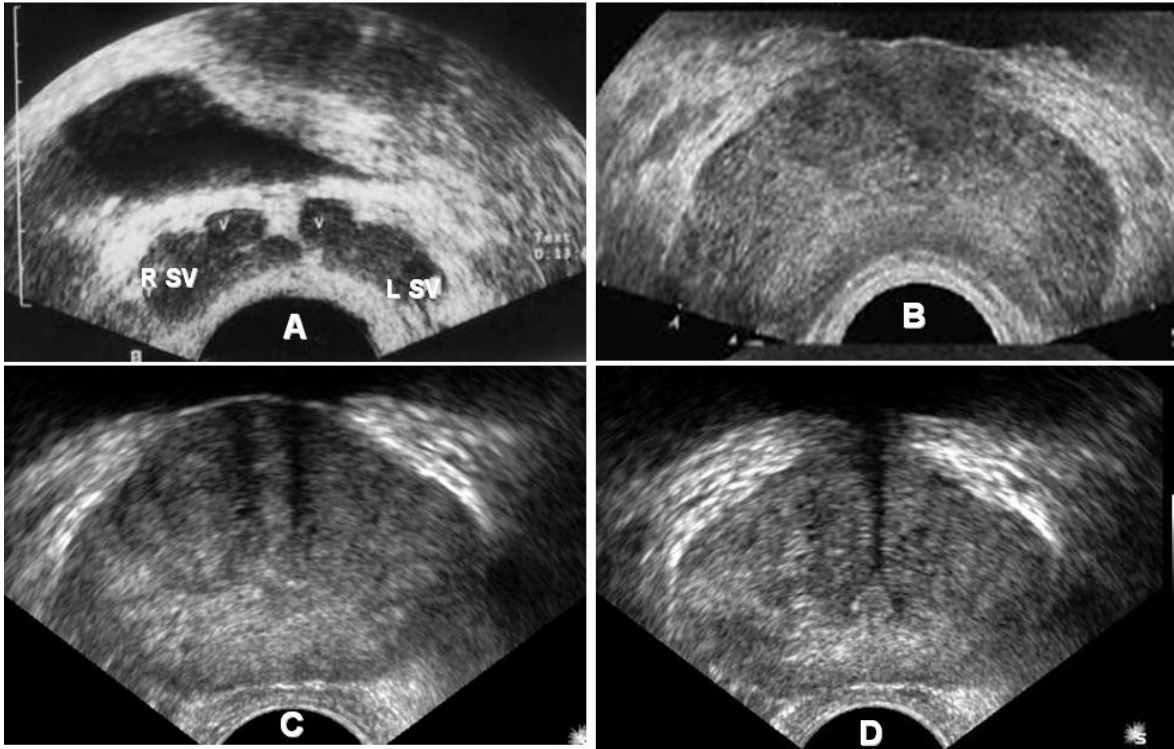


Fig (2.9) TRUS axial images. (A) the level of distal seminal tract; showing seminal vesicle (SV) and vasl ampulla (V), (B) level of prostate base, (C) level of mid gland and (D) level of veramontanum showing its appearance as tour Eiffel.

### 2.1. 6.Previous studies:

In study of Dr. SM Ma'aji Department of Radiology Usmanu Danfodiyo University Teaching Hospital, Sokoto was carried out to analyze the Trans abdominal ultra sonography (TAS) features of suspected benign prostatic hyperplasia (BPH) in 96 consecutive patients between June 2005 through June 2006 and it's showed that Trans abdominal ultrasound is useful screening test for evaluation of the prostate. In addition to the size and volume, the assessment of the kidney and the urinary bladder makes assessment of benign prostatic obstruction more reliable.



In the Study of Shi-jun Zhangetal conducted from November 2009 to June 2010 Weifang community in shangahi, china to select 1000 men aged 40 – 70 years from electoral rolls. All participants' were invited to receive prostate measurement by TRUS with 6MHZ scanning probe, prostate width was measured on an axial image, while prostate length and height were measured on mid-Sagittal image. The study showed that larger prostate volume and TVZ were positively associated with increased age and the mean TVZ per age group increased at a rate faster than TPV. The mean length of prostate increased faster than the height and width, especially after the age 60 years. The TVZ and TVL had a higher correlation with IPSS, indicating a link between prostate size and symptoms of BPH. Using width, Height and length growth rate equations, and the mean size of prostate could be calculated in any man aged 40-70 years. These equations and models can early diagnosis of BPH.

Study done by w j. kirkels et al (1995) objectives to study the prevalence symptoms of pro-statism in the community and correlation between these symptoms and age, prostate volume, flow rate and residual urine volume, the data were collected about 502 men aged between 55 and 74 years, the result detailed 12% of men's had global perception of their voiding function and 82% had no voiding complains. The result concluded that the parameters used to characterize BPH should be considered independently because no predictions about the values of a certain parameter can be made by knowing one of the other parameter values.

In the study of Dr MALEMO KALISYA conducted in the Genito-Urinary Unit (GUU) of Mulago hospital, a National Referral and Teaching Hospital In Uganda from September 2009 to May 2010 - A Cross Sectional Study involving 50 patients who presented with symptomatic BPH and an IPSS > 20 with histological confirmation of BPH were included using a consecutive sampling.

The volume of the whole prostate was estimated by a Radiologist using two modalities SPUS and TRUS the study showed that the mean age was 69.94 years (range 51 to 91). The mean volume of the prostate by SPUS and TRUS were respectively  $95.89 \pm 51.38$  ml and  $95.98 \pm 51.55$  ml. The mean of the differences between the prostate volume estimates by the two methods was 0.09 ml and has shown that SPUS is as accurate as the TRUS in assessing preoperative volume of prostate among symptomatic BPH patients. Suprapubic ultrasonography has excellent sensitivity and specificity for assigning patients to TURP relative to TRUS as gold standard. Suprapubic ultrasonography prostate volume estimates are highly correlated with the volume of the enucleated prostatic adenoma.

In the study of Basawaraj N G Assistant professor, Department of Radiology, Rajarajeswari Medical College & Hospital, Bangalore. From July 2010 to September 2010 A total of 115 individuals in the age group of 43-87 years (mean age of 65.71 years) with lower urinary tract symptoms underwent Transabdominal sonography for the estimation of prostate volume and laboratory investigation for prostate specific antigen levels in blood apart from other routine blood and urine investigations. The patients with prostatic carcinoma, serum Prostate Specific Antigen levels above 10 ng / ml and who have undergone previous prostatic surgery were excluded from the study. The study showed that There is moderate but statistically significant correlation of prostate volume with blood Prostate Specific Antigen in nonprostatic carcinoma patients. There is weak but statistically significant correlation between age and PSA. There is no correlation of prostate volume with age. Increase in the blood PSA value can be predicted by transabdominal ultrasound prostate volume

in Non-prostatic carcinoma patients. Prostate volume may be used as a surrogate for PSA levels in blood.

# **Chapter three**

## **Material and method**

## **Chapter three**

### **Materials and methods**

#### **3.1 .Material**

##### **3.1.1 .Patients**

Study included 50 male patients complain of benign prostatic hyperplasia age from 50 years old to 88Years old come to ultrasound department to check up .

##### **3.1. 2. Ethical clearance:**

- The procedures of this canning with ultrasound were explained to the patient and the purpose of incorporating his data in the study, where written consent will be acquired in case of agreement.
- Permission from the hospital and the department would be granted.
- Data was collected from different patient with maintain privacy and confidentiality.

##### **3.1.3. Instrumentations:**

Ultra sound machines mindray with curvilinear probe have a frequency from 3.5 to 5 MHZ.



(3.1) mind ray ultrasound made in china 2012.

#### **3.1.4. Ultrasound gel:**

Ultrasound Gel is a thick gel that is required to carry-out ultrasound scans on human body. It is a water-based gel that helps produce images of the inner organs. It is generally applied on the belly while sonographers perform ultrasound scan on pregnant women's belly. It actually works as a medium

in the transmission of sound-waves. Ultrasound scans require movement of the transducer on the patient's skin. For ensuring a fine image, sonographer, conducting the test, requires a frictionless surface. Ultrasound Gel comes very handy as it acts as a perfect and suitable lubricant that allows easy movement of the transducer across the skin. Ultrasound Gel mostly contains Polyacrylamide, Glycol and Glycerin. Ultrasound Gel brings a certain level of comfort to patients and is very easy to use. It also relaxes the patient's body. It is widely used these days and getting popular across the world as it is safe and non-toxic for both the sonographer and patient.

## **3.2. Method**

### **3.2.1 .Data collection**

The data would be collected by clinical data collection sheet which designed by the researcher to include all variables of the study. (Age , marital status, Prostate volume.

### **3.2.2. Ultrasound techniques of prostate:**

The patient lies supine. The patient should have a half bladder.500 ml of water 1hr before the scan, if possible, is recommended. Scans are performed in Sagittal and transverse plane from the anterior approach with tilting the probe caudal using the full bladder as acoustic windows Trans- abdominal ultrasound as well. The highest frequency transducer permitting adequate penetration is used the usually in the 3 to 5 MHz rang .a convex probe is used and acoustic gel is applied.



Fig (3.2) shows the probe position in TAUS

### **3.2.3 .Inter pretension:**

The scan done by a Radiologist and ultrasonography.

### **3.2.4 .Measurement of prostate volume:**

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

Volume of prostate = transverse diameter X depth diameter X longitudinal diameter multiply 0.52.

### **3.2.5. Data analysis:**

All the collected data will be analyzed using Excel and SPSS programs.



# **Chapter Four**

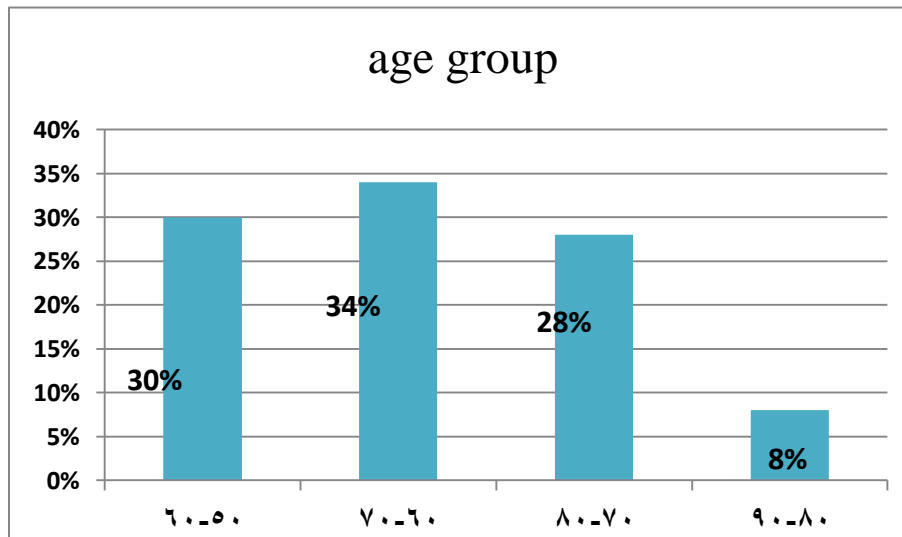
## **Results**

## Chapter Four Results

This study included 50 patients with PBH. The age ranges from 50 To 88 years old ultra sound machine using Tran's abdominal technique to measure the prostate volume.

**Table (4 .1):** Shows Age groups (percentage of patient according the age

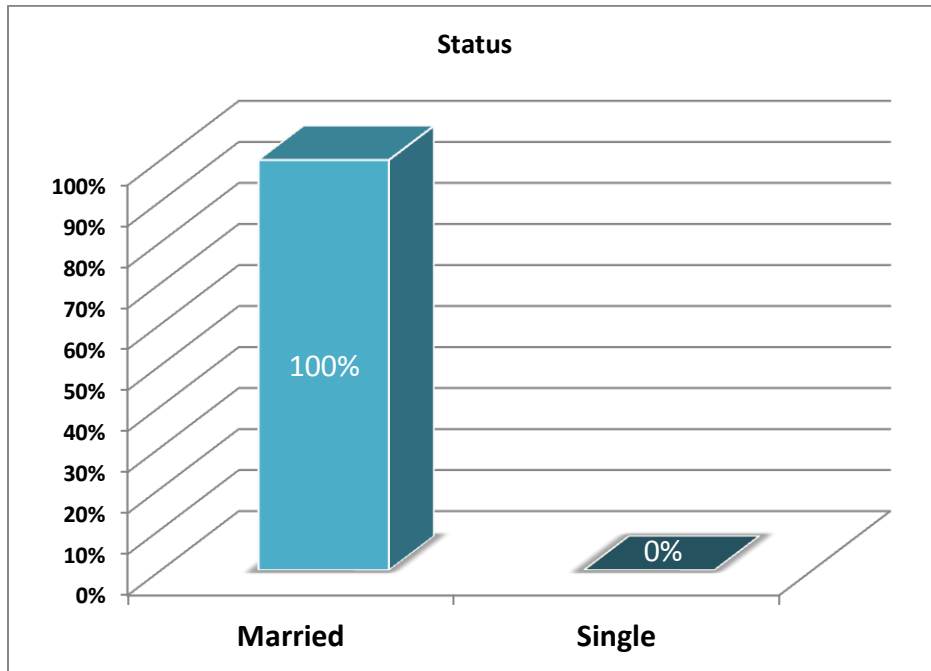
Age Group	Frequency	Percentage
(50-60 ) yrs	15	30%
(60-70) yrs	17	34%
(70-80) yrs	14	28%
(80-90) yrs	4	8%
Total	50	100%



**Figure (4.1)** Illustration of subjects' age

**Table (4-2):** Shows the Subjects Marital Status.

Status	Frequency	Percentage
Married	50	100%
Single	0	0%
Total	50	100%



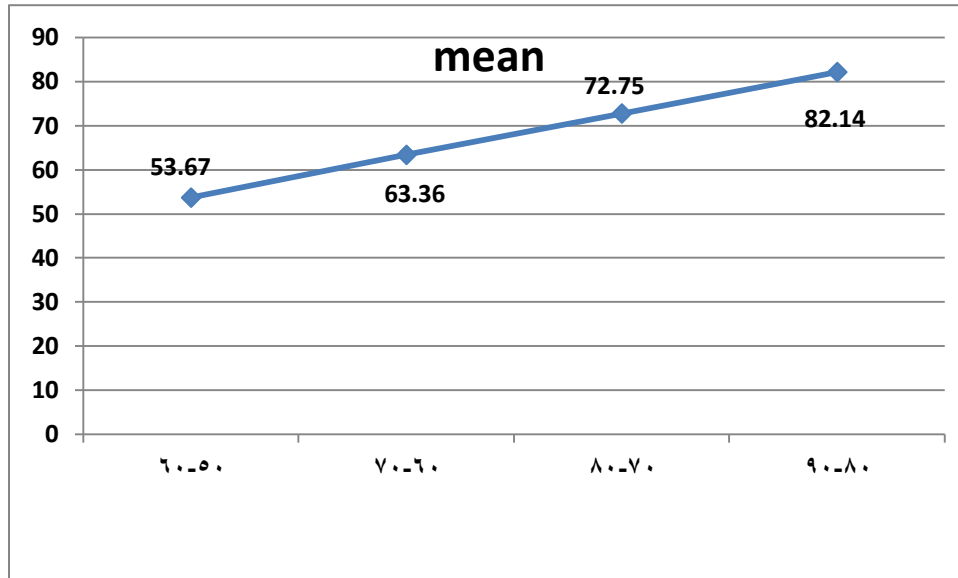
**Figure (4-2):** Shows the Description of subjects' marital status.

**Table (4.3):** Shows the age, child number and measurement of prostate (minimum, maximum, mean and STD) for length, width, height and volume of prostate.

	Minimum	Maximum	Mean	mode	Std. Deviation
Age	50	88	65	70	9.5
Child no	1	14	5.64	5	2.7
Prostate length	4	7	5.32	5	.65
Prostate width	3	7	4.7	4	.77
Prostate height	3	4.4	5.73	5	5.54
Prostate Volume	40.13	110	65	81	17.03

**Table (4.4):** Shows the mean between the prostatic volume and age.

Prostate volume	age	no	mean	Std .deviation
	50-60	9	53.67	2.44
	60-70	14	63.36	3.58
	70-80	20	72.75	2.91
	80-90	7	82.14	2.96



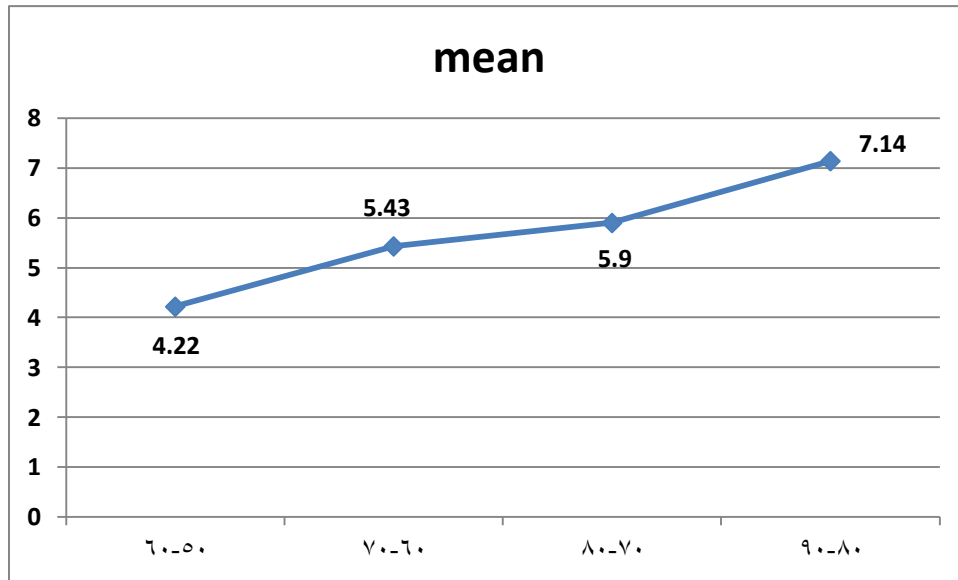
**Figure (4-3)** scatter plot diagram show a linear relationship between the prostate volume and age

**Table (4.5)** show association of Age with Prostate Volume

	Pearson Correlation	P value	Comment
Age with Prostate Volume	0.28	0.000	Significant positive

**Table (4.6)** Collation between Prostate volume & child, number

Prostate volume	age	No child	mean	Std. deviation
	50-60	36	4.22	2.33
	60-70	76	5.43	1.9
	70-80	118	5.9	2.75
	80-90	50	7.14	3.76



**Figure (4-5)** scatter plot diagram show a linear relationship between the prostate volume and child number

**Table (4.7)** show association of child number with Prostate Volume

	Pearson Correlation	P value	Comment
child number with Prostate Volume	0.43	0.000	Significant positive

**Chapter five**  
**Discussion Conclusion and Recommendation**

## Chapter five

### Discussion, Conclusion and Recommendation

#### 5.1. Discussion:

This study involves 50 patients with BPH.

According to the age of patient we found that the most affect group (60-70) yrs34% then (50-60) yrs30 %,( 70-80) yrs28% and group (80-90) yrs8%

Table (4-1) fig (4.1) show the percentage of patient according the age , the high percent is 34% in age group between (60-70).

Also the study showed the marital status of the 50 patients and it's found that 100% of the patients were married and that represent in Table (4-2) fig (4-2) and there wasn't significant relation between Prostate volume increases with marital status according to the previous studies.

Table(4.3) show the mean Age of the 50 patients from minimum age was 50 years to maximum age 88 and the mean age is = 68 also the study showed the mean prostate volume in 50 sample from minimum 40.13to maximum 110 and the mean is = 65.

Also the study show correlation between the prostatic volume and age and there was positive significant association between age and Prostate volume increase this represent in table (4.4), (4.5).

The graph in figure (4.3) shows a linear relationship between prostate volume and age.

Also the study show correlation between prostate volume and child's number and there was positive significant association between child's number and Prostate volume increase and this represent in table (4-6),(4-7). And there



wasn't significant relation between Prostate volume increases with child's number according to the previous studies.

The graph in figure (4-6) shows a linear relationship between prostate volume and child's number.

## 5.2. Conclusion:

- This study showed there is a strong relationship between Age factor and prostate volume it's found that most prostate volume increase was found in elderly patients above 50 years.
- Ultrasound scanning is very important modality to detect any prostatic changes in old men patient and to diagnosis it early.
- The study shows that using Tran's abdominal approach is an easy, rapid and simple way of prostate measurements. Hence this method can be used as a Standard screening method for imaging prostate.
- Tran rectal scanning can be used only when necessary or when ambiguity is present during Trans abdominal scanning.
- Benign prostatic hypertrophy was found in male above 50 years.
- Also benign prostatic hyperplasia increases linearly with Subject's parameters like age, child number and with marital status.

### **5.3. Recommendation:**

- A large sample size is recommended for further asses of prostate volumetric measurements.
- Ultrasonography could be used as routine check-up, follow up to help diagnosis, treatment and control of benign prostatic hyperplasia so it's the gold standard modality in evaluation of prostatic size.
- The easy and safe way to diagnosis benign prostatic hyperplasia cystitis, as well is ultrasound.
- We can use ultrasound to know the volume of prostate.
- Trans rectal ultrasonography as high sensitivity and specificity in visualisation of prostate.
- The Trans abdouminal method had a limitation in defining anatomical zones of the prostate, Tran rectal Is better in defining anatomical zones and to describe the site of the increase in the prostate so Tran rectal is recommended for future research.
- Use Doppler ultrasound to differentiate between benign and malignant prostate.

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# **Appendices**

## Appendix (1) Image of the study

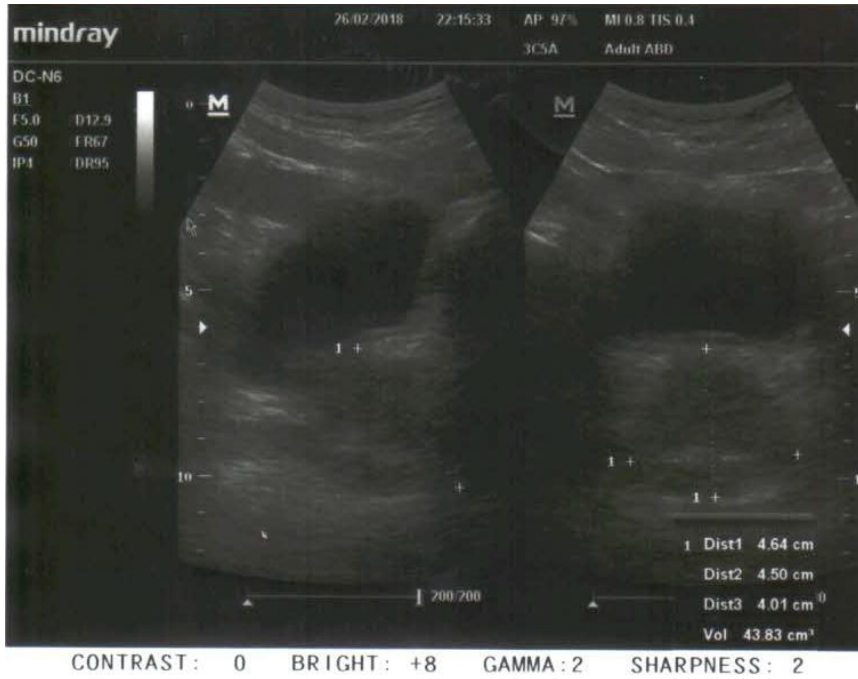


Image (1) 62 years married male, child no (4). Enlarged Prostate volume (43.83 cm).



image(2) 75 years married Child no (8) enlarged prostate volume (74.2cm).





Image (3) 70 year married child no (11), enlarged prostate volume (110.4cm).



Image (4) 67year, married child no (5), enlarged prostate volume (83.6cm).



Image (5) 50 years, married, child no (3), enlarged prostate volume (56.14cm).

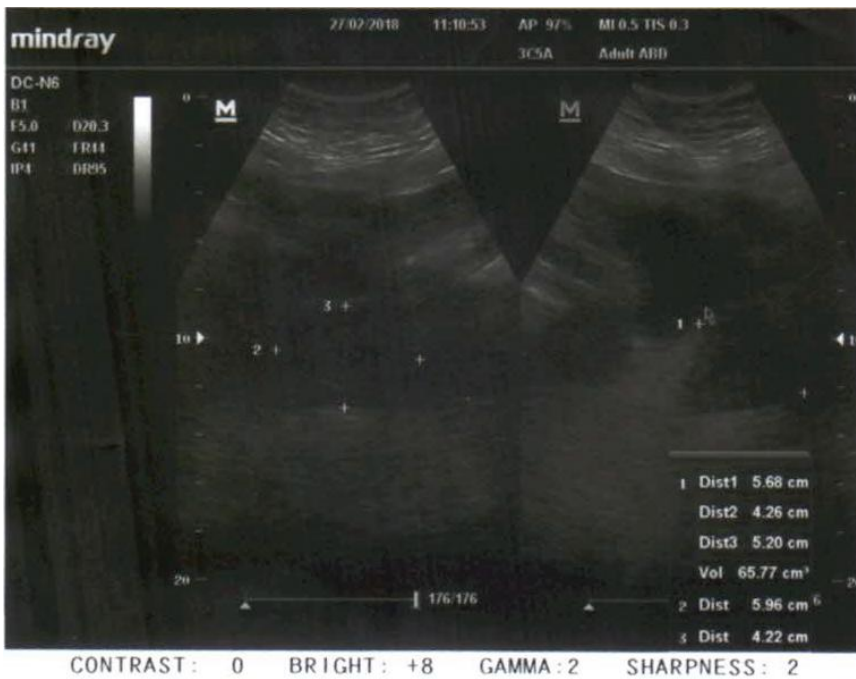


Image (6) 75 year, married, child no (2), enlarged prostate volume (65.77cm).

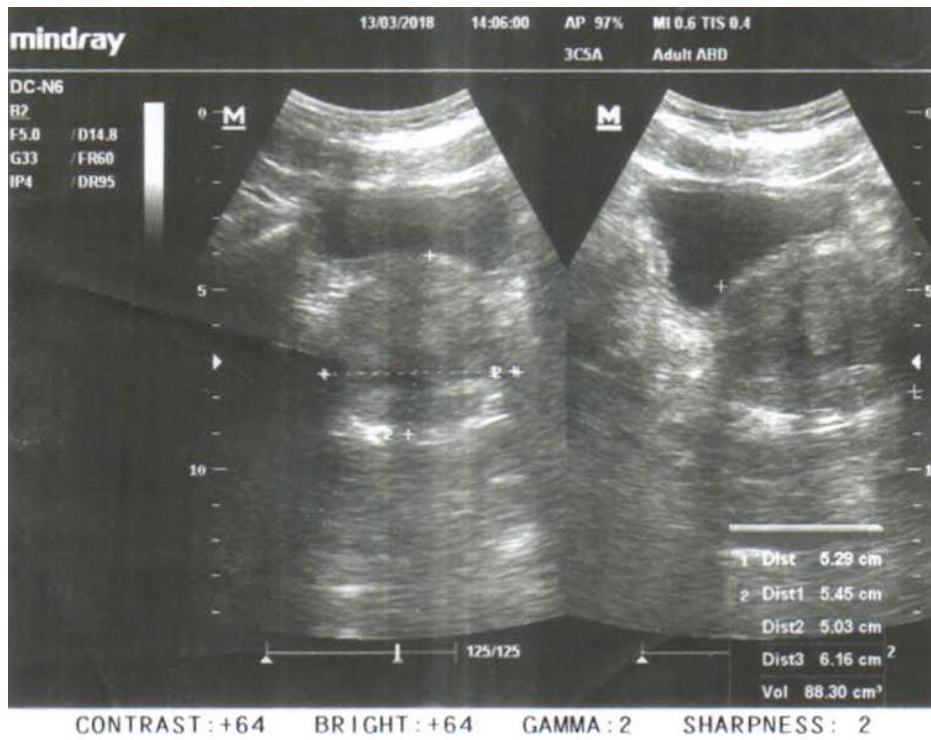


Image (7) 74 year, married, child no (6), enlarged prostate volume (88.30cm.)



Image (8) 60 year, married, child no (5), enlarged prostate volume (40.13cm).

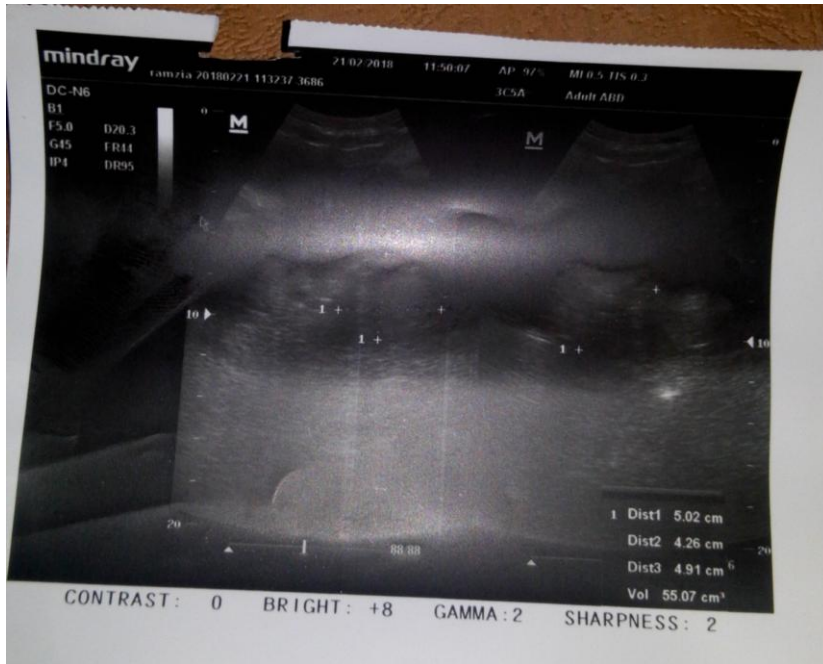


Image (9) 60 year, married, child no (1), enlarged prostate volume (55.07cm).



Image (10) 55 year, married, child no (2), enlarged prostate volume (62.43cm.)

