



Relationship between Prostate Volume, Prostate-Specific Antigen, Age, and Weight of Healthy Adults Sudanese Men

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Abstract: Ultrasound is a widely used imaging modality for evaluation of the prostate. This study was carried out to determine the Relationship between Prostate Volume, Prostate-Specific Antigen, Age, and Weight of Healthy Adults Sudanese Men using supra-pubic ultrasonography. This is Cross-sectional descriptive study was carried out at ultrasound department of Ribat University Hospital- Khartoum Sudan, included fifty asymptomatic adult their age ranges from 20 to 40, 52% are single and measurements of the maximum length, height and width of their prostate gland were obtained and the volume calculated using the ellipsoid formula. Subjects were selected, if they had no complaints related to the urinary system or signs of urinary tract disease. The results of this study for the entire study population was revealed that the transverse, AP and Longitudinal diameters mean values are (2.68) cm, (3.56) cm, and (3.02) cm respectively. Mean±SD of Weight (Kg), Prostate-Specific Antigen (PSA) and prostatic volume (PV) (cm³)ml, 66.74±7.63, 1.89±0.59, 15.24±4.30 respectively, and there is strong positive correlation between prostatic volume and age, (p value = 0.001), and PSA (p value = 0.000) there is no significant correlation between prostate volume and weight (p value = 0.0145). The study concluded that prostate gland volume increased gradually by age and PSA, the means prostatic volume 15.24±4.30 cm³, the normal reference ranges for PV for Sudanese was established.

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1. Introduction

Prostate is a compound tubuloalveolar exocrine gland of the male reproductive system. The function of prostate is to secrete slightly acidic fluid, which has the characteristic of milky or white in appearance. The secretion usually constitutes 20% to 30% of the volume of the semen along with spermatozoa and seminal vesicle fluid. In medical practice, most of the prostate abnormalities are diagnosed by measuring their volume. Normally, the prostate volume range between 0.250ml at birth to 10.000 ml sized at puberty. After puberty, the prostate volume will continuously grow as the age increase for most of the male's life. A healthy human male prostate has the volume of 10.000 ml. The prostate is located above the base of the penis and below the urinary bladder and backs into the front wall of rectum. The prostate secretes some of the fluid for semen, stops urination during ejaculation, and enhances sexual pleasureable sensations⁽¹⁾.

Reliable and precise ultrasonography measurement of prostate volume (PV) is very important for the management of prostate diseases. It is crucial not only for diagnosis purposes but also in

planning non-invasive treatments of prostate cancer and follow ups⁽²⁾

In clinical setting, measurement of prostate volume via ultrasonography is conducted in several ways, namely transperineal (TPUS), transrectal (TRUS) and transabdominal (TAUS). Transrectal ultrasound examination is a common outpatient procedure involving digital ultrasound for the assessment of prostate via rectum. Hence, transabdominal method has become a standard clinical tool for a rapid, simple and noninvasive screening of the prostate⁽³⁾

Transabdominal ultrasound uses 3-5MHz transducer through a partially or fully filled urinary bladder with caudal angulation to send the ultrasound beam under the pubic arch and permit global volume measurements of the prostate. In this method, the transmitted and reflected ultrasound waves visualize the organs through the abdominal wall. The advantage of transabdominal ultrasound is that procedure can be performed quickly, and non-invasively⁽⁴⁾

Measurements of prostate volume have become very important clinically since its association with different diseases and variables of malignancy. The American Cancer society found that prostate cancer is

one of the most common cancers in men ⁽⁵⁾, and is getting serious attention from the world as it has become a significant cause of death every year. A few researches reported that prostate volume highly contributes in diagnosis of prostate cancer. These studies show that large prostate volume has an increased risk of malignancy ⁽⁶⁾

Prostate diseases now widespread in Sudan so the present study try to assess determine the Relationship between Prostate Volume, Prostate-Specific Antigen, Age, and Weight of Healthy Adults Sudanese Men using supra-pubic ultrasonography.

2. Material and Methods

Study population

This is Cross-sectional descriptive study was carried out at ultrasound department of Ribat University Hospital- Khartoum Sudan, included fifty asymptomatic adult their age ranges from 20 to 40, 52% were selected to undergo the transabdominal ultrasonography scanning. The subjects were randomly selected with different status and body weights to find the correlation of weight to normal prostate volume. Since, this study focuses on normal prostate volume; subjects with the history of abnormal prostate condition were automatically excluded from the study.

Ultrasound examination protocol

All ultrasonographic examinations were performed by experienced senior sonologists. The examinations were performed using Siemens Aplio MX ultrasound machine equipped with 3.5 MHz curvilinear probes (Erlangen, Germany). The patient should have a half full bladder. 500 ml of water 1 hour before the scan, if possible, is recommended. The patient lies supine with amount of gel is poured on the anterior part of pubic region. Sagittal and transverse scanning is then performed to assess the entire prostate in many planes.

The probe is angled approximately 30 degrees caudal using the bladder as a window. Slight compression to ensure the inferior portion of the prostate is not obscured by the shadow artifact from the base of the bladder **Fig (1)**.

A questionnaire designed included basic sociodemographic characteristics, medical history (family history, age, renal diseases (pyelonephritis, stones, vesical pathologies and ureteric obstruction), Family history of prostatic cancer, Behavior and life style factors.

Statistical analysis

Study results were initially summarized as means ± standard deviations (SD) tables and on graphs. The analysis was performed with the Statistical Package

for the Social Sciences (SPSS) version 21, ranges, were all calculated and presented in tables and figures. The significance threshold was set at 0.05. The XY scatter plots were generated by Microsoft Excel 2010.

Patients' data were requested by clinicians. The data was collected from those who had been sent to the ultrasound examination or who are selected for evaluation of the prostate. No personnel data will be published.

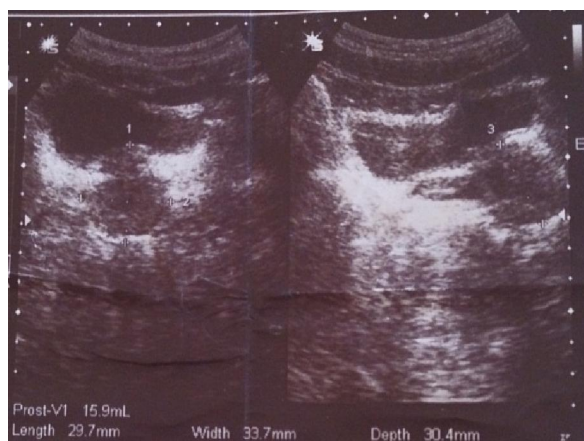


Figure (1). 23 years single male, 58 Kg. PV measured 15.9 ml. Methods used in this study.

3. Results

This study included 50 healthy male Sudanese subjects who participated in this study their age ranges from 20 to 40 years.

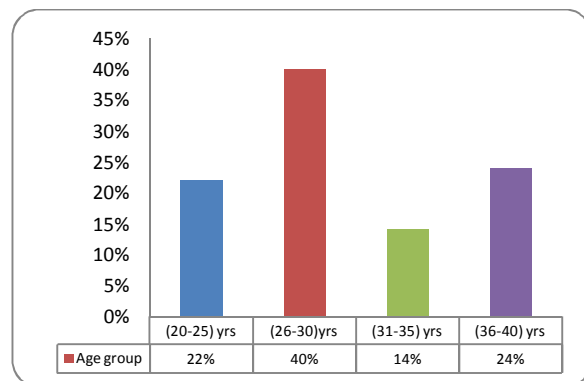


Figure (2). Illustration of subjects' age.

Table (1). Subjects Marital Status

Status	Frequency	Percentage
Single	26	52%
Married	24	48%
Total	50	100%

Table (2). Minimum, Maximum, Mean, SD, of Weight, PSA, and Prostate volume

	Minimum	Maximum	Mean	SD
Weight Kg	55.0	85.0	66.74	7.63
PSA	.94	3.60	1.89	0.59
PVcm3ml	7.50	27.40	15.24	4.30

Table (3). Prostate volume and Age correlation

Dependent Variable: Volume							
Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	0.205	12.350	1	48	0.001	10.942	0.179
The independent variable is Age.							

From the above table a linear relationship equation between Age and prostate volume can be estimated as follows: $PV = 0.179 A + 10.942$. (1)

Whereas; PV = Prostate volume. A = age

Table (4). Prostate volume and weight correlation

Dependent Variable: Volume							
Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	0.044	2.195	1	48	0.145	7.369	0.118
The independent variable is Weight.							

From the above table a linear relationship equation between Weight and Prostate volume can be estimated as follows: $PV = 0.118 w + 7.369$. (2)

Whereas; PV = Prostate volume. w = weight

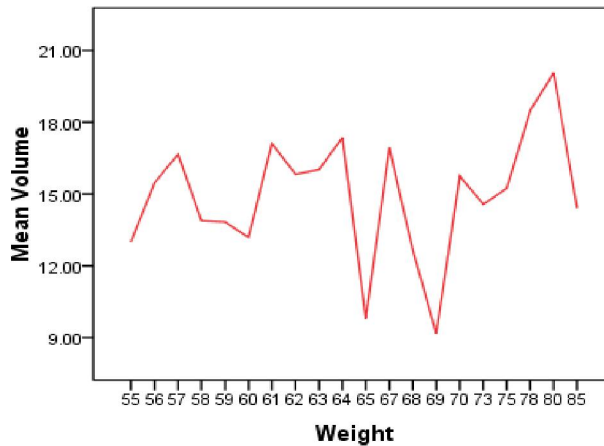


Figure (3). Graph of prostate volume and Body weight

Table (5). Prostate volume and PSA correlation

Dependent Variable: Volume							
Equation	Model Summary					Parameter Estimates	
	R Square	F	df1	df2	Sig.	Constant	b1
Linear	0.820	218.532	1	48	0.000	2.746	6.613

The independent variable is PSA.

From the above table a linear relationship equation between PSA and Prostate volume can be estimated as follows: $PV = 6.613 PSA + 2.746$. (3)

Whereas; PV = Prostate volume. PSA = Prostate-Specific Antigen

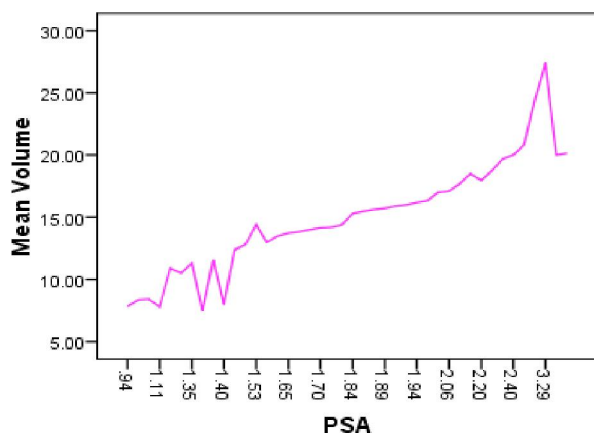


Figure (4). Graph of prostate volume and PSA.

4. Discussions

Ultrasound (US) is a widely used and well-tolerated imaging modality for evaluation of the prostate. The current study included 50 healthy male subjects met the inclusion criteria, their age of subjects analyzed in to five ages groups. The range of patients age (20-40) years with, majority (40%) of the patients were between (26-30) years age Figure 1 52% are single Table (1). The results of this study revealed that the transverse, AP and Longitudinal diameters mean values are (2.68) cm, (3.56) cm, and (3.02) cm respectively. The mean of prostate size for all patients, irrespective of the diagnosis was 15.24 ml (7.5-27.4), SD 4.30, (Table-2) Mean±SD of Weight (Kg), PSA and prostatic volume (PV) (cm³) ml, 66.74±7.63, 1.89±0.59,15.24±4.30 respectively, and there is strong positive correlation between prostatic volume and age, (p value = 0.001) this finding agree with several studies (7-9), and PSA (p value = 0.000) there is no significant correlation between prostate volume and weight (p value = 0. 0.145) this finding disagrees with study done by Hoo et al in 2012 (7).

This normal volume is acceptable since it is very close to the average prostate volume of adult after puberty as literature state that (6), this finding agree with several studies (7-9). have shown that the PV increased gradually with age. A linear relationship equation between Age and prostate volume (Table-3), can be estimated as follows:

$$PV = 0.179 A + 10.942 \quad (1)$$

Whereas; PV = Prostate volume. A = age

The study found that there is no significant difference between the weight of the subject and prostate volume (p value = 0. 0.145),

figure 3 shows a linear relationship between prostate volume and body weight of a male. A linear relationship equation between weight and prostate volume (Table-4), can be estimated as follows:

$$PV = 0.118 W + 7.369 \quad (2)$$

Whereas; PV = Prostate volume, W = weight.

Figure 4 shows that the PSA is dramatically increases with any increasing in the prostate size (volume) this finding agree study done by Park et al in 2015(10). This relationship good indicator for diagnosis and treatment of prostatic disorders. A linear relationship equation between PSA and prostate volume (Table-5), can be estimated as follows:

$$PV = 6.613 PSA + 2.746 \quad (3)$$

Whereas;, PV = Prostate volume. PSA = Prostatic specific antigen.

Studies have shown that PV and PV change rate is associated with several clinical parameters, including age (11), serum prostate-specific antigen (PSA) level (12), and body mass index (BMI) (13). Recent technical advances in US applications have led to new aspects in the analysis of the prostate. Structural analysis is applied for measurement of prostate volume, study of echotexture, and illustration of tissue stiffness or elasticity. Functional analysis illustrates macrovascularity and microvascularity, which are indicators of tissue perfusion.

Conclusion

This study shows that using transabdominal approach is an easy, rapid and simple way of prostate measurements, Also this study found that there is significant proportional relation between patient age and prostate gland size and no significant linear correlation between prostate volumes, and weight.

Further study needed to show the relationship between prostate volume and ethnicity.

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