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RESEARCH ARTICLE

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Study Prostatic Gland Size Using Ultrasound in Khartoum State August 2022

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ABSTRACT

This is a descriptive study, carried out in order to know the normal measurements (volume and diameters) of prostate gland in Khartoum State. The study was done in Khartoum teaching hospitals from April-to August 2022. About 92 patients were randomly selected, their age from 18 years and above, there are not any symptoms related to prostate pathologies. Trans- abdominal ultrasound scanning by 3.5 MHz probes was performed, and the maximum height, width, and depth of their prostate diameters were obtained, as well as them. prostate volumes the results of this study found AP and longitudinal diameters mean values were (3.52) cm, (2.73) cm, and (2.98) cm respectively, the mean prostate volume obtained from the parameters was 15.28± 4.7ml. The study was concluded, there was increased in the prostate volume in relation to increase in the patient's age, weight, and body mass indexes by 0.09 ml/year, 0.11.ml/kg, and 0.3 ml/kg/m2 respectively Moreover the study reveals that the normal prostate has mid-grey level echogenicity, and homogeneous in. texture.

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Introduction

The prostate is a compound tubule-alveolar exocrine gland of the male reproductive system in most mammals. It differs considerably among species anatomically (chemically, and physiologically) In humans the prostate is an unpaired accessory structure of a male reproductive system that surrounds the urethra (prostatic urethra) in the pelvic cavity [1,2]. It's shaped as an upside-down truncated cone with the base of the gland above related to the urinary bladder, and an apex inferiorly, and four walls, anterior wall, posterior wall, and two inferiolateral walls Structure of the prostate (see page.6) is described traditionally as having five lobes anterior, posterior, median, and two lateral lobes [3]. But more usefully the gland is described based on its internal architecture as having three glandular zones (peripheral, central, and transition) with the non-glandular isthmus anteriorly the normal size of the gland varies according to so many recourses: while it's 20gm in young, more than 40gm is Benign prostatic hypertrophy [4, 5].

The mean weight is 11gm ranging from (7-16 gm), it's in some books up to 25gm More over as the prostate volume is calculated with the “oblate spheroid” formula: volume = 0.5236 × (W × AP × L), where W; is the maximal transverse width (right to left), AP; is the anteroposterior plane (anterior midline to rectal surface), and L; is the length (maximal head to foot) [6]. Again there is also variations in the values of these above mentioned three dimensions; while in some recourses these dimensions were 3.5 x4.5 x 3.5 (Block, 2004), or 4 x 3 x 2, they were 3 x 3 x 5 in others Prostate volume can be converted to prostatic weight because the specific gravity of the prostate tissue is about 1, thus 1cc (1ml) is equivalent to.(1gm) Estimation of prostatic gland size can be carried out clinically by doing digital per-rectal examination (DRE), or by trans-rectal US (TRUS), both of which are harmful techniques, and many patients get empresses from it, and may refuse them, moreover trans-urethral US (TUUS) is a useful technique but it's invasive and not widely used [7,8]. So, this study will help to respect trans-abdominal US (TAUS) as more practical, more acceptable and accurate technique for normal dimensions and volumes of the prostate in NKS.

Prostate Development

The prostate gland develops as (30-40) individual complex glands, which grow from the urethral epithelium into the surrounding wall of the urethra. Collectively, these glands enlarge the wall of the urethra into what known as the prostate. The pelvic part of the endodermic urogenital sinus gives rise to lateral epithelial buds which become the prostatic acini of the peripheral zone. Dorsal out growths from above the level of entry of the mesonephric ducts from the acini of the central zone. The fibromuscular stroma develops from the surrounding mesenchyme [9].

Shape and Location

The prostate is a fibro-muscular gland shaped like an upside-down pyramid, which surrounds the prostatic urethra, extending from the urinary bladder base to the urogenital diaphragm The

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base of the gland is related to the urinary bladder above, an apex inferiorly sitting on the pelvic (urogenital diaphragm), an anterior wall which is separated from the pubic symphysis by the retro-pubic fatty space (of Retzius), a posterior wall related to the rectum, and two infrolateral walls related to the muscles of the pelvic side wall and the anterior part of the levator ani muscles on either side [10].

Structure of Prostate

The gland have the five lobes which are not well demarcated from one another: a muscular anterior lobe (or isthmus) which is anterior to the urethra and is composed mainly of fibro-muscular fibers, and contains little if any glandular tissue, a posterior lobe which is posterior to the urethra and inferior to the insertion of the ejaculatory ducts, a median lope between the urethra and the ejaculatory ducts, and two lateral lobes, which form the bulk of the gland. The five lobes can only be differentiated in the fetus up to twenty weeks gestation, in mature gland only three lobes-two lateral lobes and one median- can be distinguished, with the fibro-muscular stroma anteriorly. These lobes can be palpated from the rectum by doing digital per rectum examination The prostate may more usefully be described based on its internal architecture as having three glandular zones (Figure 1 with the non-glandular isthmus anteriorly) so as the following: the central zone comprises approximately 25% of glandular tissue, resistant to diseases, and it's a midline wedge at the base of the prostate between the peripheral and transitional zones, the peripheral zone comprises approximately 70% of glandular tissue, surrounds the distal urethral segment, separated from the central zone by the surgical capsule, occupies the posterior, lateral, and apical regions of the prostate and its site for most prostatic cancers, and finally the transitional zone comprises 5% of the glandular tissue and periurethral glands, consists of two small glandular areas adjacent to the proximal urethral sphincter, bound caudally by the verumontanum, separated laterally and posteriorly from the outer glands by the surgical capsule, and it's an area where benign prostatic hypertrophy (BPH) originates [11,12].

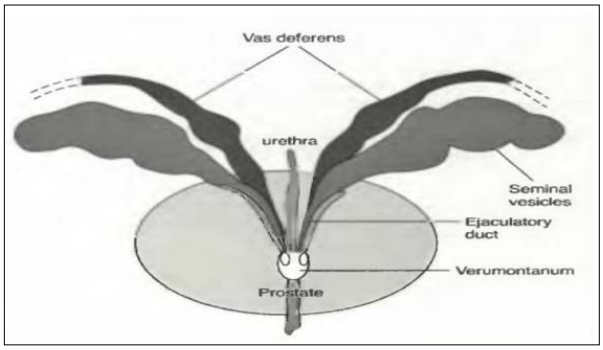

Figure 1: Seminal Vesicles and Vas Deferens Both End into Ejaculatory Duct That Ends in Verumontanum

Normal Sonographic Appearance

The prostate gland has a homogeneous structure demonstrating a median-level echo pattern (Figure 2). The peripheral zone (PZ) appears uniform in texture and slightly more echo-genic than the central zone (CZ). A hyper-echoic band (surgical capsule) separates the PZ from CZ. The seminal vesicles appear as hypo-echoic structures superior to the prostate gland. The verumontanum appears hyper-echoic compared with the parenchyma. Patients may have benign calcification and simple-appearing cysts within the prostate as well [13].

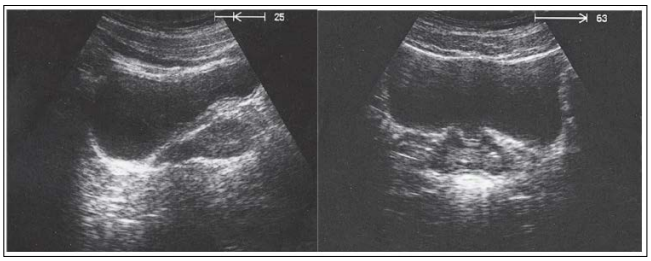

Figure 2: TAUS, Longitudinal Plane and Transverse Plane / Normal

Prostate biopsy is taking a sample from the gland to be sent for histopathological study to find out the definite diagnosis. Two methods of prostate biopsy may be used: trans-rectal and trans-perineal. The trans-rectal approach (Figure 3) is more common and less painful put carries a greater risk of infection. The trans-perineal approach is generally only used if the rectum is absent e.g., surgically removed [14].

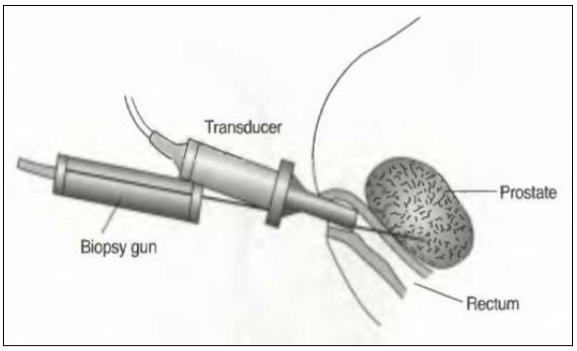

Figure 3: Trans-Rectal Biopsy Procedure

Materials

This is a descriptive study, carried out in order to state the normal measurements of prostate gland in Khartoum State. This study was conducted in Khartoum state. This study was conducted in duration from April- to August 2022. The population of this study was an adult patient who referred for abdominal US scans Shimadzu 2200 in Khartoum state who were not suffering from any symptoms related to prostate diseases. The sample size of this study was consisted of 92 cases, and they were randomly selected.

Technique

The technique was done through the following steps: The patient needs optimal bladder filling with the legs extended with gently breathing Begin with the transducer perpendicular at the body, just superior to the symphysis pubis and angle inferiorly [15]. The prostate is visualized here. Once the long axis of the prostate is located, angle the transducer inferiorly to scan apex of the prostate until come beyond it. Return to midline just superior to symphysis, with the transducer angled inferiorly-less than before-to locate the long axis of the prostate. When locating the long axis of the prostate, slowly move the transducer towards the patient's right, scan laterally through the prostate until you are just beyond it, going on with the right lateral scan through the pelvic side wall. Return to the midline superior to symphysis with inferior transducer angulations; locate the long axis of prostate. When locating the long axis of the prostate, slowly move the transducer

towards the patient's left, scan laterally through the prostate until you are just beyond it. Continue to scan left lateral through the pelvic. (side wall until beyond it Still in sagittal plane, locate the long axis of the prostate; rotate the transducer 90 degree into the transverse seaming plane [15]. Begin with the transducer angle inferiorly, at the midline of the body, just superior to the symphysis pubis. Angle the transducer back into the pelvis; look first for the apex of the prostate. Then scan superiorly through the prostate until you are beyond the base of it [15].

Measurements

The prostate width and height were taken in a transverse plane, by measuring the maximum right to left diameter and the maximum antero-posterior diameter respectively, while the prostate depth is from a sagittal one, by taking the maximum crainio-caudal diameter. The volume of prostate is calculated by the US machine automatically after measuring the above mentioned three dimensions. The prostate echogenicity and texture were. Observed all through the scan [16].

Data Collection Method

The data of this thesis is collected by using special data collection sheet, which contains eleven variables, divided into two parts: personal data, and sonographic findings. These data were collected in the following ways. The personal data consists of five variables: patient's index, age, height, weight, and marital status. The patient's age, and marital status were picked up from the patient by direct questions to him (after taking a permission), and this process is done by the doctor in the office, the radiologist, or the technologist. After completing the scan, the patient is sent to a nurse so as to complete the other two variables which are the height, and the weight. The nurse does this by using an equipment that measures the weight automatically when the patient stands on it, but the height is calculated manually by another tool found in the same equipment The sonographic finding data includes six variables which are: the height, width, depth, volume, echogenicity, and texture of the prostate gland. These variables are taken also by the radiologist or technologist from the US machine while they were doing the scan, also after the patient has been informed and agree of it.

Statistical Methods

The use of comparative analytical method using the SPSS statistical program based descriptive statistics and comparative and relationship hypothesis tests (0.05 sig. level), to demonstrate the differences in (Prostate volume) with respect to (age, height, weight, marital and body mass index). The test was used for (simple linear regression, binary logistic regression, t-tests and correlations) to study the hypothesis which states there is significant. differences in Prostate volume.

Results

About 92 cases having neither complain nor pathology related to prostate were selected for

this study. The results of this study are presented into tables and figures so as the following:

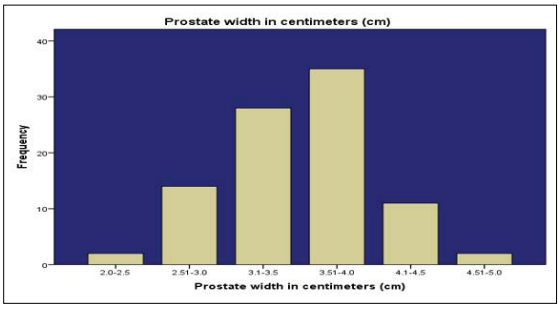

Figure (4-1A): Shows Bar Graph Displaying Frequency Distribution of Prostate Width

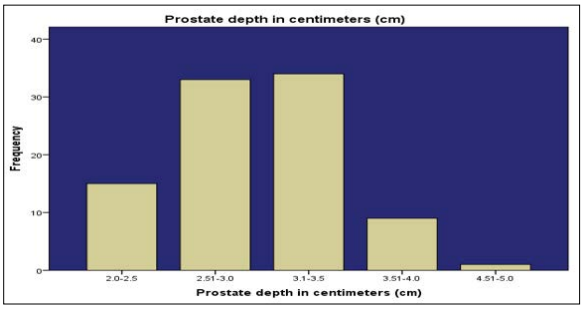

Figure (4-1B): Shows Bar Graph Displaying Frequency Distribution of Prostate Depth

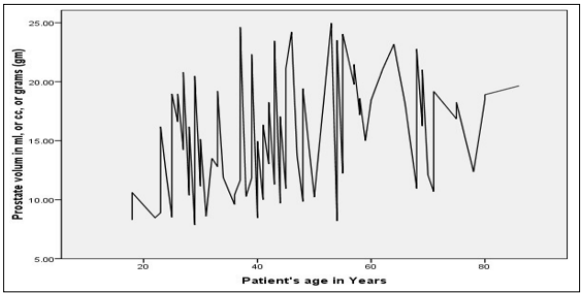

Figure (4-2): Line Plot Shows the Linear Relationship Between Patient's Age and Prostate Volumes

Table (4-1): Model Coefficients Test Expressing the Positive Linear Relationship between the Patient's Age and Prostate Volume

Sig.	t	Unstandardized Coefficients		Model
		Std. Error	B	
000.	8.357	1.342	11.214	(Constant)
002.	3.226	028.	090.	Patient's age in Years

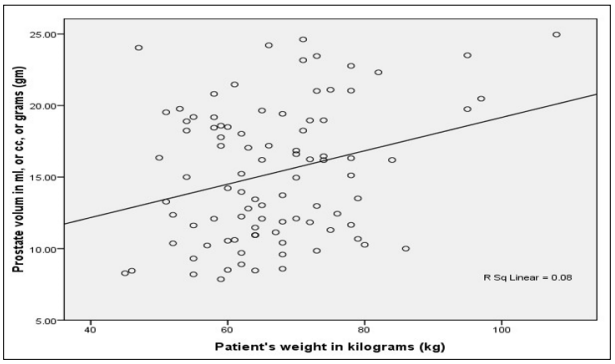

Figure (4-3): Shows Scatter Plot Expressing the Linear Relationship between the Patient's Weight and Prostate Volume

Table (4-2): Model Coefficients Test Expressing the Positive Linear Relationship between the Patient's Weight and Prostate Volume

Sig.	t	Unstandardized Coefficients		Model
		Std. Error	B	
009.	2.66	2.82	7.51	(Constant)
006.	2.79	042.	117.	Patient's weight in (kilograms (Kg)

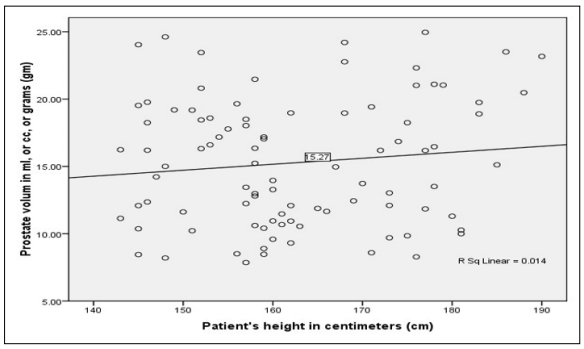

Figure (4-4): Shows Scatter Plot Expressing the Linear Relationship between the Patient's Height and Prostate Volume

Table (4-3): Model Coefficients Test Expressing the Positive Linear Relationship between the Patient's Height and Prostate Volume

Sig.	t	Unstandardized Coefficients		Model
		Std. Error	B	
220.	1.24	6.518	8.057	(Constant)
270.	1.11	040.	044.	Patient's height in (centimeters (cm)

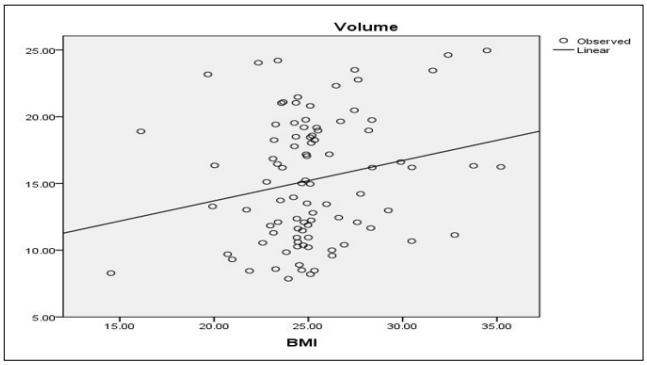

Figure (4-5): Shows Scatter Plot Expressing the Linear Relationship between the Patient's Body Mass (Kg/M²) Index and Prostate Volume

Table (4-4): Model Coefficients Test Expressing the Positive Linear Relationship between the Patient's Body Mass Index and Prostate Volume

Sig.	t	Unstandardized Coefficients		Model
		Std. Error	B	
041.	2.07	3.700	7.669	(Constant) 1
041.	2.07	145.	301.	Body Mass Index

Table (4-5): Shows Distributions of Two Groups (Marred and Single) with Means and Slandered Deviations Calculated Marital Status:

Marital status	Mean	N	Std. Deviation
Married	15.5280	79	4.66278
Single	13.7285	13	4.79826

Table (4-6): T-Test for Equality of Means of Two Groups

t-test for Equality of Means							
Confidence 95% Interval of the Difference		St. Error Difference	Mean Difference	Sig. (2- tailed)	df	t	
Upper	Lower						
4.58	**98.-**	**1.40**	**1.8**	**2.**	**90**	**1.28**	**Prostate volume**

Table (4-7): Shows the Frequency Distribution of Prostate Echogenicity

Percent	Frequency	Prostate Frequency
83.7	77	Normal echogenicity (mid-grey)
5.4	5	Hypo-echoic
10.9	10	Hyper-echoic
100.0	92	Total

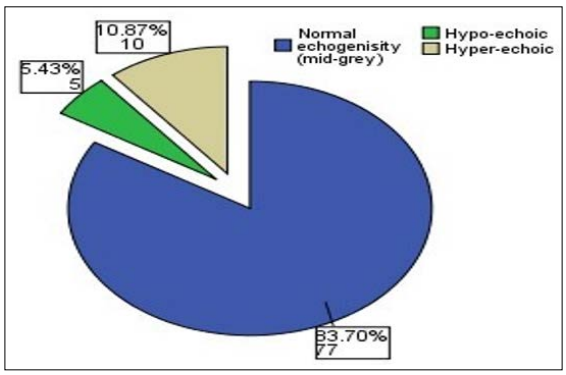

Figure (4-6): Show that Most (83.7%) of Participants were Normal Echogenicity (Mid-Grey) Prostate, (10.9%) Hyper-Echoic While (5.4%) of them Appeared Hypo-Echoic

Table (4-8): Shows the Frequency Distribution of Prostate Texture

Percent	Frequency	Prostate Frequency
95.7	88	Homogeneous
4.3	4	Heterogeneous
100.0	92	Total

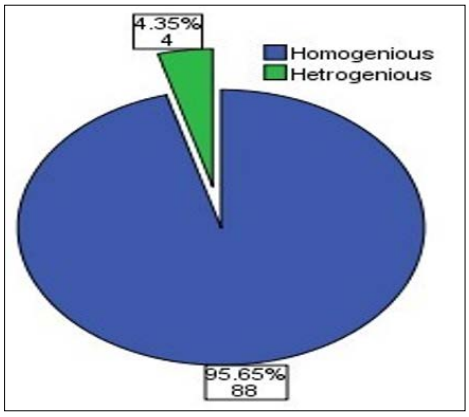

Figure (4-7): Show that Most (95.7%) of Participants were Homogeneous Prostate Texture, While (4.3%) of them were Heterogeneous

Discussion

As mentioned earlier, the main purpose of this study is to identify the normal measurements of the prostate gland (volume, and dimensions) in Khartoum peoples using trans-abdominal ultrasound, and to state these measurements in relation to their individual characteristics. So about 92 patients were selected randomly, who have no complains related to prostate: pathology. The results of this thesis find out the following the prostate transverse, width and depth diameters were measured and displayed in Figure (4-1 A, B), and their mean values were (3.53) cm, and (2.98) cm respectively, the mean prostate volume obtained from the above parameters was 15.27± 4.7ml this means ranges from (7.86- 24.96) ml. These results agree with study, see previous studies Also the results confirmed that there is positive linear relationship between the age of patients and their prostate volumes Figure (4-2), that's to say when patient's age increases by 1year the prostate volume also increases by 0.09 ml, see Table (4-1) [17]. This linear relationship can be stated in the formula: prostate volume (PV) = 0.09 x Age of patient + 11.21. This positive relationship is expected because aging is main risk for prostate enlargement BPH as mentioned. And this result agrees with all previous studies Moreover there is also another positive linear relationship between the prostate volume and patient's weight Figure (4-3), that's to say an increase in body weight by 1kg there should be an increase in prostate volume by 0.11 ml, see Table (4-2). This linear relationship can be expressed in the formula: prostate volume (PV) = 0.11 x weight of patient + 7.51. This positive relationship is also expected because an increase in patient weight increases fats concentration in the body, which were the main source of steroid hormones that influence the growth of the prostate gland. Also this result agrees with all previous. Studies Concerning to the relation between the height of the patient and the patient's prostate volume, there is also linear relationship Figure (4-4), and also it's a positive one. That's to say an increase in body height by 1cm there should be an increase in prostate volume by 0.04 ml, see Table (4-3). When this correlation is tested: the coefficients Table (4-3) provides that ("Sig." = 0.270 > 0.05) which indicates that there no statistically significant correlation between the patient's height and prostate volume. And that this positive relationship occurs by chance. But when comparing this result with those found in the previous studies, we can accept this positive relationship, based on two out of four theses confirming it, and one of them said that there is negative relationship and the last one do not mention any correlation [1, 16,17].

Regarding to the body mass index (BMI) and prostate volume, the (BMI) were calculated to all patients by the equation: weight/ height squire and we find out that there is a positive linear relationship Figure (4-5), that's to say an increase in the BMI by 1kg/m2 there should be an increase in prostate volume by 0.3 ml, see Table (4-4). This linear relationship can be expressed in the formula: prostate volume (PV) = 0.3 x BMI of patient + 7.67. This positive relationship is also expected because higher BMI simply means heavy weights. This result agrees with study Relating to the effect of marital status on the prostate volume, we find that see Table (4-5), the married patients were 79 persons, and the single ones were 13 persons, and that the mean prostate volumes for both were 15.53± 4.67, and 13.73± 4.8 respectively [16]. And that the difference in means between them is 1.8. We use T test to test the difference in means between these two mean groups and the results tell us that there is not significantly different because the values in the "Sig. (2tailed)" Colum see Table (4-6) is 0.2 which is more than 0.05. So, we can conclude that marital status has no effect . Table (4-7), and Figure (4-6) shows the echogenicity of the prostate and that 77 patients have normal echo's, 5 patients were hypo-echoic, and 10 of them hyper-echoic. And Table (4-8), and Figure (4-7) Shows the texture of the prostate and that 88 patients have homogeneous texture, and 4 patients have heterogeneous texture. So we can state that from the results the normal prostate sonographic appearance is mid-grey level echo's (83.7%), and at the same time homogeneous texture (95.7%).

Conclusion

The results of this thesis states that the prostate transverse, width and depth diameters mean values were (3.53) cm, and (2.98) cm respectively, the mean prostate volume obtained from the above. parameters was 15.27± 4.7ml The study also concludes that, there was linear increase in the prostate volume in relation to increase in the patient's age, weight, height, and body mass

indexes by 0.09 ml/year, 0.11 ml/kg, 0.04 ml/cm, and 0.3 ml/kg/m2 .respectively. Moreover, the normal prostate volume has mid-grey level echogenicity (83.7%), and homogeneous in texture (95.7%). Also, the study found out that the prostate volume didn't affect by the marital status of the patients among these populations [18-20].

References

[1] Anwar Adam. evaluation of prostate weight in patients above 50 years. 2010; https://prostate.net/.

[2] Berthold B. Color Atlas of Ultrasound Anatomy. Thieme Stuttgart, New York. 2004; https://www.ajronline.org/doi/full/10.2214/ajr.184.4.01841371?mobileUi=0.

[3] Carol MR, Stephanie RWJ, William C, Deborah L. Diagnostic Ultrasound. 4th Edition. 2011; 1: 398-414.

[4] Siddeeg G. Specialist of Urology. Egyptian fellowship of urology. 2010; http://egyfellowship.com/the-egyptian-fellowship-specialties/.

[5] Gilani SAG. Burwin Institute of ultrasound- Canada. 2001; https://www.burwin.com/.

[6] Jarble. 2008 https://www.google.com/searc.... q=prostate&oq=pros&aq...://en.m.wikipedia.org/wiki/prostate.

[7] Lee Young. 2011; www.usg.co.kr.

[8] Matthias H, Tatjana R, Peter FW. Ultrasound Teaching Manual. Thieme Stuttgart. 1999; 56.

[9] Paul B, Adam WMM, Jeremiah CH. Applied Radiological Anatomy. 2013; https://www.worldcat.org/title/817921614.

[10] Richard SS. Clinical Anatomy for Medical Students. 1995; https://www.worldcat.org/title/31410594.

[11] Chummy SS. Last's Anatomy Regional and Applied. 10th Editon, Elsevier Limited, China 2004; 291-292.

[12] Ritchard LD, Wanye V, Adam WMM. GRAY'S Anatomy for Students. 10th Edition Elsevier Limited. 2007; 397-416.

[13] Roderick NMM, Keith W. Muir's Textbook of Pathology. 13th Edition, Arnold A member of the Hodder. 1992; 1068.

[14] Roger CS, Thomas CW. Clinical Sonography. 4th Edition, Lippincott William and Wilkins, USA. 2007; 252-259.

[15] Setven MP. Examination Review For Ultrasound. Lippincott William and Wilkins, China 2011; 143-144.

[16] Skudai Malaysia. 2012; http://www.sustech.com/.

[17] Yahya HYA. MScs of measurement of Normal Prostate Volume in Healthy Adult Sudanese Using Ultrasound. 2015; https://repository.sustech.edu/handle/123456789/11340?show=full.

[18] Stephanie R, Michelle M, Stephen E. Anatomy for Diagnostic Imaging. 2nd Edition, Elsevier Limited, China. 2007; 229-231.

[19] Susanna O. Sonography Exam Review. 2nd Edition, Elsevier Limited, USA. 2014; 231-238.

[20] Vinay K, Abul KA, Nelson F. Robbins and Cotran. Pathologic Basis of Disease, 7th Edition, Elsevier Limited, Chinan. 2005; 1055.