Sudan University of Science and Technology

College of Graduate Studies

Measurement of Urinary Bladder Wall Thickness in Healthy Adults Using Ultrasonography

قياس سمك جدار المثانة لدي البالغين الأصحاء باستخدام التصوير بالموجات فوق الصوتية

A Thesis Submitted for Partial fulfillment for the Requirements of **M.Sc.** Degree in Medical Diagnostic Ultrasound

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الآيـة

قال تعالى:

(أمن هو قانت آناء الليل ساجداً و قائماً يحذر الآخرة و يرجو رحمة ربه قل هل يستوي الذين يعلمون و الذين لا يعلمون إنما يتذكر أولوا الألباب).

سوره الزمر

الآية (9)

Dedication

This work is dedicated to my colleagues and my family…

Acknowledgement

First of all I would like to thanks our God for enabling me to complete this thesis. I would like to thank Dr. Ahmed Mostafa Abukonna my supervisor for his help and guidance.

Thanks extend to Ultrasound Department in Bashair Teaching Hospital. I am also very grateful to many individuals who played a part in preparing this work. My great fullness for all my teachers in different educational levels and everybody who helped me in this project specially

Abstract

This is descriptive cross-sectional study which was carried out during the period from September 2018 to August 2019 in Bashair teaching hospital in Khartoum state. The aim of this study was to evaluate the urinary bladder wall thickness in healthy adult Sudanese. A total of 60 participants were selected randomly, their age ranged between 18 to 74 years. All participants were normal, participants with renal disorder, lower urinary tract symptoms or prostate abnormalities were excluded. Data were collected using data collection sheet and the bladder measurements were recorded using ultrasound scan.

The results of the study showed that the mean height was 155.38 cm, mean weight was 70.85 kg and mean of body mass index was 29.86. The mean of anterior urinary bladder wall thickness in healthy Sudanese adult was 3.43 mm, the mean posterior urinary bladder wall thickness was 3.81mm and the lateral urinary bladder wall thickness was 4.05mm, while the mean of urinary bladder volume was 121ml. The urinary bladder volume was correlated significantly with body mass index ($p < 0.01$), this correlation was positive and was not significant when the BMI greater than 25kg/m. The bladder volume decrease when the body mass index more than 25kg/m.

This data set could be used for future research, in other parts of the country, with large sample size for a possible nationwide nomogram.

المستخلص

هذه دراسة وصفية عرضية اجريت في الفترة من سبتمبر 2018 إلى أغسطس 2019 في مستشفي بشائر التعليمي في الخرطوم حيث كان الهدف من الدراسة هو تقييم سمك جدار المثانة لدي السودانبن البالغين الاصحاء. وقد تم اختيار مجموعةمن 60 من المستهدفين بشكل عشوائي اعمارهم تتراوح مابين 18 و74 سنة وتم استبعاد اي مريض يعاني من اضطراب الكلي وانخفاض اعراض المسالك البولية او تشوهات البروستاتا. وقد تم جمع البيانات باستخدام ورقة جمع البيانات الاساسية و تم تسجبل قياسات جدارالمثانة بالمسح بالموجاتالصوتية.

أظهرت نتائج هذه الدراسة ان متوسط اطوال المرضي 155.38 سم ومتوسط اوزانهم 70.85ومتوسط مؤشر كتلة الجسم 29.86كجم/متر مربع ،متوسط سمك جدار المثانة الامامي 3.43 ملم ومتوسط سمك جدار المثانة الخلفي 3.81 ملم ومتوسط سمك جدار المثانة الجانبي 4.05 ملم ومتوسط حجم المثانة121مل بالاضافة الي ذلك خلصت الدراسة إلى أن سمك جدار المثانة لدي البالغين يتناسب طرديا مع كتلة الجسم. هذه العلاقة بين مؤشر كتلة الجسم والحجم تكمن في الى حجم 25كجم\م^2 بيزداد السمك ثم بعد 25كجم\م فما فوق يبدا الحجم بالنقصان لكن ليس هناك علاقة ذات دلالة احصائية في حال مؤشر كتلة الجسم أكبر من 25كجم\م^2

List of Contents

List of Tables

List of Figures

List of Abbreviation

A –U –T:	Anterior urinary bladder wall thickness
BMI:	Body mass index
BOO:	Bladder outlet obstruction.
BPH:	Benign prostate hyperplasia
BWM:	Bladder wall mass.
BWT:	Bladder wall thickness
DWT:	Detrusor wall thickness
IPSS:	International prostate syndrome score
L –U –T:	Lateral urinary bladder wall thickness
P – U – T:	Posterior urinary bladder wall thickness
TCC:	Transitional cell carcinoma
U – V:	Urinary bladder volume
UBWT:	Urinary bladder wall thickness.

Chapter one

Introduction

Chapter one

1.1 Introduction:

The urinary bladder is roughly spherical in shape, although its shape and size vary among individuals, and it depends greatly on the volume of urine that it contains. The normal adult bladder can accommodate 300 to 600 mL of urine. Many tiny wrinkles known as rugae line the inner surface of the bladder and allow it to stretch as it fills with urine. As urine accumulates, the rugae flatten and the wall of the bladder thins as it stretches, allowing the bladder to store larger amounts of urine without a significant rise in internal pressure (van der Horst and Junemann, 2004).

The urinary bladder wall thickness (BWT) is an important parameter in assessing the pathophysiologic condition of the urinary bladder and / or other adjoining organs. Ultrasound is a dynamic examination, with the huge benefit over other cross-sectional imaging of direct patient contact. The examination can be tailored to the patient's physical state and to their clinical problem. Ultrasound of the bladder is usually performed as part of a more comprehensive examination of the urinary system. Despite dramatic improvement of MRI and CT over the past generation, sonography continuous occupies the central role in evaluation of renal, ureteral and bladder anatomy and disease process (Levin et al., 2000).

Evaluating the morphology and function of bladder wall is very important because normal bladder function is necessary for micturition. Some pathological conditions such as vesicoureteral reflux, detrusor over activity, dysfunctional voiding and bladder obstruction and neuropathic bladder may cause increase in bladder wall thickness (BWT). BWT is increased during urinary tract infection (UTI) chemotherapy, urinary stones, and inflammation. Most of the studies done in children and school age (Ugwu et al., 2019).

Internal changes in urinary bladder could be evaluated by cystoscopy or cystography, but as these tests are harmful because of their intervention or radiation, safer tests are needed such as transabdominal ultrasonography (US). Ultrasound could be used as an accurate, safe, and non-interventional method. Measurement of bladder wall thickness appear to be a useful predictor of outlet obstruction with diagnostic value exceeding free uroflowmetery although it does not represent substitution to invasive urodynamic and can detect it better than post residual urine or prostate volume (Oelke et al., 2006). The objectives of this study, therefore, were to determine normal values of BWT in a healthy adult Sudanese population using a Sonographic method, as well as to determine the association between BWT with anthropometric variables.

1.2 Problem of study:

Urinary bladder wall thickness is a predictive measurement for many pathological conditions, and be more accurate in diagnosis of urinary bladder outlet obstruction than uroflometery, prostate volume and residual urine. Estimate normal measurement to make a cut of value to diagnosis urinary bladder abnormality. To the knowledge of the researcher, there are no sufficient previous studies to measure UBWT in Sudanese adult.

1.3 objectives

1.3.1 General objective:

To evaluate normal urinary bladder walls thickness in Sudanese adults.

1.3.2 Specific objectives:

- To measure urinary bladder wall thickness (AWT, PWT, LWT).
- To measure urinary bladder volume.
- To correlate the bladder wall thickness with age and gender.
- To correlate the bladder wall thickness with BMI.
- To correlate bladder wall thickness with urinary bladder volume.

1.4 Overview of the study

This study fall into five chapters

Chapter one: Are the introduction, problem and objectives.

Chapter two: literature review.

Chapter three: material and method.

Chapter four: deal with data presentation and data analysis (Result)

Chapter five: contain discussion of the result, conclusion and recommendation

Chapter two

Literature review

Chapter Two

Theoretical Background and Literature Review

2.1 Anatomy of the bladder:

The bladder is a hollow muscular, highly distensible, and rounded organ situated at the base of the pelvis. Urine collects in the bladder from the two ureters, which open into the bladder at its back and connect to the kidneys. Urine leaves the bladder via the urethra, a single muscular tube which ends in the urethral orifice. The bladder is situated below the peritoneal cavity near the pelvic floor. In men, it lies in front of the rectum, separated by a space. In women, it lies in front of the uterus (Campioni et al., 2002).

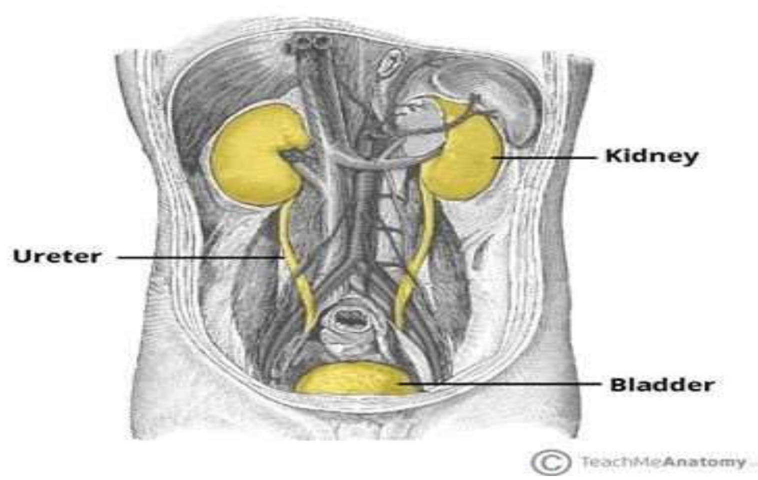

Figure 2.1: Over view of urinary tract (Oliver, 2017)

2.1. 1 Shape of urinary bladder:

The morphological appearance of the bladder varies with filling. When full, it exhibits an oval shape, and when empty it is flattened by the overlying intestines.

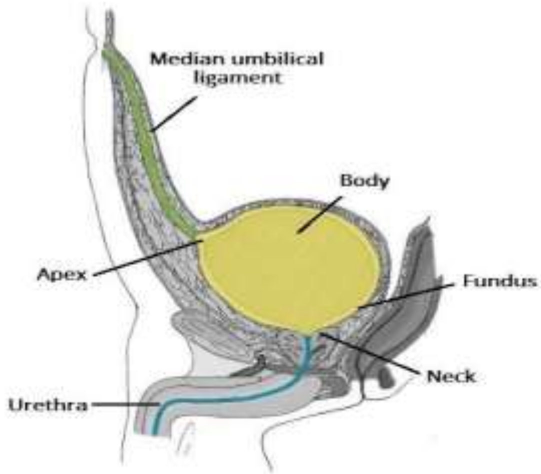

Figure 2.2: Sagittal section of the male pelvis. The external anatomical features of The bladder. [Oliver 2017].

2.1.2 The external anatomical features of the bladder:

The urinary bladder composed from apex which it is located superiorly, pointing towards the pubic symphysis. It is connected to the umbilicus by the median umbilical ligament (a remnant of the urachus), the body; the main part of the bladder, located between the apex and the fundus, urinary fundus (or base) – located posteriorly. It is triangular-shaped, with the tip of the triangle pointing backwards and bladder neck which formed by the convergence of the fundus and the two inferolateral surfaces. This structure joins the bladder to the urethra.
Urine enters the bladder by the left and right ureters, and exits via the urethra. Internally, these orifices are marked by the trigone – a triangular area located within the fundus. In contrast to the rest of the internal bladder, the trigone has smooth walls (Naranjo-Ortiz et al., 2016).

There are two sphincters controlling the outflow of urine; the internal and external urethral sphincters. The internal urethral sphincter is only present in men (Snell, 2011).

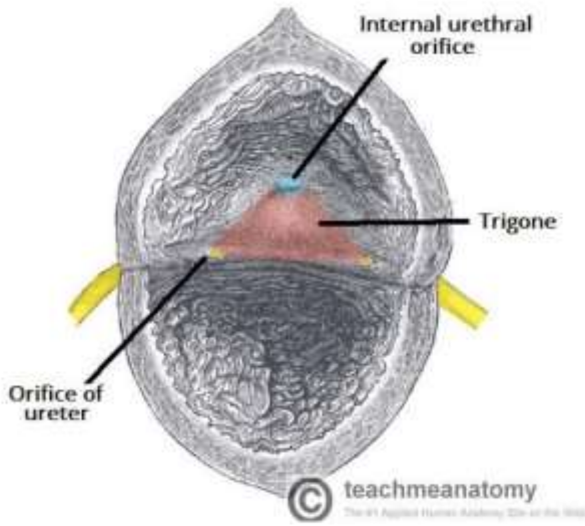

Figure 2.3: The internal surface of the bladder, highlighting the trigone [Oliver, 2017].

2.1.3 Musculature:

The musculature of the bladder, and coordination of its action, plays a key role in the functions of the bladder. In order to contract during micturition, the bladder wall contains specialized smooth muscle, known as **detrusor muscle**. Its fibers are orientated in three directions, thus retaining structural integrity when stretched. It receives innervation from both the sympathetic and parasympathetic nervous systems (Nepal et al., 2015).

During micturition, the detrusor muscle contracts. There are also two muscular sphincters located in the urethral orifices: the internal urethral sphincter is located in males only. It consists of circular smooth fibers, which are under autonomic control. It is thought to prevent seminal regurgitation during ejaculation and the external urethral sphincter is present in both sexes. It is skeletal muscle, and under voluntary control. During micturition, it relaxes to allow urine flow (Snell, 2011).

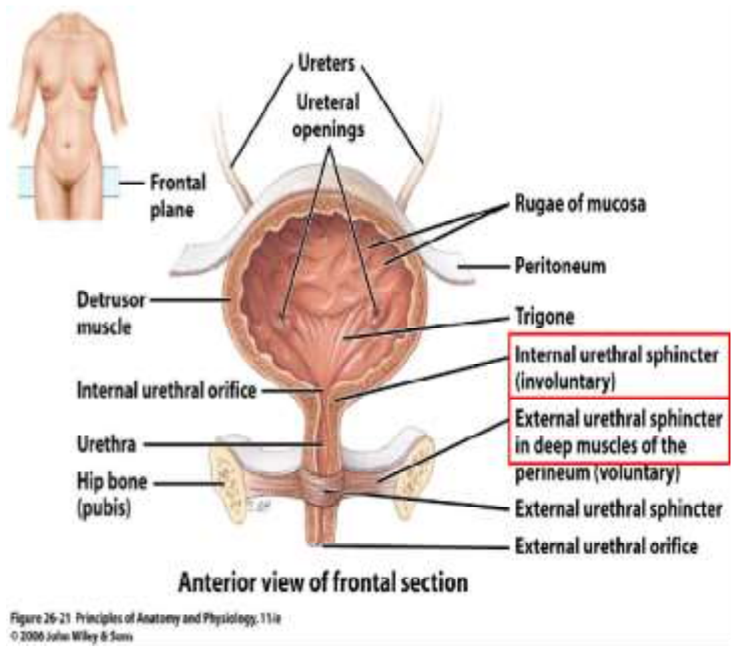

Figure 2.4: Anatomy of urinary bladder

[Oliver, 2017].

2.1.3 Vasculature

The bladder primarily receives its vasculature from the internal iliac vessels. Arterial supply is delivered by the superior vesical branch of the internal iliac artery. In males, this is supplemented by the inferior vesical artery, and in females by the vaginal arteries. In both sexes, the obturator and inferior gluteal arteries also contribute small branches. Venous drainage is achieved by the vesical venous plexus, which empty into the internal iliac vein (also known as the hypogastric vein) (Dunn et al., 2019).

2.1.3 Nervous Supply

Neurological control is complex, with the bladder receiving input from both the autonomic (sympathetic and parasympathetic) and somatic arms of the nervous system: the sympathetic nervous system communicates with the bladder via the hypogastric nerve (T12 – L2). It causes relaxation of the detrusor muscle. These functions promote urine retention. The parasympathetic nervous system communicates with the bladder via the pelvic nerve (S2-S4). Increased signals from this nerve causes contraction of the detrusor muscle. This stimulates micturition. And the somatic nervous supply gives us voluntary control over micturition. It innervates the external urethral sphincter, via the pudendal nerve (S2-S4). It can cause it to constrict (storage phase) or relax (micturition). In addition to the efferent nerves supplying the bladder, there are sensory (afferent) nerves that report to the brain. They are found in the bladder wall and signal the need to urinate when the bladder becomes full. Embryologically, the bladder is derived from the hindgut (Dunn et al., 2019).

2.2 Function of the urinary bladder:

The bladder largely serves two functions: Temporary store of urine that bladder is a hollow organ. The walls are very distensible, with a folded internal lining (known as rugae), this allows it to hold up to 600ml and another function that it is assists in the expulsion of urine – During voiding, the musculature of the bladder contracts, and the sphincters relax. The urinary bladder usually holds 300-350 ml of urine. As urine accumulates, the rugae flatten and the wall of the bladder thins as it stretches, allowing the bladder to store larger amounts of urine without a significant rise in internal pressure (Nepal et al., 2015).

2.3 pathology of urinary bladder:

2.3.1 Bladder Infection:

Acute cystitis more commonly affects women than men. The primary mode of infection is from periurethal, vaginal or fecal flora. The diagnosis is made clinically. In severe cases, the three-layer sign of the bladder wall and debris in urine may be seen. Ultrasonography can diagnose predisposing factors, e.g. bladder calculi, tumors, an enlarged prostate, diverticula, or neurogenic bladder. Female lower tract infections are more likely to be associated with functional than anatomical abnormalities. Son graphically the bladder wall may appear normal in early stage of inflammation, when inflammation is increase bladder wall became diffuse or non-diffuse with hypo echoic thickness (Penny, 2018).

Figure 2.5: Acute cystitis. In severe cases, the three-layer sign of the bladder wall And debris in the urine are seen (Penny, 2018).

Figure 2.6; recurrent cystitis (Penny, 2018)

2.3.2 Schistosomiasis:

Schistosomiasis (also known as bilharziosis) is a parasitic infection caused by trematodes. It is an endemic disease in Africa (especially along the river Nile in Egypt), Asia, Middle East and South America. Schistosomiasis is transferred by freshwater snails who release cercariae to the water. The infection is then transmitted to humans who drink or swim in contaminated water. Cercariae may migrate through intact skin to the subcutaneous vessels. The adult worm then migrates by systemic circulation throughout the host's body and releases eggs in different organs including the bladder, where they can be seen on cystoscopy. As a result of the high antigenic character of the eggs, granuloma and fibrosis are induced. Schistosoma Haematobium is associated with an increased risk of bladder carcinoma. Sonographically appear as thick and calcified urinary bladder wall (Hagen-Ansert, 2013).

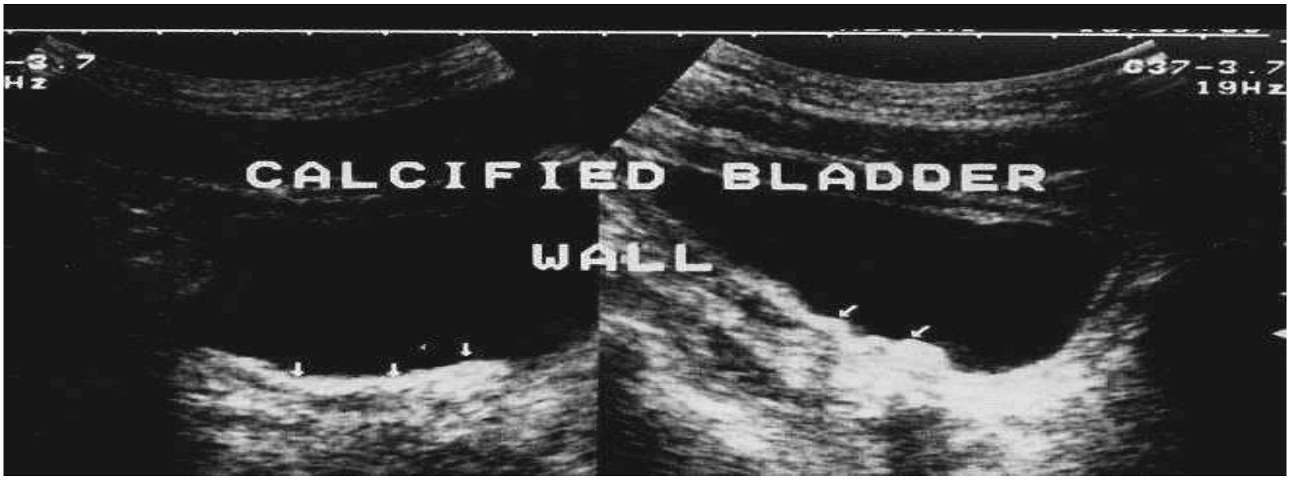

Figure 2.7: Represent bladder Schistosomiasis (Hagen-Ansert, 2013)

2.3.3 Bladder Diverticula

A bladder diverticulum is an out pouching in the bladder wall. A diverticulum of the bladder may be associated with a urethral obstruction or it may be congenital. Complication of a bladder diverticulum include infection, ureteral obstruction, tumor development, and a urinary tract infection. Sonographic finding is a neck of varying size connecting the adjacent fluid filled to the bladder (Hagen-Ansert, 2013)

Figure 2.8: Bladder diverticulum (Hagen-Ansert, 2013)

2.3.4 Bladder Stones*:*

Most bladder stones are seen in men and usually are a manifestation of an underlying pathological condition, including voiding dysfunction, foreign bodies, and infections; kidney stones may pass through the ureter and come into the bladder. Bladder stones appear as highly reflective masses within the bladder, move with altered posture and cast shadows. Stones can be multiple and are always associated with outflow obstruction. Stones complicating diverticula are common. Bladder stones may occlude the bladder outlet at the internal urethral meatus. Small stones may pass through and can be lodged anywhere in the Urethra (Ural et al., 2008).

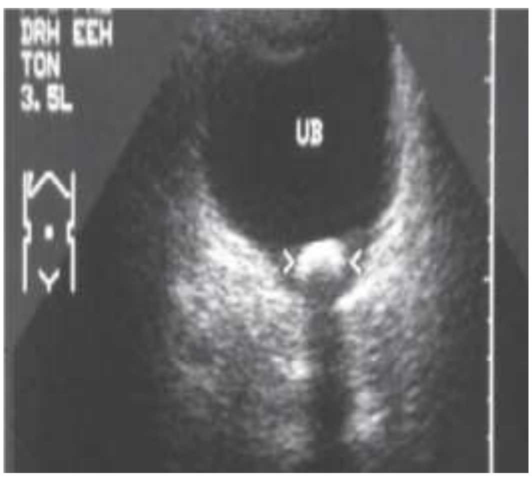

Figure 2.9: Bladder stone. Transverse scan of the bladder

(Ural et al., 2008).

2.3.5 Ureterocele:

A ureterocele is a saccular protrusion of terminal part of ureter into bladder. Ectopic ureteroceles can arise anywhere in the lower urogenital tract .Ureterocele occurs seven times more often in females than in males, and approximately 10% of cases are bilateral. Ureteroceles appear as a “cyst within a cyst” They are dynamic and gradually increase in size with accumulation of urine and then collapse. When the walls of the cystocele are very thin, they can be easily missed and careful scanning is needed (Wang and McKenney, 2019).

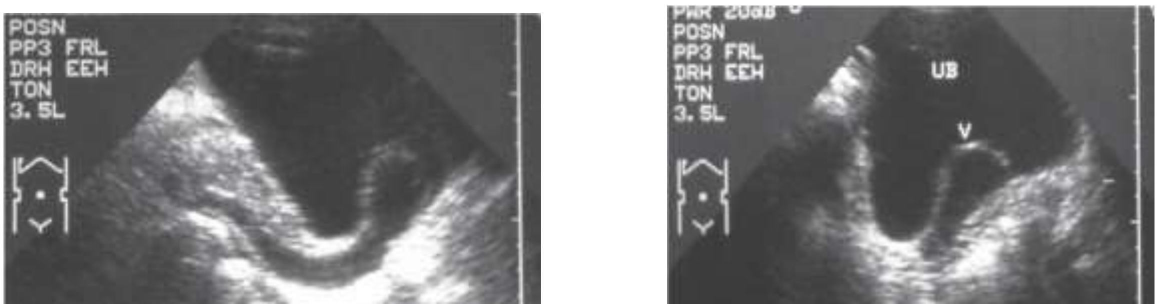

Figure 2.10: Ureterocele. Sagittal section of the bladder showing a well-defined cystic lesion overlying the ureteric orifice. A dilated distal ureter is also seen (Wang and McKenney, 2019).

2.3.6 Blood Clots:

In patients with clots and hematuria, ultrasonography is useful for assessing how much clotting remains within the bladder. Echogenic structures within the bladder without shadows and show change of position with change of body posture are typical ultrasonographic findings for blood clots. Care must be taken to differentiate a mobile intravesical clot from a sessile bladder tumor by examining the patient supine and decubitus (Kwong et al., 2017).

Figure 2.11: Blood clot (Kwong et al., 2017)

2.3.7 Foreign bodies:

The presence of foreign bodies causes cystitis and hematuria. Ultrasound can detect such objects. Embarrassment may cause the victim to delay medical consultation, and they are often found incidentally in the assessment of patients with hematuria or urinary tract infections (Bakare et al., 2018).

2.3.8 Transitional cell carcinoma of the bladder:

The most common malignant tumor of the bladder is TCC. Patient typically present with gross hematuria and may pass some blood clots. The sonographic appearance of TCC within the urinary bladder is smooth or papillary hypoechoic mass that project into the lumen of the bladder (Budak et al., 2018).

Figure 2.12: Represent Transitional cell carcinoma of the bladder (Steven, 2011)

2.4 Urine jet*:*

Urine jet is the rhythmic expulsion of urine through the ureteral orifice (ostium) into the bladder. It can be visualized by real-time color Doppler ultrasound of the bladder. The diagnostic role is to identify the bladder trigone and assess the ureteral function particularly for the diagnosis of ureteral obstruction. The absence of unilateral urine jet may suggest unilateral obstruction owing to urolithiasis. Urine jets are not only seen on color Doppler, but on B-mode grey scale ultrasound if there is a difference in the specific gravity of ureteral and bladder urine (Akiyama et al., 2019).

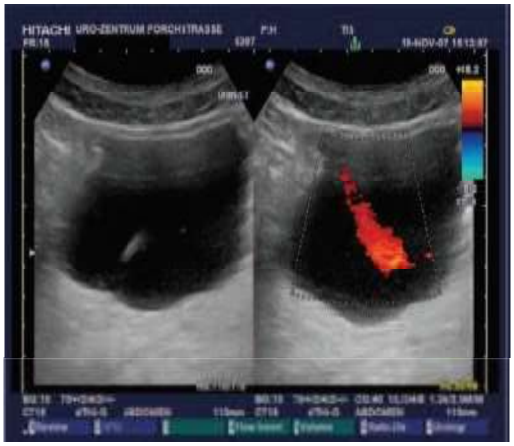 

Figure 2.13: Left image represent normal ureteric jet while Left one represent Abnormal ureteric jet (Akiyama et al., 2019).

2.5 Ultrasound of urinary bladder:

2.5.1 Role of Ultrasound:

Ultrasound is an important tool for assessing the bladder wall for wall thickening, trabeculation, masses and diverticulae. Pre and post micturition volumes. Vesicoureteric junctions .Also can be visualized Bladder calculi and foreign bodies. Use the full bladder as an acoustic window to assess the prostate in males and gynecological structures in females (Penny, 2018).

2.5.2 Limitations

- Extensive pelvic scarring or overlying bowel gas will make scanning the bladder difficult.
- If the bladder is not sufficiently distended, pathology may be hidden by the folds.

2.5.3 Equipment Selection

Use of a curvilinear probe (3-5MHZ) with color Doppler.

Figure 2.14: Curvilinear probe (Penny, 2018)

2.5.4 Patient Preparation

The patient must present with a full bladder.

- 2hrs prior to the scanning, the patient should empty their bladder.
- Over the next hour they should drink at least 1 litre of water. This allows time for the water to reach the bladder.
- Patient asked not go to the toilet until instructed by the Sonographer.

2.5.5 Scanning Technique

Patient supine with suprapubic area exposed.

- Examine the bladder sagittal in the midline. Now angle laterally & sweep the probe both left and right to check the lateral margins.


Figure 2.15: Represent probe position of longitudinal scan (Left) and ultrasonic Image of section (right) (Penny, 2018)

Rotate 90degrees into the axial (transverse) plane. Sweep through from the superior dome to the bladder base. Ensure the ultrasound beam is projected as close to perpendicular to the bladder wall as possible (Hagen-Ansert, 2013).


Figure 2.16: Represent probe position of transverse scan (Left) and ultrasonic image of section (right). http://www.ultrasoundpaedia.com/normal-bladder.

Look for ureteric jets at the bladder base. This confirms bilateral renal function and ureteric patency. To do this, in transverse angle inferiorly using power Doppler (or color Doppler with low PRF & wall filter settings). You may need to be patient to wait for the ureteric jet depending on renal function and degree of hydration (Hagen-Ansert, 2013).

2.5.6 Echogenicity of the bladder and bladder content:

When filled with urine the bladder content should be anechoic. Within the anechoic urine reverberation artifacts can often be seen

Figure 2.17: Urinary bladder echogenicity (Hagen-Ansert, 2013)

On ultrasound the bladder wall appears as a three layer structure. The detrusor muscle is of medium homogeneous echogenicity. The outer serosa (adventitia) layer and the inner mucosa (urothelial) layer are hyperechoic compared with the middle detrusor smooth muscle (muscularis propria) layer (Hagen-Ansert, 2013).

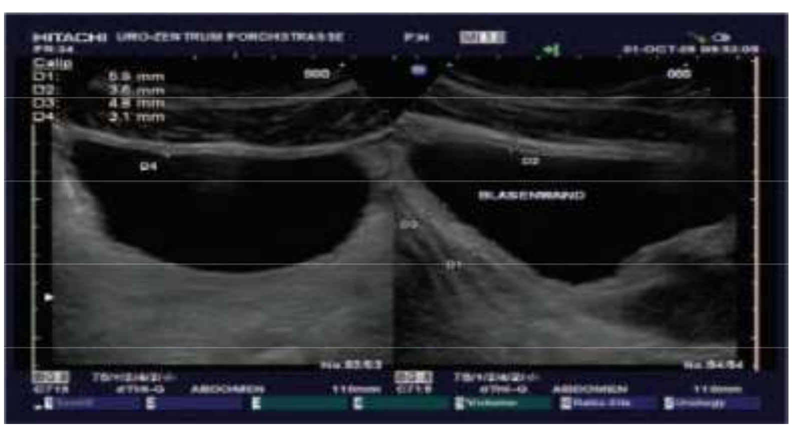

Figure 2.18: Urinary bladder wall thickness measurement (Hagen-Ansert, 2013)

2.6 Urinary bladder measurement:

2.6.1 Urinary bladder volume:

Bladder volume can be calculated by scanning the bladder transversely and longitudinally and using the following ellipsoid formula:

Volume = height × width × depth × 0.5236

However, the bladder is never totally spherical, therefore volume calculations must allow for some measurement error. Ultrasound bladder volume measurement is clinically important in defining the post-void residual urine in patients with bladder voiding disorders, especially BOO. As already mentioned the BPH obstructive stage can be estimated non-invasively by IPSS, uroflowmetry and ultrasound postvoid residual urine measurement (Oelke et al., 2006).

2.6.2 Urinary bladder wall thickness:

Detrusor hypertrophy results in a thickening of the bladder wall and in augmentation of the bladder wall mass (BWM). Bladder wall thickness (BWT) can be directly measured with ultrasound by measuring the any one of urinary bladder wall (anterior, lateral or posterior) transabdominally with a 7.5MHz probe.

BWT was measured from the interface of urine and internal mucosal layer of bladder to outer part of hypoechogenic muscular layer, in the middle of the left or right lateral walls, and in the middle of the posterior wall to rectum (Oelke et al., 2006).

2.7 Previous Studies:

Study of 488 adult with different sex and ages, healthy and another with prostatic benign hyperplasia and lower urinary tract symptoms was done by Hakenberg OW, et al reported that the mean BWT was 3.04 mm in healthy women, 3.33 mm in healthy men, and 3.67 mm in men with LUTS and BPE. Study also reported a small increase in BWT with age for both genders; BWT and age for both men ($r = 0.12$, $P < 0.014$) and women ($r = 0.17$, $P < 0.013$). BWT tends to be greater in men than in women. Men with LUTS and BPE show a moderate increase in BWT. The study represent that there were a weak negative correlation with bladder volume ($r = -0.12$, $P < 0.003$) (Hakenberg et al., 2000a)

Another study done by BIRANG SH, et al on 212 normal adult with different sex and age ranged 12 – 70 years old by 3.5 -5 MHZ ultrasound probe at posterior lateral trigone represent the thickness of full bladder was 2.57+/0.57 mm with the range of 1.41 to 3.65 mm and the thickness of empty bladder was 5.48 +/- 0.12 mm with the range of 7.10 to 3.86 mm. He concluded the thickness to be 2-3 mm in fullness and 4-6 mm in empty status (Birang et al., 2006).

A study done in 55 healthy adult volunteers between 15 and 40 years of age, DWT was measured at the anterior bladder wall with a 7.5 MHz ultrasound probe and with a full bladder by Höfner K , et al reported men had a greater DWT compared to women (1.4 vs. 1.2 mm, $P < 0.001$). The age and BMI did not have a significant impact on DWT (Oelke et al., 2006).

A study done on 204 healthy adult Nigerian volunteers, with empirical evidence of absence bladder pathological, using 3.5 MHz curvilinear ultrasound probe .The study objectives were to determine sonographically the mean urinary bladder Wall thickness in healthy Nigerian population and correlate it with anthropometric parameters .the pre void bladder wall thickness was 2.3-50+-0.45 mm with mean of 3.15+- 0.45 mm. The post void BWT was 3.0+-7. 3+-0.73mm with mean of 5.24+-0.73 mm .Males have thicker bladder wall than females with mean and standard deviation of 3.27+-1.24 mm and 3.10+-0.64 mm respectively. BWT correlated positively with height but negatively with urinary bladder volume .No correlation was noted between BWT and age, weight, and body mass index (Ugwu et al., 2019).

A study done on 106 children (54 boys and 52 girls, aged 8 months to 15 years) without any history and laboratory findings of bladder dysfunction or infection. Us measurement of bladder points were performed with bladder filled to at least 50% of its expected capacity. The objective of the study was to determine the ultrasonographic bladder wall thickness in normal children. The mean thickness of four bladder walls points was 1.79+_ 0.28mm. The mean anterior wall thickness was 1.5+- 0.31mm (range 0.9 – 2.2mm), posterior 2+- 0.36mm (range 1.2 – 3.1 mm), right lateral 1.8+- 0.34mm (range 0.8 – 3mm) and left lateral 1.8+- 0.36mm (range 1 – 3mm). There was a significant difference between bladder sites (P>0.05) except between lateral sites (Hadi Sorkhi, 2009)

A study carried out on 50 randomly selected patients ages ranged between 15 to 75, with normal bladder function. The data was collected using master data collection sheet and analyzed using SPSS. The results of this study showed that the mean age of participants was 38.64 years, mean weight was 68.26 kg, mean height was 163.26 cm, mean body mass index was 17.867 kg/m2, mean posterior urinary bladder wall thickness was 2.468mm and mean urinary bladder volume was 245.821(Hind Suliman, 2016).

.

Chapter Three

Material and method

Chapter Three

Material and Method

3.1 Material:

3.1.1 Machine used:

Siemens 2006 with curvilinear probe 3.5 – 5 MHZ.

3.1.2 Subjects:

Study has been done in the department of ultrasound at Bashair Teaching hospital, a total of 60 participants were selected randomly, their age ranged between 18 to 74 years. All participants were normal, participants with renal disorder, lower urinary tract symptoms or prostate abnormalities were excluded.

3.2 Method:

3.2.1 Design of the study:

This study is descriptive cross sectional study.

3.2.2 Methods of data collection:

Using a special data collection sheet which was designed to evaluate patient urinary bladder wall thickness (anterior, posterior, lateral), urinary bladder volume, patient age, sex, height, weight and calculated body mass index.

3.2.3 Technique used:

Patient in supine position with full bladder; all patient asked to drink sufficient water and a void from going to the micturition. The patient should lie supine. The patient should be relaxed, lying comfortably and breathing quietly, lubricates the lower abdomen with coupling agent. Hair anywhere on the abdomen will trap air bubbles so apply coupling agent generously. Curve linear probe of 3.5 MHZ frequency is uses in scanning. Both transverse and longitudinal by placing probe in supra pubic area. The urinary bladder volume is calculated. The urinary bladder wall thickness is measure from the posterior wall.

Sonography took place and information of the patient was collected using special data collecting sheet.

3.2.4 Methods of analysis:

Cross tabulation, correlation, frequency, t- test analysis is applied using SPSS (20) program.

3.2.5 Ethical approval:

The ethical approval was granted from the hospital and the ultrasound department; which include commitment of the non-disclosure of any information concerning the patient identification.

Chapter four Result

Chapter Four

Results

Table (4.1) frequency distribution of gender

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	27	45.0	45.0	45.0
Female	33	55.0	55.0	100.0
Total	60	100.0	100.0	

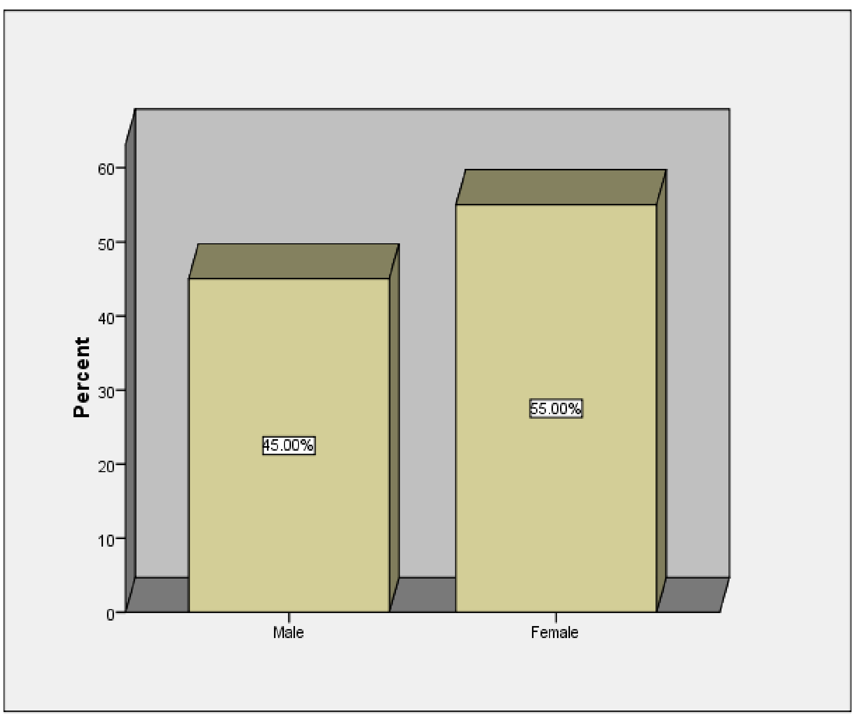

Figure (4.1) frequency distribution of gender

Table (4.2) frequency distribution of age group

Age \years	Frequency	Percent	Valid Percent	Cumulative Percent
18-27	14	23.3	23.3	23.3
28-37	21	35.0	35.0	58.3
38-47	13	21.7	21.7	80.0
48-57	5	8.3	8.3	88.3
58-67	4	6.7	6.7	95.0
68-74	3	5.0	5.0	100.0
Total	60	100.0	100.0	

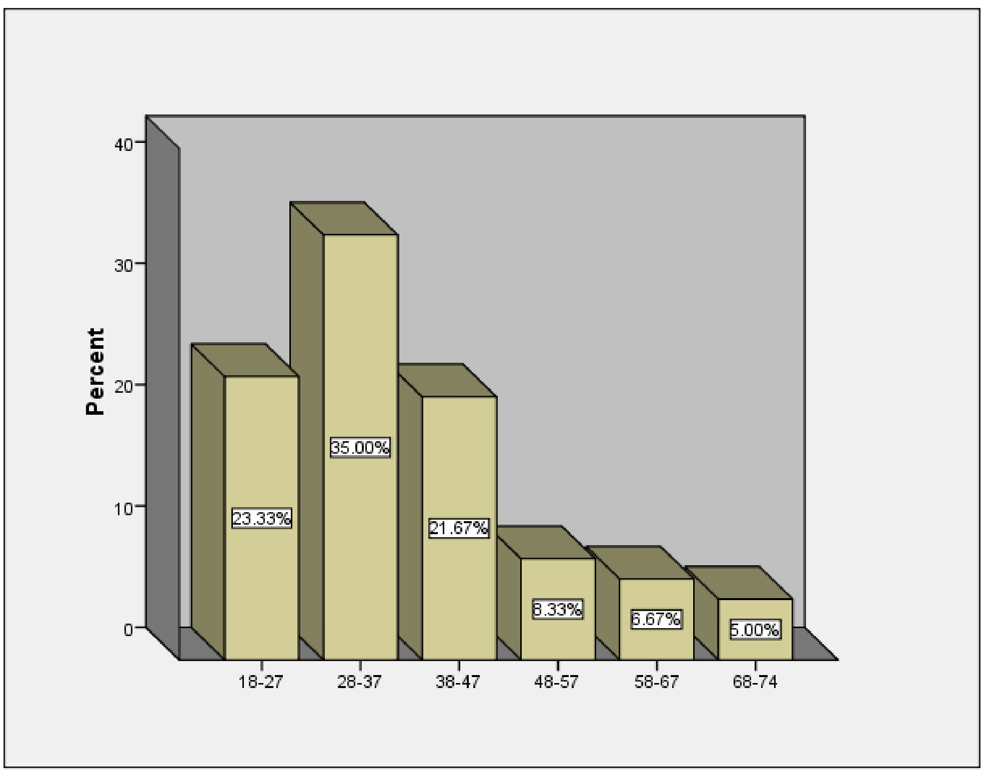

Figure (4.2) frequency distribution of age groups

Table (4.3) descriptive statistic age, height, weight, BMI, UB Wall measurements and volume

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age	60	18	74	38.57	13.72
Height	60	125	189	155.38	16.31
Weight	60	50	107	70.85	11.22
BMI	60	20.90	45.78	29.86	5.80
Ant .wall thickness	60	2.0	7.0	3.43	.94
Lat. wall thickness	60	2.0	7.0	4.05	1.15
Post. Wall thickness	60	2.0	7.0	3.81	1.15
Volume of UB	60	44	180	121.00	25.53

Table (4.4) means UB Wall measurements and volume in different age group

Age group		Ant. Wall thickness	Lat .wall thickness	Post. wall thickness	Volume
18-27	Mean	3.14	4.00	3.21	119.43
	Std. Deviation	.949	1.038	.699	24.098
28-37	Mean	3.62	3.90	3.88	117.90
	Std. Deviation	1.244	1.044	1.224	23.809
38-47	Mean	3.46	4.54	4.38	117.00
	Std. Deviation	.519	1.391	1.325	34.349
48-57	Mean	3.00	4.20	3.60	132.20
	Std. Deviation	.707	1.095	1.140	18.512
58-67	Mean	3.75	3.75	4.25	133.75
	Std. Deviation	.500	1.258	.500	15.019
68-74	Mean	3.67	3.33	3.33	131.67
	Std. Deviation	.577	1.528	1.528	25.658

Table (4.5) mean age and UB Wall measurements and volume in both genders

Variables	Gender	N	Mean	Std. Deviation	Std. Error Mean
Age	Male	27	39.67	12.058	2.320
	Female	33	37.67	15.072	2.624
Ant .wall thickness	Male	27	3.48	.975	.188
	Female	33	3.39	.933	.162
Lat .wall thickness	Male	27	4.00	1.109	.214
	Female	33	4.09	1.208	.210
Post. Wall thickness	Male	27	3.81	1.178	.227
	Female	33	3.80	1.159	.202
Volume	Male	27	120.93	28.471	5.479
	Female	33	121.06	23.316	4.059

Table (4.6) correlation between UB Wall measurements and volume with age, height, weight and BMI

		Age	Height	Weight	BMI
Ant. wall thickness	Pearson Correlation	.093	-.067-	-.005-	.072
	Sig. (2-tailed)	.479	.611	.970	.585
	N	60	60	60	60
Lat. wall thickness	Pearson Correlation	-.038-	-.059-	.024	.120
	Sig. (2-tailed)	.772	.657	.855	.362
	N	60	60	60	60
Post. wall thickness	Pearson Correlation	.141	-.048-	.120	.170
	Sig. (2-tailed)	.281	.715	.362	.195
	N	60	60	60	60
Volume	Pearson Correlation	.172	.377**	.204	-.283*
	Sig. (2-tailed)	.188	.003	.118	.029
	N	60	60	60	60
*. Correlation is significant at the 0.05 level (2-tailed).					
**. Correlation is significant at the 0.01 level (2-tailed).					

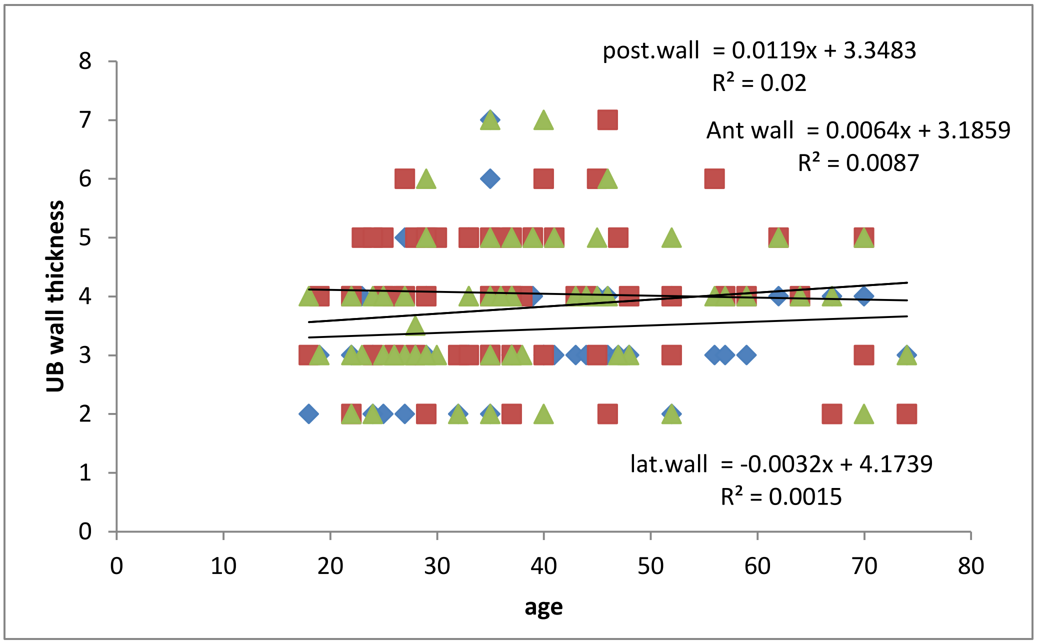

Figure (4.3) scatterplot shows relationship between UB Wall measurements and age

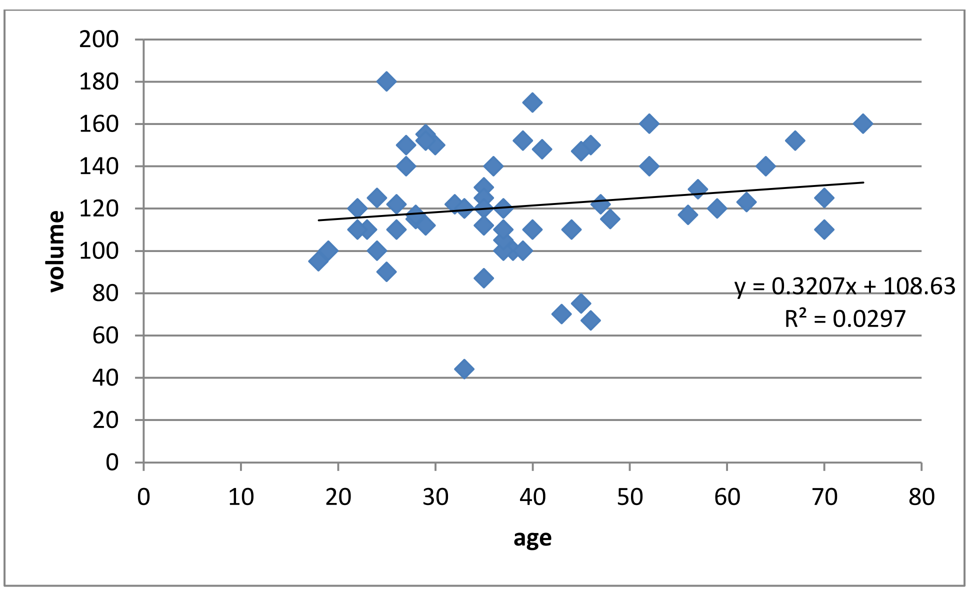

Figure (4.4) scatterplot shows relationship between volume and age

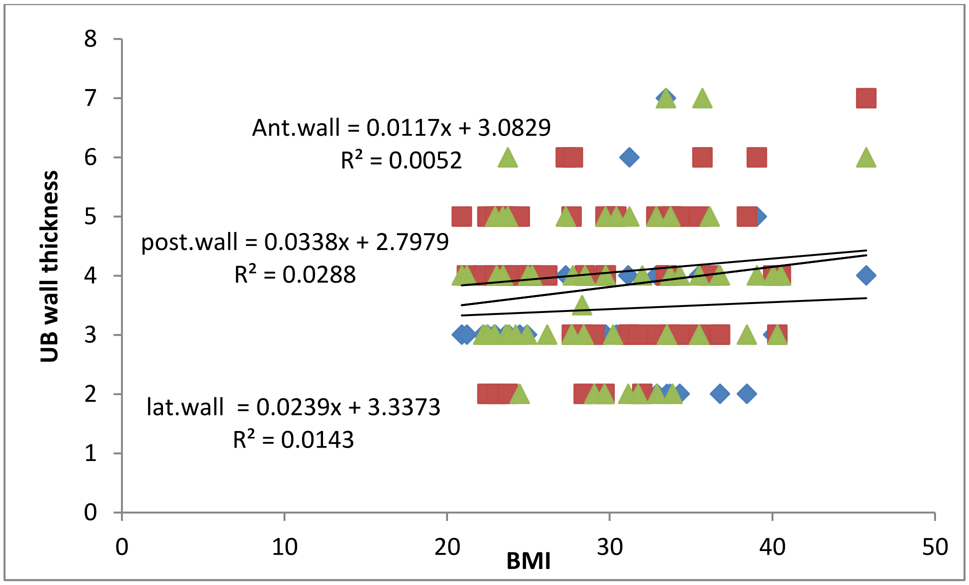

Figure (4.5) scatterplot shows relationship between UB Wall measurements and BMI

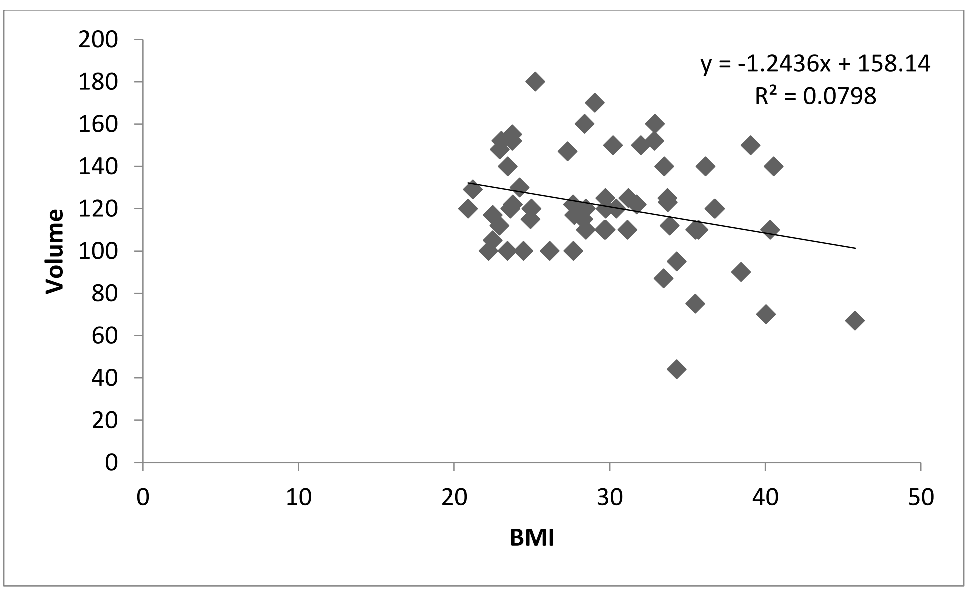

Figure (4.6) scatterplot shows relationship between volume and BMI

Table (4.7) compare means UB Wall measurements and volume in different BMI

BMI		Ant. wall	Lat. wall	Post .wall	Volume
Normal 18.5 -25	Mean	3.39	4.06	3.72	124.28
	Std. Deviation	.502	1.056	1.018	18.528
Overweight (>25-30)	Mean	3.27	3.93	3.57	127.07
	Std. Deviation	.458	1.223	.904	25.132
Obese > 30	Mean	3.56	4.11	4.00	115.44
	Std. Deviation	1.311	1.219	1.359	29.230
Total	Mean	3.43	4.05	3.81	121.00
	Std. Deviation	.945	1.156	1.157	25.536
P value		0.627	0.895	0.481	0.303

Table (4.8) correlation between UB Wall measurements and volume

		Ant .wall	Lat .wall	Post. wall	Volume
Volume	Pearson Correlation	-.041-	-.172-	-.042-	1
	Sig. (2-tailed)	.753	.188	.751	
	N	60	60	60	60
**. Correlation is significant at the 0.01 level (2-tailed).					

Chapter five
Discussion,
Conclusion and recommendation

Chapter Five
Discussion, conclusion and recommendations

5.1. Discussion

In this study 60 adults of both genders (45% male and 55% female), with different age ranging from 18 to 74 years were included. More frequent age group was (28-37) years. The mean age of the participants was (38.57) years, mean height (155.38) cm, mean weight (70.58) kg, mean B.M.I (29.86), mean A.W.T (3.43) mm, L.W.T (4.05) mm, P.W.T (3.81) mm. This present work was similar to the Nigerian study done by (Ugwu et al., 2019) but showed variation from the findings of (Blatt et al., 2008) who found mean male and female BWT values of 2.1 mm and 1.9 mm, respectively. (Kanyilmaz et al., 2013) and (Chan et al., 2005) derived a mean BWT of 2.0 ± 0.4 mm and 1.79 ± 0.2 mm, respectively, which were lower than the values within this study.

In this study Age had a weak positive correlation with BWT in the present study. The findings support those reported by (Hakenberg et al., 2000b) who found a weak positive correlation between BWT and age for men and women. Height, weight, and BMI in the present study had no significant correlation with BWT. This disagrees with the work of (Bright et al., 2010) who found a statistically significant but weak correlation between BWT versus weight and BWT versus BMI. (Sorkhi et al., 2009) however, established a significant correlation between height and weight with BWT. This disparity may be due to the fact that (Sorkhi et al., 2009) worked with set of pediatric participants, with a maximum age 15 years.

The study shows that the relation between the B.M.I and volume increases till overweight and then decreases in very obese. The volume increases till 25 kg/m^2 and then decreases when the B.M.I goes above this level.

The study showed there is a difference between male and female in B.W.T (table 4.5) and this agrees with the study done in healthy Nigerian volunteers (Ugwu et al., 2019).

This study has determined normal values of BWT in a healthy set of adults, using a Sonographic method. While BWT, DWT, and BW did not differ significantly with sex, there were significant differences in BWT compared with published Caucasian values.

5.2. Conclusion

This study has showed that ultrasound is reliable in the evaluation of the urinary bladder wall thickness. Urinary bladder wall thickness is slightly different in A.W.T, P.W.T, and L.W.T. The urinary bladder wall thickness is not impacted by age and sex. The urinary bladder wall thickness is impact by height, BMI. The urinary bladder volume is increase tell 25 kg/m, and then decrease when BMI more than 25kg/m

5.3 Recommendation:

- The urinary bladder wall thickness should be measured routinely so that is easy and low cost to diagnosis the urinary bladder abnormality
- The competent authorities should introduce the modern ultrasound centers.
- The competent authorities should increase the specialist hospitals for urinary tract diseases.
- Further studies should be carried out in this field on many aspect such as increasing of participants so as confirm the results of this study.

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Appendix

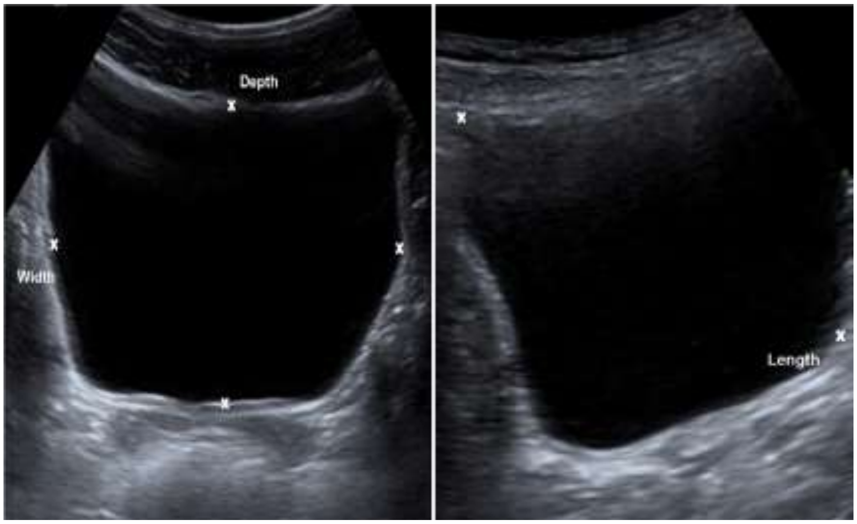

Image 1: represents the measurement of urinary bladder volume in male 37 years old, transverse and longitudinal section, the urinary bladder volume 105 ml

Image 2: represents the measurement of posterior urinary bladder volume =3 mm