بسم الله الرحمن الرحيم

Sudan University of Science and Technology

College of Graduate Studies

Measurement of Seminal Vesicles Diameter among Adult Sudanese Using Ultrasonography

قياس قطر الحويصلات المنوية الطبيعي لدي السودانيين البالغين باستخدام الموجات فوق الصوتية

A thesis Submitted for Partial fulfillment for the Requirement of the M.Sc. Degree in Medical Diagnostic Ultrasound

By:

Mohammed Eltaj Abdalaziz Ibrahim

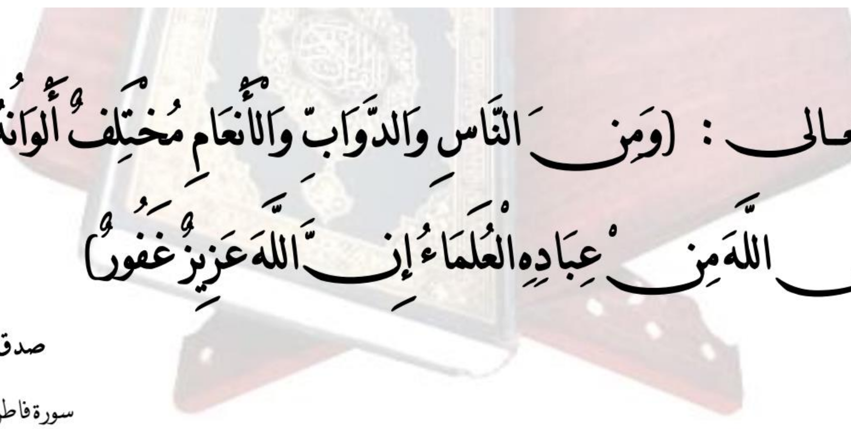
Supervisor:

Dr. Ahmed Mustafa Abukonna

2020

الآية

بِسمِ اللهِ الرَحمنِ الرَحِيم



قال تعالى : (وَمِنَ النَّاسِ وَالدَّوَابِّ وَالْأَنْعَامِ مُخْتَلِفٌ أَلْوَانُهُ كَذَلِكَ
إِنَّمَا يَخْشَى اللَّهَ مِنْ عِبَادِهِ الْعُلَمَاءُ إِنَّ اللَّهَ عَزِيزٌ غَفُورٌ)

صدق الله العظيم

سورة فاطر [الآية :28]

Dedication

- *To my parents who have never failed to give me financial and moral support, for giving all my need during the time I developed my stem.*
- *To my brothers and sisters, who have never left my side.*
- *To my cute little boy and girls*
- *To my wife for understanding and patience*
- *To my friends for their help and support.*
- *Finally, ask Allah to accept this work and add it to my good works.*

Acknowledgement

My acknowledgements and gratefulness at the beginning and at end to Allah who gave us the gift of the mind and give me the strength and health to do this project work until it done completely, the prayers and peace be upon the merciful prophet Mohamed.

I would like to give my grateful thanks to my supervisor **Dr. Ahmed Mustafa Abukonna** who helped and encouraged me in every step of this study.

Abstract

This study was conducted in Khartoum State in Alnhda Reference Medical Center during the period from January (2019) to October (2019). The problem of the study there is no previous studies include measurements of the normal seminal vesicle’s diameter in adult Sudanese. The objective of this study was to establish standard measurements of the seminal vesicles’ diameter in normal adults Sudanese by trans-abdominal ultrasound in order to find measurement range related to age, married status and prostate volume. This study was cross sectional descriptive study where the data were collected from (80) Sudanese adult male using data collecting sheet.

The results showed the average diameter of the right seminal vesicles (10.22 ± 2.84) mm and average diameter of the left seminal vesicles (10.29 ± 2.88) mm. The range values of the right seminal vesicle’s diameter (4mm - 21.5 mm) and the range values of the left seminal vesicle (4mm - 22.5 mm) .The study showed that, there was no relationship between the patient's age with right and left vesicle diameters. Also, the study found out that the right and left vesicle diameters wasn't affected by the married status of the patients among these populations. Also, there is no relationships between the prostate volumes with right and left vesicle diameters but there was moderate positive relationship between prostate volume and patient age ($R2= 0.53$ and P value =0.000). The normal seminal vesicle has low level echogenicity (100%) and homogenous in texture (100 %).

The study recommended that future research studies should be done with expanding period of time and include more sample data for precise and accurate results.

المستخلص

أجريت هذه الدراسة بمركز النهضة الصحي المرجعي في ولاية الخرطوم في الفترة من يناير (2019) وحتى أكتوبر (2019). تمثلت مشكلة البحث في عدم وجود دراسات سابقة تشمل قياسات قطر الحويصلات المنوية عند السودانيين البالغين كما هدفت هذه الدراسة الي قياس قطر الحويصلات المنوية لدى السودانيين البالغين باستخدام الموجات فوق الصوتية والمقارنة مع عمرالمريض والحالة الاجتماعية وحجم البروستاتا. هذه الدراسة مقطعية عرضية وصفية حيث جمعت البيانات من (80) ذكر سوداني بالغ من سن (18) سنة الي (60) سنة ومتوسط الاعمار 40.4 سنة باستخدام ورقة جمع البيانات. اظهرت الدراسة ان متوسط قطر الحويصلات المنوية اليمني كانت (2.84 ± 10.22 ملم.) و أن متوسط قطر الحويصلات المنوية اليسرى كانت (2.88 ± 10.29ملم). مدى قطر الحويصلات المنوية اليمنى يتراوح بين(4 – 21.5 ملم) وان مدى قطر الحويصلات المنوية اليسرى (4 - 22.5 ملم) أظهرت الدراسة انه ليس هنالك علاقة بين عمر المريض و قطر الحويصلات المنوية و انه كذلك ليس هنالك علاقة بين الحالة الاجتماعية (متزوج أو عازب) و قطر الحويصلات المنوية كذلك أوجدت هذه الدراسة أنه ليس هنالك علاقة بين حجم البروستاتا و قطر الحويصلات المنوية وأخيرا أوضحت هذه الدراسة إن الحويصلات المنوية الطبيعية تظهر متجانسة.

توصي هذه الدراسة بضرورة إجراء دراسات بحثيه أخرى يتم فيها توسيع الفترة وتشمل بيانات أكثر للحصول على نتائج أكثر دقة.

List of contents

List of tables

List of Figures

List of Abbreviations

SV	Seminal vesicles
RT	Right
LT	Left
BPH	Benign prostatic hyperplasia
BMI	Body mass index
DR	Dynamic range
ROI	Region of interest
SNR	Signal to noise ratio
SPSS	Statistical package for the social sciences
TGC	Time gain compensation
UCL	Upper confidence limit

Chapter One

Introduction

Chapter One

Introduction

1.1 Introduction

With The rapid advances of medical imaging and computer technologies, Sonography has been widely applied to the abdominal organs in order to benefit and or replace other more complicated and invasive examinations, Sonography is very convenient and simple for the examination of male reproductive system (Wiley-KT et al., 2010).

However, there are limited literatures concerning its application for the measurement of seminal Vesicles, which important to exclude many diseases related to pathological and obstructive condition which cause change in the diameter of the seminal vesicles however the seminal vesicle diameter is better than the volume because it is easy to measure and give us accurate result which importance to exclude the pathology from the normal. Sometime in the practice the seminal vesicles volume difficult to calculate and the volume not accurate because give you different results when measure by different operator because that in this study will use the estimation of the diameter of the seminal vesicles. (Keqin et al., 2007).

The seminal vesicles are a pair of glands that are positioned below the urinary bladder and lateral to the vas deferens. Each vesicle consists of a single tube folded and coiled on itself, with occasional diverticula in its wall. The excretory duct of each seminal gland unites with the corresponding vas deferens to form the two ejaculatory ducts, which immediately pass through the substance of the prostate gland before opening separately into the verumontanum of the prostatic urethra (Devin et al., 2005).

Each seminal vesicle spans approximately (5 cm), though its full unfolded length is approximately (10 cm), but it is curled up inside the gland's structure. (Sandra et al., 2001)

There are many pathologies affected the seminal vesicle such as Inflammation-Seminal vasculitis may be associated with acute infections of the prostate gland or occur as an isolated infection. (Shin SH, et al 2013). Sonographically the vesicle is enlarged with thickened walls. Abscesses may develop as a complication. Agenesis - Absence of one or both may be identified with transrectal ultrasound. Agenesis may be the cause of infertility (Rumack et al., 2011)

Agenesis is associated with unilateral renal agenesis and dysplastic kidney. Cysts - Congenital seminal vesicle cysts may be associated with ipsilateral renal abnormalities, such as agenesis, dysplasia, or hypoplasia. Approximately two thirds of seminal vesicle cysts are associated with ipsilateral renal agenesis Seminal vesicle cysts are also associated with adult dominant polycystic renal disease. In the absence of associated renal anomalies, differentiation between congenital and acquired seminal vesicle cysts is not possible. Most patients are asymptomatic until the third or fourth decade of life at which time they may present with abdominal, pelvic or perineal pain, dysuria, painful ejaculation, chronic recurrent epididymitis or prostatitis and sometimes, infertility. Infection is a frequent complication. Acquired cysts may be due to infection, fibrosis or seminal vesicle stones which cause obstruction of the vas deferens or ejaculatory ducts and result in seminal vesicle cysts, TRUS provides good visualization of the pelvic structures and permits guidance for cyst aspiration. (Jane et al., 2018)

Cysts rarely are greater than 5 cm but sizes greater than cm have been reported (Shaw A, et al, 2018). The cyst wall is thickened and sometimes calcified, Cancer- Seventeen percent of men with positive biopsy at the prostate base had seminal vesicle extension. Sonographically seminal vesicle extension is demonstrated by enlargement, asymmetry and loss of the acute angle between the posterior seminal vesicles and the base of the prostate. (Shin SH et al., 2013).

Ejaculatory duct cysts are usually small and probably represent cystic dilation of the ejaculatory duct, possibly as a result of obstruction. Alternatively, they may be diverticula of the duct. (Rumack, et al, 2011). They tend to be fusiform in shape and are typically pointed at both ends. Ejaculatory duct cysts contain spermatozoa when aspirated. They can be associated with infertility and may be seen in patients with a low sperm count. Some may cause perineal pain (Jane et al., 2018)

1.2 Problem of the study:

This study would be useful as a reference of seminal vesicle diameter because there are no previous studies concerning the normal measurements of seminal vesicles among Sudanese.

1.3 Objectives:

1.3.1 General objective:

The general objective of this study to establish standard measurement of the seminal vesicles' diameter in normal adults Sudanese by trans-abdominal ultrasound.

1.3.2 Specific objectives:

- To measure seminal vesicle diameter.
- To obtain response dominate age.

- To identify the relation between the seminal vesicle diameter and individual's age.
- To identify the relation between the diameter of the right and left seminal vesicles.
- To identify texture and echo-pattern of normal seminal vesicle.
- To measure the prostate volume

1.4 Significance of the study:

This study will help in condition of the seminal vesicles by knowing the standard reference of seminal vesicles diameter.

1.5 Overview of the study:

This study was containing 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 and material study (material and methods). Chapter four contains results. Chapter Five consist of discussion conclusion and recommendations in addition to reference and appendix.

Chapter Two

Background & Literature review

Chapter Two

Literature Review

2.1 Seminal vesicle anatomy:

2.1.1 Seminal vesicles development:

In humans, the male accessory glands are the seminal vesicles, prostate and the bulbourethral glands. The male gonad, the testis, differentiates embryonically initially under the influence of the (Y) chromosome. Later under the influence the gonad-derived fetal testosterone acting through androgen receptors, a region of the urogenital sinus (UGS) mesenchyme differentiates to form the primordial prostate buds. The buds then signal back to the overlying epithelium, inducing duct formation, this was one of the early studied (1970's) examples of a mesenchymal-epithelial interaction in development. The accessory sexual glands originate from two epithelial tissues. They either come from the epithelial mesodermal origin of the mesonephric duct (Wolff) or from the epithelial endodermal origin of the urogenital sinus (Devin et al., 2005)

The seminal vesicle differentiates itself during the 12th week from a protrusion on the deferent duct, near where it opens at the back wall of the urogenital sinus (future prostatic part of the urethra). They thus have a mesodermal origin. These paired glands produce a viscous, fructose-rich secretion that serves as a source of energy for the sperm cells. The portion of the mesonephric duct that lies between the junction of the seminal vesicle and the prostatic part of the urethra is called the ejaculatory duct. Between the two ejaculatory duct junctions the prostatic utricle (remainder of the paramesonephric duct) has its opening. This location is called the seminal colliculus (Shin et al., 2013).

2.1.2 Shape and location:

These are paired anatomical structures (**Fig. 2.1**), lying superior to the prostate, posterior to the bladder, and lateral to the vas deferens. Ducts of the seminal vesicles enter the central zone of the prostate. It stores sperms, and joins the vas deferens to form the ejaculatory ducts. (Keqin et al., 2007).

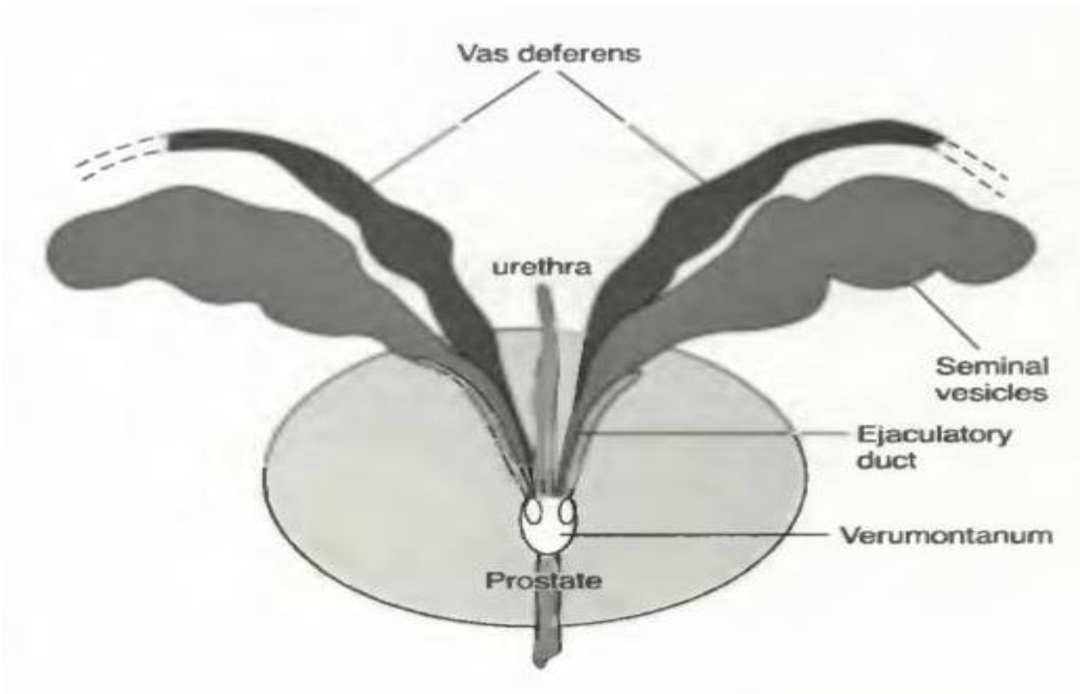


Figure (2.1): shows the seminal vesicles and vas deferens both end into ejaculatory duct that ends in Verumontanum. (Nose H et al., 2005)

The seminal vesicles are two lobulated organs about inch. (5 cm) long lying on the posterior surface of the bladder. On the medial side of each vesicle lies the terminal part of the vas deferens. Posteriorly, the seminal vesicles are related to the rectum. Inferiorly, each seminal vesicle narrows and joins the vas deferens of the same side to form the ejaculatory duct. Each seminal vesicle consists of a much-coiled tube embedded in connective tissue. (Devin et al., 2005).

2.1.3 Structure of seminal vesicles:

The seminal vesicles are located below the bladder and above the prostate gland. An individual seminal vesicle consists of a single coiled tube of which several pouches branch. The tube of a seminal vesicle is made up of three different layers: moist inner layer of specialized cells that work to produce seminal vesicle fluid. middle layer of smooth muscle tissue outer layer of connective tissue. Part of the seminal vesicles and the vas deferens combine to form the ejaculatory duct, which eventually drains into the prostatic portion of the urethra. During ejaculation, the smooth muscle layer of the seminal vesicle's contracts, releasing the seminal vesicle fluid into the ejaculatory duct. (Devin et al., 2005)

Histologically, Under microscopy, the seminal vesicles can be seen to have a mucosa, consisting of a lining of interspersed columnar cells and a lamina propria; and a thick muscular wall. The lumen of the glands is highly irregular and stores secretions from the glands of the vesicles. In detail: The epithelium is pseudostratified columnar in character, similar to other tissues in the system. The height of these columnar cells, and therefore activity, is dependent upon testosterone levels in the blood. The lamina propria, containing underlying small blood vessels and lymphatics. Together with the epithelia, this is called the mucosa, and is arranged into convoluted folds, increasing the overall surface area A muscular layer, consisting of an inner circular and outer longitudinal layer of smooth muscle, can also be found. Spermatozoa may occasionally be found within the lumen of the glands, even though the vesicles are blind-ended in nature. This is thought to be because of slight reflux due to muscular contractions of the urethra during ejaculation. (Shin SH et al., 2013)

2.1.4 Relations of the seminal vesicles:

The anterior aspect of each seminal vesicle is in contact with the posterior wall of the bladder. The posterior aspect of each vesicle, however, is separated from the rectum by the recto prostatic Douvillier's fascia. Inferior to the seminal vesicles is the prostate with the ureters located anterior to them. Medial to the seminal vesicles are the ampulla of the vas deferens, whereas the veins of the prostatic venous plexus lie lateral to them. (Devin et al., 2005)

2.1.5 Blood Supply:

The inferior vesicle and middle rectal arteries. The veins drain into the internal iliac veins. The internal iliac nodes. (Devin et al., 2005)

2.2 Seminal vesicles Function:

The function of the seminal vesicles is to produce a secretion that is added to the seminal fluid. The secretions nourish the spermatozoa. During ejaculation, the seminal vesicles contract and expel their contents into the ejaculatory ducts, thus washing the spermatozoa out of the urethra. (Devin et al., 2005)

2.3 Prostate anatomy:

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 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 inferno lateral walls related to the muscles of the pelvic side wall and the anterior part of the levatorani muscles on either side. (Siccardi MA.,2020).

2.3.1 Prostatic urethra:

The prostatic urethra is about (1.25)inches (3cm) long and begins at the neck of the bladder. It passes through the prostate from the base to the apex, where it becomes continuous with the membranous part of the urethra. On its posterior wall is a longitudinal ridge called the urethral crest, on each side of these ridges is a groove called the prostatic sinus, the prostatic glands open into these grooves. On the summit of urethral crest is a depression, the prostatic utricle, which is an analog of the uterus and vagina in females. On the edge of the mouth of the utricle are the openings of the two ejaculatory ducts. (Devin et al., 2005)

2.3.2 Periurethral glands:

The urethral or periurethral glands are glands that branch off the wall of the urethra of male mammals. The glands secrete mucus and are most numerous in the section of the urethra that runs through the penis. Urethral glands produce a colloid secretion containing glycosaminoglycan; this secretion protects the epithelium against urine. Untreated urethritis can lead to infection of the urethral glands, which can in turn result in impeding urethral strictures.(Jane A. Bates et al, 2018). Comprise1% of glandular tissue, also it's the tissue that lines the prostatic urethra. (Keqin et al., 2007)

2.3.3 Verumontanum:

It's the region where the ejaculatory ducts enter the urethra and divides the urethra into proximal and distal segments. (Keqin et al., 2007)

The seminal colliculus, or verumontanum, of the prostatic urethra is a landmark near the entrance of the ejaculatory ducts (on both sides, corresponding vas deferens and seminal vesicle feed into corresponding ejaculatory duct). Verumontanum is translated from Latin to mean 'mountain ridge', a reference to the distinctive median elevation of urothelium that characterizes the landmark on magnified views. Embryologically, it is derived from the uterovaginal primordium. The landmark is important in classification of several urethral developmental disorders. The margins of seminal colliculus are the following: The orifices of the prostatic utricle, The slit-like openings of the ejaculatory ducts, The openings of the prostatic ducts.(Jane A Bates et al., 2018)

2.3.4 Blood supply of the prostate:

In males, both the prostate and seminal vesicles are supplied with blood by the inferior vesical artery. It is comparable to the vaginal artery in females. The two are considered to be homologous, which means that they have the same basic structure and are likely closely related in terms of how they evolved. According to some research articles and medical texts, the inferior vesical artery is found in both males and females, making the inferior vesical artery an artery that branches off the vaginal artery in women. This artery may have a common trunk with the superior gluteal and internal pudendal, or can branch off from the internal pudendal. This varies from person to person, and usually occurs as only one additional branch. The inferior vesical artery also supplies the ductus deferens, which is a section of the passage through which sperm travel in the male reproductive system. (Merland et al., 2012)

2.3.5 Function of the prostate:

The function of the prostate is the production of a thin, milky fluid containing citric acid and acid phosphatase. The smooth muscle in the capsule and stroma contract, and the secretion from the many glands is squeezed into the prostatic urethra. The prostatic secretion is alkaline and helps to neutralize the acidity in the vagina. (Devin et al., 2005). Moreover, the prostatic secretion constitutes between 13% and 30% of the volume of semen. (Penny et al., 2011)

2.4 Vas Deferens:

The vas deferens is a thick-walled tube about 18 in. (45 cm) long that conveys mature sperm from the epididymis to the ejaculatory duct and the urethra. It arises from the lower end or tail of the epididymis and passes through the inguinal canal. It emerges from the deep inguinal ring and passes around the lateral margin of the inferior epigastric artery. It then passes downward and backward on the lateral wall of the pelvis and crosses the ureter in the region of the ischial spine. The vas deferens then runs medially and downward on the posterior surface of the bladder. The terminal part of the VA deferens is dilated to form the ampulla of the vas deferens. The inferior end of the ampulla narrows down and joins the duct of the seminal vesicle to form the ejaculatory duct. (Devin et al., 2005)

2.5 Ejaculatory Ducts:

The two ejaculatory ducts are each <1 in. (2.5 cm) long and are formed by the union of the vas deferens and the duct of the seminal vesicle. The ejaculatory ducts pierce the posterior surface of the prostate and open into the prostatic part of the urethra, close to the margins of the prostatic utricle; their function is to drain the seminal fluid into the prostatic urethra. (Devin et al., 2005).

2.6 Ultrasound physics:

Unlike x-rays, sound waves constitute a mechanical longitudinal wave, which can be described in terms of particle displacement or pressure changes. Some of the more important quantities that are described in ultrasound imaging consist of: frequency, propagation speed and pulsed ultrasound, interaction of ultrasound with tissue, angle of incidence and attenuation. Many of the objects and artifacts seen in ultrasound images are due to the physical properties of ultrasonic beams, such as reflection, refraction and attenuation. Indeed, physical artifacts are an important element in clinical diagnosis. (Rumack et al., 2011).

2.6.1 Ultrasound Interaction with Tissue:

As a beam of ultrasound travels through a material, various things happen to it. A reflection of the beam is called an echo, a critical concept in all diagnostic imaging. The production and detection of echoes form the basis of the technique that is used in all diagnostic instruments. A reflection occurs at the boundary between two materials provided that a certain property of the materials is different. This property is known as the acoustic impedance and is the product of the density and propagation speed. If two materials have the same acoustic impedance, their boundary will not produce an echo. If the difference in acoustic impedance is small, a weak echo will be produced, and most of the ultrasound will carry on through the second medium. If the difference in acoustic impedance is large although, a strong echo will be produced. If the difference in acoustic impedance is very large, all the ultrasound will be totally reflected. (Rumack et al., 2011)

2.6.2 Angle of Incidence:

If a beam of ultrasound strikes a boundary obliquely, however, then the interactions are more complex than for normal incidence. The echo will return from the boundary at an angle equal to the angle of incidence, as shown in. The transmitted beam will be deviated from a straight line by an amount that depends on the difference in the velocity of ultrasound at either side of the boundary. This process is known as refraction, and the amount of deviation is given by the relationship known as Snells law, which relates the angle of refraction to the speed of sound in that tissue. (Rumack et al., 2011).

Table (2.1): Percentage reflection of ultrasound at boundaries: (Rumack et al., 2011).

Boundary	% Reflected
Fat/muscle	1.08
Fat/kidney	0.6
Soft tissue/water	0.2
Bone/fat	49
Soft tissue/air	99

2.6.3 Attenuation:

The intensity of the ultrasound beam is further reduced by attenuation due to various processes such as reflection, refraction, scattering, and absorption. All these processes divert energy from the main beam. Reflection and refraction occur at surfaces that are large compared with the wavelength of the ultrasound. For objects that are small in comparison with the wavelength, energy is scattered in many directions, and the eventual fate of the ultrasound is to be absorbed as particle vibration and the production of heat. The amount of attenuation varies with the frequency of ultrasound. A high-frequency beam will be attenuated more than a lower frequency. This means that if the examiner wants to penetrate and subsequently image deep into the body, he or she will, in general, have to use a lower-frequency transducer. (Rumack et al., 2011).

2.6.4 B Mode Imaging Controls

2.6.4.1 Depth/F.O.V. Control:

Varying the depth of the F.O.V. varies the write zoom and therefore the number of pixels per cm and spatial resolution potential of the system. It is important not to use excessively large F.O. V's that reduce spatial resolution achievable but also not to 'clip' the F.O.V. too tightly around the region of interest such that relationships with other structures are not shown. (Xinyue Chen.,2015)

2.6.4.2 Gain:

Refers to the degree of amplification applied to all returning signals. If set too low, there will be underwriting of the image and real echo will be lost from the display. If set too high, there will be overwriting of the display with artifactual noise introduced and also a reduction in contrast resolution as all echoes get progressively brighter. (Xinyue Chen.,2015).

2.6.4.3 T.G.C:

The T.G.C. control compensates for the effects of attenuation by progressively increasing the amount of amplification applied to signals with depth (time). The sonographer aims to produce an image of uniform brightness from top to bottom and this requires regular adjustment of this control during scanning. (Xinyue Chen.,2015)

2.6.4.4 Power or Output Control:

This controls the strength of the voltage spike applied to the crystal at pulse emission. Increasing power output increases, the intensity of the beam and therefore the strength of echo return to the transducer. i.e. increases signal to noise ratio (SNR). However, it also increases the patient's ultrasound dose. It is best practice to operate on minimum power and maximum gain, remembering though that no amount of gain can compensate for insufficient power. The obvious alternative to increasing power output if 'dropout' artefact is encountered at depth is to use a lower frequency transducer. (Xinyue Chen.,2015).

2.6.4.5 Dynamic Range:

Refers to the range of echoes processed and displayed by the system, from strongest to weakest. The strongest echoes received are those from the ‘main bang’ and transducer-skin interface and they will always be of similar strength. As DR is reduced therefore it is the echoes at the weaker end of the spectrum that will be lost. DR can be considered as a variable threshold of writing for weaker signals. For general imaging the DR should be kept at its maximum level to maximize contrast resolution potential. However, in situations where low-level noise or artefacts degrade image quality the DR can be reduced to partially eliminate these appearances. (Xinyue Chen.,2015)

2.6.4.6 Focal Zones:

Throughout the scan the sonographer should constantly check the position of the focal zone(s) and ensure they are at the depth of interest. Multiple focal zones can be used to maximize lateral resolution over depth if motion is not encountered, but it is important to minimize the focal zones used when assessing moving i.e. a fetal heart. (Xinyue Chen.,2015).

2.6.4.7 Frequency:

It is best to use the maximum frequency possible to image the region of interest, allowing for adequate penetration to this depth and thus avoiding ‘dropout’ artefact. There are several reasons for this, increasing frequency will; improve axial resolution, produce a better beam shape (longer near field) and increase the return from non-specular interfaces. Transducer frequencies common today are 5-15MHz for superficial work and 2-7MHz for deeper areas. (Xinyue Chen.,2015).

2.7 Seminal vesicles sonogram:

The paired seminal vesicles are oval, lobulated structures 3-5 cm long and 1-2 cm wide. In the transverse plane, the seminal vesicles have a bow tie appearance. Mild asymmetry is common. They are hypoechoic to the prostate. An acute angle between the posterior seminal vesicles and the base of the prostate is filled with echogenic fat. (Devin et al., 2005)

2.7.2 Ultrasound techniques:

Transabdominal ultrasound can adequately assess the seminal vesicles diameter. The patient must come with full urinary bladder; 200- 500ml of clear fluid should be period. Ingested one hour before the exam and finished with in a15-20 minutes time Patient lies on supine position, with a normal respiration. The transducer used is convex type of 3-5 MHz frequency. Seminal vesicles scanning with transducer perpendicular at the body. Just superior to the symphysis pubis and rocking the probe to Right side for the RT seminal vesicle and LT side for LT seminal vesicle after that measure the anterior-posterior diameter for the RT and LT seminal vesicles, also can measured the seminal vesicles diameter in the transverse view with transducer transverse at the body just superior to the symphysis pubis and caudally tilting. (Devin et al., 2005)

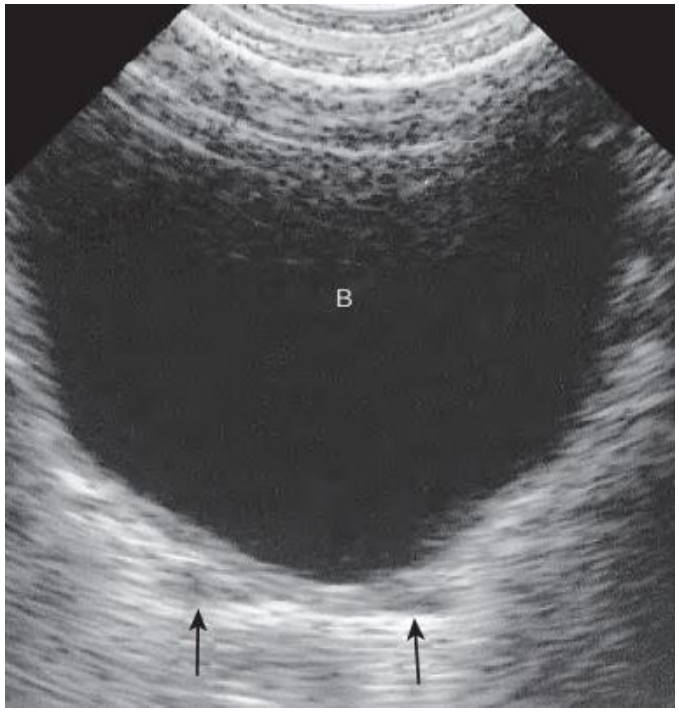


Figure (2.2): Seminal vesicles. Through a well distended bladder (B), the seminal vesicles (arrows) are seen as hypoechoic, bilaterally symmetrical structures. (Rumack et al., 2011).

2.8 Pathology of seminal vesicles:

2.8.1 Inflammation:

Seminal vasculitis may be associated with acute infections of the prostate gland or occur as an isolated infection. Sonographically the vesicle is enlarged with thickened walls. Abscesses may develop as a complication.

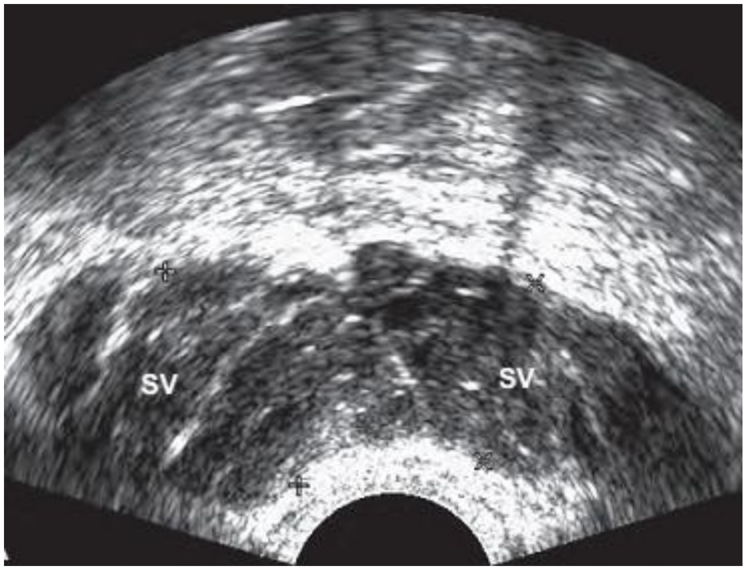


Figure (2.3): shows Bilateral dilated seminal vesicles (SV) (>1.5 cm). This is evidence of obstruction to the ejaculatory ducts. (Rumack et al., 2011).

2.8.2 Agenesis:

Absence of one or both may be identified with transrectal ultrasound. Agenesis may be the cause of infertility. Agenesis is associated with unilateral renal agenesis and dysplastic kidney.14 TRUS provides good visualization of the pelvic structures and permits guidance for cyst aspiration. Cysts rarely are greater than 5 cm but sizes greater than (Shaw A, et al, 2018) cm have been reported. The cyst wall is thickened and sometimes calcified. (Devin et al., 2005).

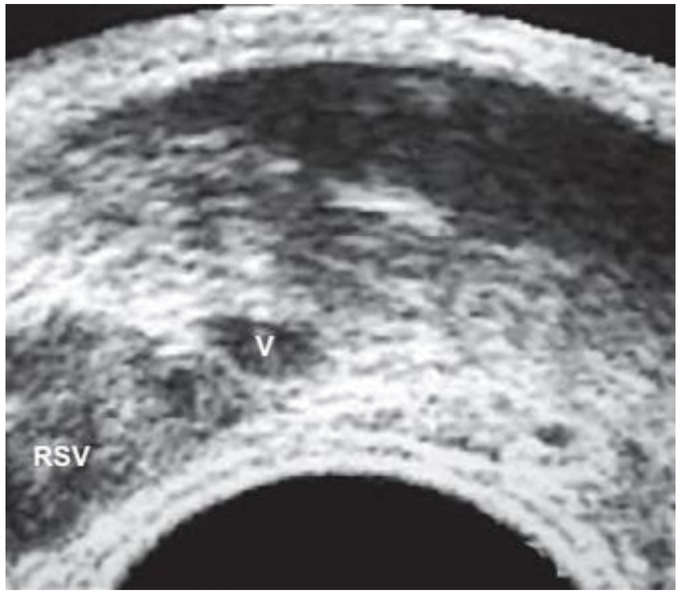


Figure (2.4): shows Unilateral agenesis of left seminal vesicle and vas deferens (V). Only the right side is intact; RSV, right seminal vesicle. (Rumack et al., 2011).

2.8.3. Cysts:

Congenital seminal vesicle cysts may be associated with ipsilateral renal abnormalities, such as agenesis, dysplasia, or hypoplasia. Approximately two thirds of seminal vesicle cysts are associated with ipsilateral renal agenesis. seminal vesicle cysts are also associated with adult dominant polycystic renal disease. In the absence of associated renal anomalies, differentiation between congenital and acquired seminal vesicle cysts is not possible. Most patients are asymptomatic until the third or fourth decade of life at which time they may present with abdominal, pelvic or perineal pain, dysuria, painful ejaculation, chronic recurrent epididymitis or prostatitis and sometimes, infertility. Infection is a frequent complication. Acquired cysts may be due to infection, fibrosis or seminal vesicle stones which cause obstruction of the vas deferens or ejaculatory ducts and result in seminal vesicle cysts. (Devin et al., 2005)

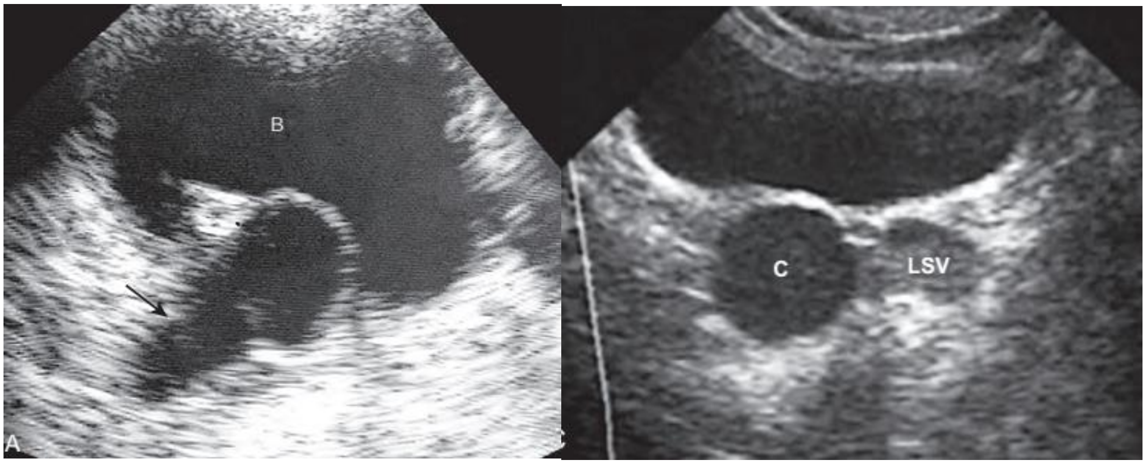


Figure (2.5): shows **A.** Transverse sonogram shows tubular structure (arrow) with a rounded portion projected over bladder (B). **B.** Unilateral right seminal vesicle cyst (C); transvesical scan; LSV. (Rumack et al., 2011).

2.8.4 Cancer:

Seventeen percent of men with positive biopsy at the prostate base had seminal vesicle extension. Sonographically seminal vesicle extension is demonstrated by enlargement, asymmetry and loss of the acute angle between the posterior seminal vesicles and the base of the prostate. (Devin et al., 2005).

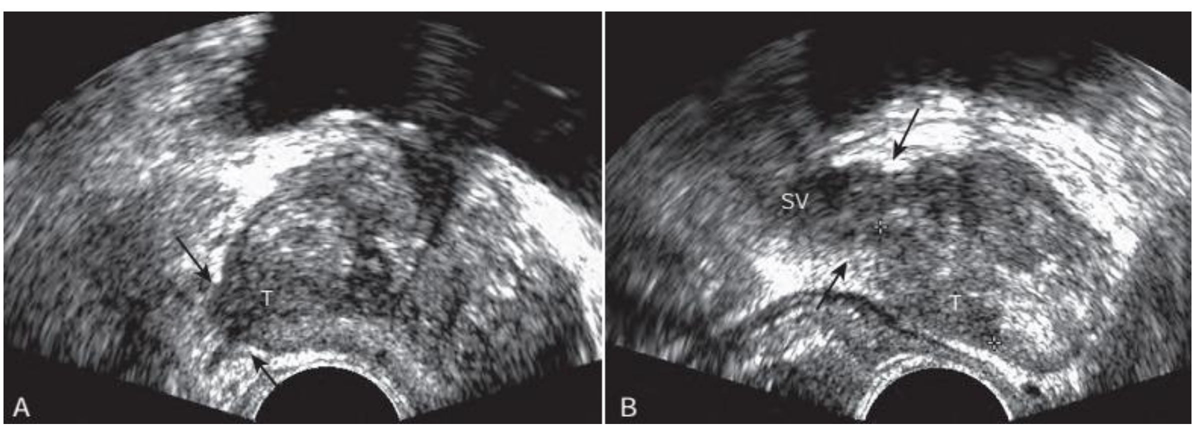


Figure (2.6): shows **A**, Stage T3A cancer (T) has extended outside the prostate at the neurovascular bundle (arrows). **B,** Stage T3C (parasagittal view) cancer (T) extending (arrows) into the seminal vesicles (SV) above the prostate. (Rumack et al., 2011).

2.9 Previous studies:

First study done by **(Ryoji et al., 2008):** To clarify the morphological alteration of prostate and seminal vesicles (SV) quantitatively after testosterone ablation, we investigated the prostate volume (PV) and the SV volume (SVV) using transrectal ultrasonography. Between July 2002 and October 2004, we prospectively investigated 29 prostate cancer patients. The medical castration group included 21 patients (42 SV and 21 prostate; median Gleason sum, 74 years) who were diagnosed as having T1b to T3aN0M0 prostate cancer and underwent androgen ablation with a luteinizing hormone-releasing hormone (LH-RH) analogue and chlormadinone acetate. As normal controls, 8 patients (16 SV and 8 prostates; median age, 68.5 years) with T1aN0M0 prostate cancer without any other additional treatment were enrolled in this study. We measured both PV and SVV in these groups with transrectal ultrasonography. Both PV and SVV significantly decreased in the medical castration group (PV: 28.4 ± 9.3 mL to 17.0 ± 5.3 mL, SVV: 3.5 ± 1.8 mL to 1.9 ± 1.0 mL; median, 6 months), whereas those in the control group were maintained (PV: 16.6 ± 5.7 mL to 16.5 ± 5.3 mL, SVV: 2.5 ± 1.0 mL to 2.6 ± 1.6 mL; median, 12 months). In longitudinal assessment, mean PSA, PV, and SVV were significantly reduced gradually up to 12 months after medical castration. Not only PV but also SVV was significantly reduced after medical castration. Moreover, size reduction continued up to 12 months in SV, with especially marked reduction seen through the first 6 months. These results demonstrated that optimum duration for androgen ablation before radiotherapy is at least 6 months, and up to 12 months for the maximum effect.

Another study done by **(Fuse H et al., 1992):** Twenty males underwent transrectal ultrasonography before and after ejaculation to examine possible alterations that could influence interpretation of seminal vesicle ultrasonography. The preejaculation length of 35 mm was significantly ($p < 0.05$) decreased to 30 mm after ejaculation. The mean width of the seminal vesicles was 13 mm before and 11 mm after ejaculation. The seminal vesicle volume was significantly diminished after ejaculation ($p < 0.05$). It therefore seems important to maintain a period of abstinence when evaluating the seminal vesicles by ultrasonography.

Chapter Three

Material &Methodology

Chapter Three

Materials and Methods

3.1 Study design:

This was a cross-sectional, descriptive study where the samples selected randomly.

3.2 Study area:

The study was conducted in Khartoum state at Alnhda Reference Medical Center.

3.3 Study duration:

This study was conducted during the period from January to October (2019).

3.4 Sample size:

The study conducted in (80) adult Sudanese male.

3.5 Inclusion criteria:

All adult's Sudanese patient who referred for abdominal US scans during the duration of the study.

3.6 Exclusion criteria:

Patients who are not Sudanese, pediatric age groups, infertility male, patients who have history of seminal vesicles diseases or detected have seminal vesicle pathology during US scan.

3.7 Data collection:

Information's such as (age, marital status, RT seminal vesicles diameter, LT seminal vesicles diameter and prostate volume) were obtained from patients using data collecting sheet.

3.8 Ethical consideration:

Permission from hospital was applied and verbal consent was taken from patients those involved in the study.

3.9 Data analysis:

The collected data were analyzed by Statistical Package for Social Sciences SPSS) version (23) and Microsoft office excel 2016 computerized program.

3.10 Equipment used:

Ultrasound machines with curvilinear array 3.5- 5 MHz, coupling gel. The sonographic examination was performed with a high-resolution real-time scanner (Mindray DP 50 with a 3.5-5MHz convex transducer)

3.11 Technique:

Any adult Sudanese Patient from who referred for Transabdominal ultrasound can adequately assess the seminal vesicles diameter. The patient must come with full urinary bladder; 200- 500ml of clear fluid should be period. Ingested one hour before the exam and finished with in a15-20 minutes' time Patient lies on supine position, with a normal respiration. The transducer used is convex type of 3-5 MHz frequency. Seminal vesicles scanning with transducer perpendicular at the body. Just superior to the symphysis pubis and rocking the probe to Right side for the RT seminal vesicle and LT side for LT seminal vesicle after that measure the anterior-posterior diameter for the RT and LT seminal vesicles, also can measured the seminal vesicles diameter in the transverse view with transducer transverse at the body just superior to the symphysis pubis and caudally tilting.

Chapter Four

Results

Chapter Four

The Results

4.1 Results:

About (80) cases having neither complain nor pathology related to seminal vesicles selected for this study. The results of this study are presented into tables and figures below.

Table (4-1): shows age group frequency and percent.

Age Groups	Frequency	Percent
18-27	11	7.49%
28-37	28	27.57%
38-47	13	17.02%
48-57	18	22.58%
58-67	10	18.35%
Grand Total	**80**	**100.00%**

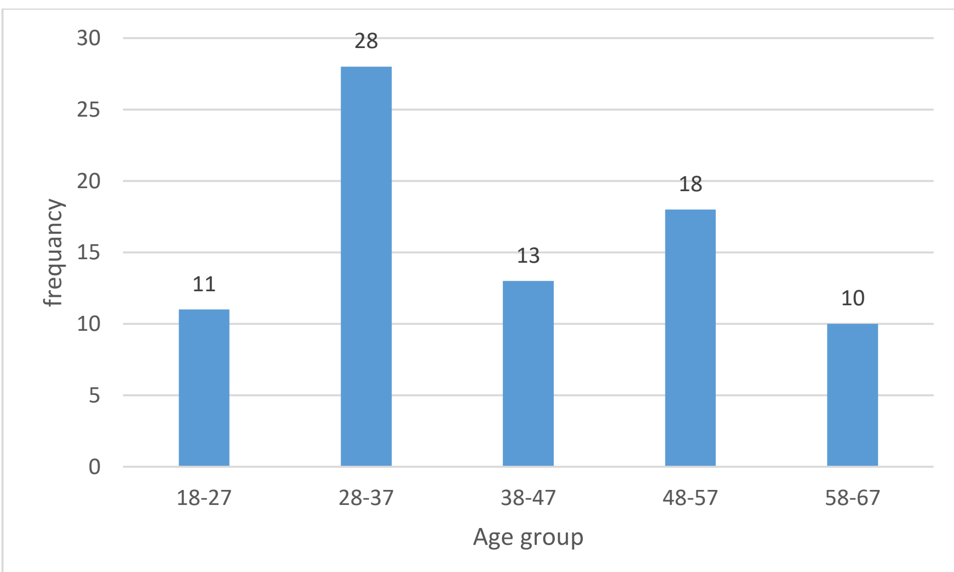


Figure (4-1): shows age group frequency and percent.

Table (4-2): shows the married status frequency and percent.

Status of married	**Frequency**	**Percent**
Married	57	71.25%
Unmarried	23	28.75%
Grand Total	**80**	**100.00%**

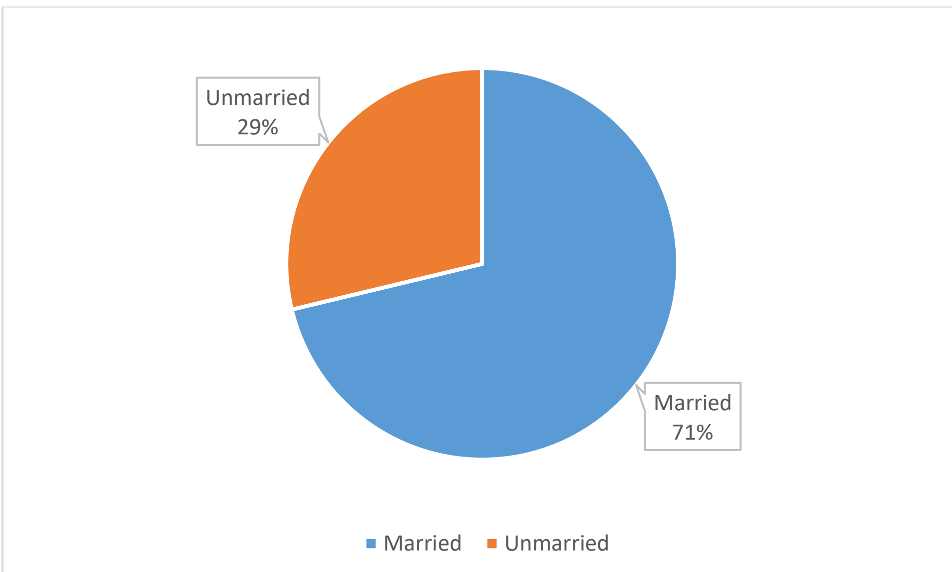


Figure (4.2): pie chart shows the married status percent.

Table (4-3): Model expressing descriptive statistics of age, right and left vesicles diameter and prostate volume.

Descriptive Statistics	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
age	80	18	60	40.40	12.830
LSV (mm)	80	4.0	22.5	10.29	2.8854
RSV (mm)	80	4.0	21.5	10.22	2.8423
Prostate volume (ml)	80	14.0	70.0	22.66	9.1430
Valid N (listwise)	80				

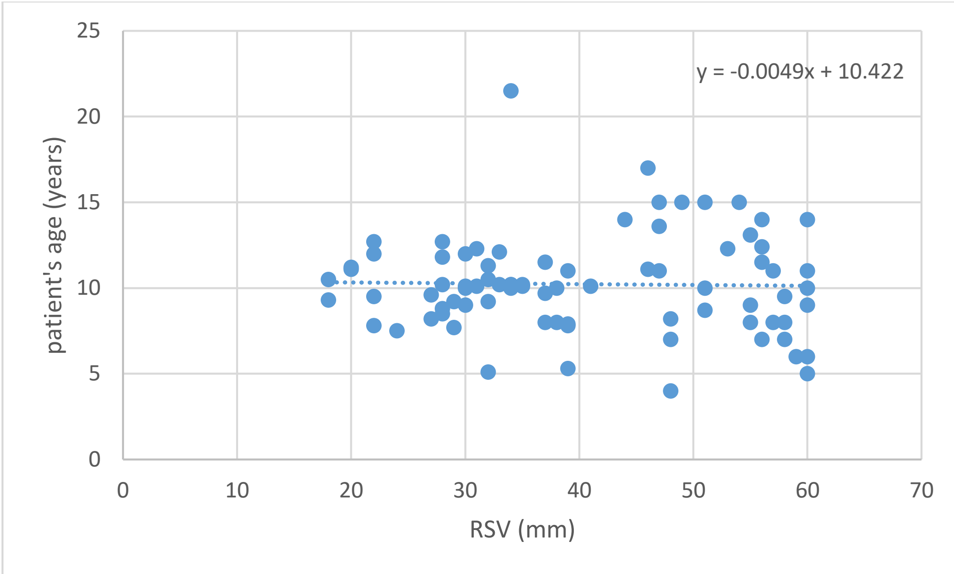


Figure (4-3): scatter plot shows the relationship between patients age and right vesicle diameter.

Table (4-4): Model correlation test expressing the relationship between the patient's age and right seminal vesicle diameter:

Correlations		Age	RSV (mm)
age	Pearson Correlation	1	-.022
	Sig. (2-tailed)		.847
	N	80	80
RSV (mm)	Pearson Correlation	-.022	1
	Sig. (2-tailed)	.847	
	N	80	80

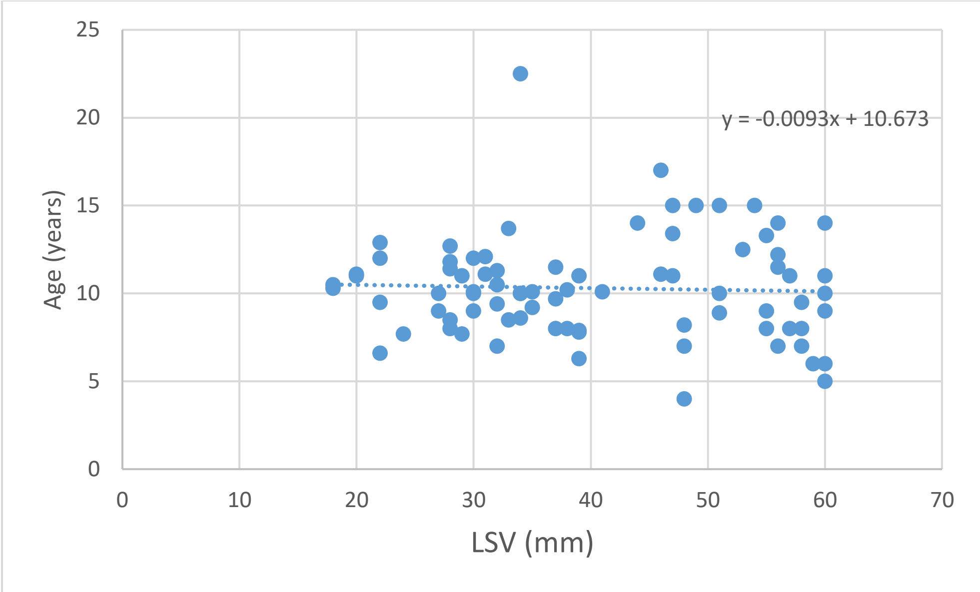


Figure (4-4): scatter plot shows the relationship between patient's age and left vesicle diameter.

Table (4-5): Model correlation test expressing the relationship between the patient's age and left seminal vesicle diameter:

Correlations		Age	LSV (mm)
age	Pearson Correlation	1	-.041
	Sig. (2-tailed)		.717
	N	80	80
LSV (mm)	Pearson Correlation	-.041	1
	Sig. (2-tailed)	.717	
	N	80	80

Table (4-6): Shows distributions of two groups (Married and un married) with their means and standard deviations calculated:

vesicle diameter	**Marital Status**	**N**	**Mean**	**Std. Deviation**
Right vesicle diameter in mm	Unmarried	23	9.986	1.8174
	Married	57	10.424	3.223

Table (4-7): T-test for Equality of Means of two groups:

t-test	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
RSV (mm)	-.763	78	.448	-.5372	.7040	-1.9387	.8643
	-.934	65.8	.354	-.5372	.5751	-1.6855	.6111

Table (4-8): Shows distributions of two groups (Married and unmarried) with their means and standard deviations calculated:

vesicle diameter	**marital status**	**N**	**Mean**	**Std. Deviation**
Left vesicle diameter in (mm)	Unmarried	23	9.843	1.902
	Married	57	10.381	3.145

Table (4-9): T-test for Equality of Means of two groups:

t-test	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
LSV (mm)	-.612	78	.543	-.4376	.7156	-1.862	.9871
	-.767	69.38	.446	-.4376	.5709	-1.576	.7012

Table (4-10): Model correlation test expressing the relationship between the prostate volume with right and left seminal vesicles diameter

Correlations		age	LSV (mm)	RSV (mm)
Patients Age (years)	Pearson Correlation	1	-.041	-.022
	Sig. (2-tailed)		.717	.847
	N	80	80	80
Prostate volume (ml)	Pearson Correlation	.534**	.123	.135
	Sig. (2-tailed)	.000	.279	.236
	N	80	80	80
**. Correlation is significant at the 0.01 level (2-tailed).				

Table (4-11) Model expressing frequency distribution of seminal vesicle texture and echogenicity:

Texture and Echogenicity		Frequency	Percent
Valid	Homogenous	80	100.0%
Valid	hypoechoic	80	100.0%

Chapter Five

Discussion, Conclusion & Recommendations

Chapter Five

Discussion, Conclusion and Recommendation

5.1 Discussion:

This was cross sectional study conducted at Alnhda reference medical center includes 80 patients came to ultrasound department during period of the study for scanning purposes rather than any abnormalities in order to exclude the disease than can affect the measurement of the seminal vesicles.

The results of this study showed that mean of the age (40.40 ± 12.83) with the age ranging from 18 to 60 years, most of sampling within age group 28 to 37 years (27.57%) and according to married state 71.25% was married and unmarried 28.75% of the sampling. The study found that the means measurement of the right and left seminal vesicle diameters were measured and displayed in table (4.3) and their mean values were (10.22 ± 2.84) mm and (10.29 ± 2.88) mm respectively, it was agreed with study done by (Fuse H et al., 1992).

Also the results confirmed that there is no relationship between the age of patients and their right and left seminal vesicle diameters fig. (4-3) and (4-4) respectively, that's to say when patient's age increases the right and left seminal vesicle diameters did not affect, see table (4-4) and (4-5) respectively.

Relating to the effect of marital status on the right seminal vesicle diameter, we find that see table (4-4), the married patients were (57) persons and the single ones were (23) persons and that the mean seminal vesicle diameter for both were (9.98 ± 1.81) and (10.42 ± 3.22) respectively. The difference in means between them is (-0.44). We use T-test to test the difference in means between these two mean groups and the results tell us that there is no significant difference because the value in the "Sig. (2-tailed)" Colum see table (4-7) is (0.448) and (0.354) respectively which is more than (0.05). So, we can conclude that marital status has no effect in the right seminal vesicle diameter among this population.

Also relating to the effect of marital status on the left seminal vesicle diameter, we find that see table (4-8), the married patients were (57) persons and the single ones were (23) persons and that the mean seminal vesicle diameter for both were (10.38 ± 3.14) and (9.84 ± 1.90) respectively. The difference in means between them is (-0.53). We use t-test to test the difference in means between these two mean groups and the results tell us that there is no significant difference because the value in the "Sig. (2-tailed)" Colum see table (4-7) is (0.44) which is more than (0.05). So, we can conclude that marital status has no effect in the left seminal vesicle diameter among this population.

Also, the study found there is no relationship between patient's prostate volumes with right and left vesicle diameters because the value in the "Sig. (2-tailed)" Raw see table (4-10) is (0.279) and (0.236) respectively which is more than (0.05) but there is significate positive relationship between the patient age and prostate volume with R^2 = 0.53 and "Sig. (2-tailed)" Raw see table (4-10) is (0.000) less than (0.01) it was agreed with study done by Ryoji et al., 2008.

Studding the echogenicity and texture of the vesicles the results reveals that, table (4-11) showed that all patients have homogenous texture and hypo echoic echogenicity, so we can state that from the results the normal vesicle sonographic appearance is low level echo's (100%) and at the same time had homogenous texture (100%).

5.2 Conclusion:

The results of thesis states that the mean of age was (40.40 ± 12.83) and the means of the right and left vesicle diameters had nearly same mean values were (10.22 ± 2.84) mm and (10.22 ± 2.88) mm respectively.

The study also concludes that, there was no relationship between the patient's age with right and left vesicle diameters. Also, the study found out that the right and left vesicle diameters wasn't affected by the marital status of the patients among these populations. Also, there is no relationships between prostate volumes with right and left vesicle diameters but found significate positive relationship between the patient age and prostate volume with R^2 = 0.53 and P value = (0.000). Moreover, the normal seminal vesicle has low level echogenicity (100%) and homogenous in texture (100 %).

5.3 Recommendations:

- Trans-abdominal ultrasound is a respectful approach, and should be used confidently in the measurements and evaluation of the seminal vesicle diameters and pathologies among Sudanese.
- In order to improve the image quality, the patients should be well prepared, and the ultrasound machines should be well adjusted to have better resolution.

References

References:

- Devin Dean. 2005. Abdominal Ultrasound and instrumentation. Part1. Module1. 1st Ed. The burwin institute of diagnostic medical ultrasound. Luneburg; Canada:.p. 42-49
- Fuse H, Okumura A, Satomi S, Kazama T, Katayama T. 1992: Evaluation of Seminal Vesicle Characteristics by Ultrasonography before and after Ejaculation. Urol Int; 49:110-113. doi: 10.1159/000282404
- Siccardi MA, Bordoni B. 2020. Anatomy, Abdomen and Pelvis, Perineal Body. In StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2020 Jan. Available : https://www.ncbi.nlm.nih.gov/books/NBK537345/
- Ibrahim and Abdullah Z. 2018. sonographic measurement of residual urine volume in BPH prostatic. 10., 11:30 AM. /123456789/10319.
- Jane A. Bates. 2004. Abdominal Ultrasound How, Why and When. 2nd ed. Elsevier. China. p. 139-245
- Keqin Z, Zhishun X, Jing Z, Haixin W, Dongqing Z, Benkang S. 2007. Clinical significance of intravesical prostatic protrusion in patients with benign prostatic enlargement. Urology. 70:1096–1099.
- Merland J-J, Chiras J. 2012. Arteriography of the pelvis: Diagnostic and therapeutic procedures: Springer Science & Business Media; P120-138
- Nose H, Foo KT, Lim KB, Yokoyama T, Ozawa H, Kumon H. 2005. Accuracy of two noninvasive methods of diagnosing bladder outlet obstruction using ultrasonography: intravesical prostatic protrusion and velocity-flow video urodynamic. Urology.; 65: 493–497.
- Penny SM. 2011. Examination Review for Ultrasound: Abdomen & Obstetrics and Gynecology: 2ed edition. Lippincott Williams & Wilkins. P211-231

- Rumack CM, Wilson SR, Charboneau JW, LevineD. 2011. Diagnostic ultrasound.4th ed. Elsevier Mosby; Philadelphia. p. 146-152.
- Ryoji Furuyaa, Shinichi, Hisasueb, SeijiFuruyaa, Nobuhito, Saitoha Hiroshi Oguraa Satoshi, Takahashib, TaijiTsukamotob. 2008. Fate of Seminal Vesicles and Prostate After Medical Castration: How Long Is the Optimal Duration of Neoadjuvant Treatment for Prostate Cancer Before Radiation, Volume 72, Issue 2. Pages 417-421.
- Sandra L.Hagen Ansert. 2001. Textbook of Diagnostic Ultrasonography 5th edition, Volume 1. Mosby Company. p 423:7.
- Shaw A, Smith B, Howlett Dc. Frcr. 2011. Anatomy Mock Examinations: Part 1. Cambridge University Press; 432
- Shin SH, Kim J, Oh M, and Moon DG. 2013. Defining the Degree of Intravesical Prostatic Protrusion in Association with Bladder Outlet Obstruction. Korean J Urol. Jun. 54 (6):369-372.
- Watanabe, H, Nihon, Hinyokika and Gakkai zasshi. 1968. Diagnostic application of ultrasonography to the prostate. Japanese journal of urology. 59.4: 273.
- Wiley-KT Foo. 2010. Decision making in the management of benign prostatic enlargement and the role of transabdominal ultrasound**.** Into J Urol. 17(12):974-9.
- Wiki Radiography: physics ultrasound physics. xinyue_chen; Jun 12 2015 [online: accessed on November 8 2018. at 7:45pm]; www.wikiradiography.net/Ultrasound+Physics

Appendices

Appendices (A)

Sudan University of sciences and technology

Faculty of Graduate Studies and Scientific Research

Data Collection Sheet

Measurement of Normal Seminal Vesicles Diameter in Adults Sudanese Using Ultrasonography in Khartoum State

Patient information:

- Patient No (   )
- Patient Age (   )
- Married (   )   Unmarried (   )

U/S findings:

- **The seminal vesicles diameter measurements**
  - RT - SV= (   ) mm
  - LT – SV = (   )mm.
- **Echogenicity:**
  - Hypoechoic (   )
  - Hyperechoic (   )
- **Echotexture**

  Homogeneous (   )   Heterogeneous (   )
- **prostate volume (   ) cc**

Appendix B

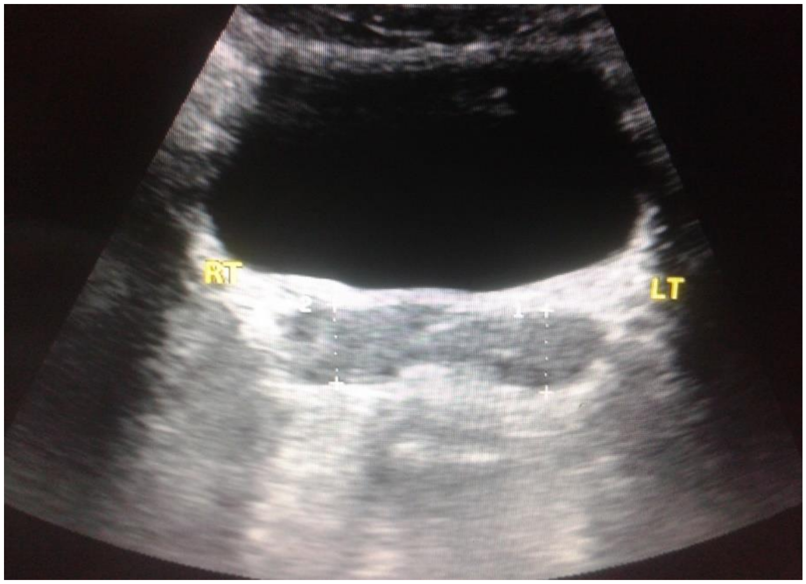


Image (1): Transverse U/S image of seminal vesicles for male in 38 years age, marred for 10 years with prostate volume =20 cc. The seminal vesicles diameter measurements (RT = 12.4 mm, LT = 12.4 mm)

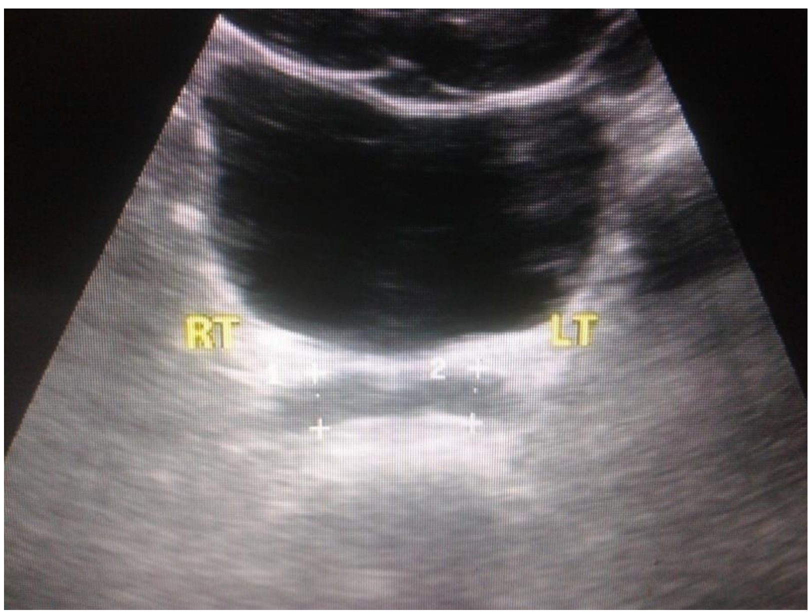


Image (1): Transverse U/S image of seminal vesicles for male in 32 years age, marred for 3 years with prostate volume =14 cc. The seminal vesicles diameter measurements (RT = 10.2 mm, LT = 10.2 mm).

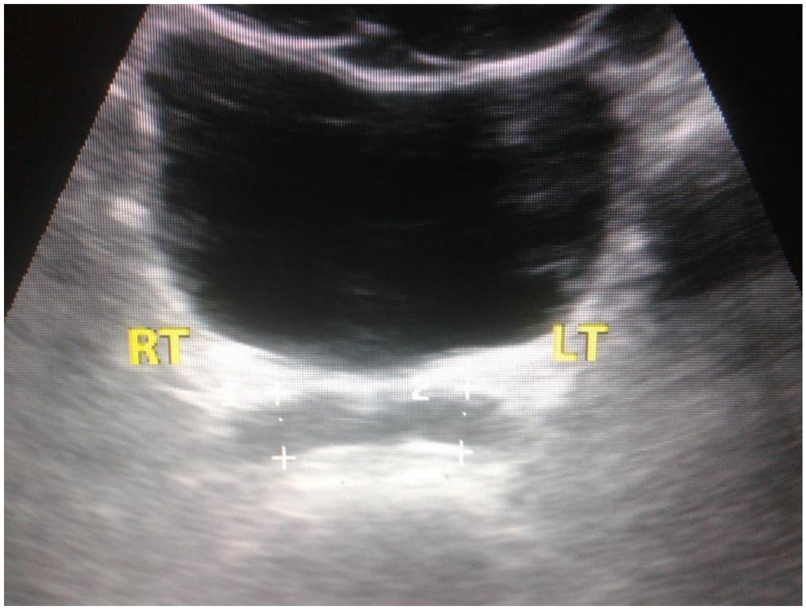


Image (1): Transverse U/S image of seminal vesicles for male in 22 years age, single with prostate volume =16 cc. The seminal vesicles diameter measurements (RT = 12.5 mm, LT = 12.5 mm).

Image (1): Transverse U/S image of seminal vesicles for male in 50 years age, single with prostate volume =24 cc. The seminal vesicles diameter measurements (RT = 7.3 mm, LT = 7.3 mm).

Image (1): Transverse U/S image of seminal vesicles for male in 60 years age, marred for 40 years with prostate volume =54 cc. The seminal vesicles diameter measurements (RT = 9.4mm, LT = 9.4 m.