Sudan University of Sciences and Technology
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A study of Renal Cysts by Using Ultrasonography In Khartoum state

دراسة الاكياس الكلوية باستخدام الموجات فوق الصوتية في ولاية الخرطوم

Thesis submitted for partial fulfillment for requirement of master degree (M.Sc). in diagnostic ultrasound

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2017

الآيــة

بسم الله الرحمن الرحيم

قال تعالى :

(قَالُوا سُبْحَانَكَ لَا عِلْمَ لَنَا إِلَّا مَا عَلَّمْتَنَا ۖ إِنَّكَ أَنْتَ الْعَلِيمُ الْحَكِيمُ)

صدق الله العظيم

سورة البقرة الآية (32)

Dedication

To :

My parents

My husband

My sons

My teachers

Acknowledgement

Im so grateful to those peoples who played apart in preparing this research.

My grate Thanks to D.r Muna Ahmed M.ahmed my supervisor for her help and guidance

My grateThanks to my family who always encourage and supporting me.

ABSTRACT

Renal cysts are around pouches of fluid that form in or on the kidney and its acommon findings in daily routine ultrasound examinations.

The aim of the study was to classify the renal cysts by using ultrasound .

This study was conducted in khartoum state in several ultrasound departments from May 2017 to August 2017. Total of 100 patients males and females have been examined with ultrasound for abdomen and confirmed diagnose with renal cysts , every cyst was measured by longitudinal and transeverse diameter by centimeter in addition to the genetic history of the family .

This study found age and gender were significant risk factors of renal cysts .

this study showed correlation between blood pressure and form of renal cysts .

Ultrasound plays an effective role to classify and asses renal cysts that help in management and follow-up.

ملخص

الاكياس الكلوية هى عبارة عن جرابات دائرية تحتوى على سوائل تتكون فى او على الكلية وتعتبر من النتائج الشائعة واليومية عند الفحص بالموجات فوق الصوتية.

الهدف من الدراسة هو تصنيف الاكياس الكلوية باستخدام الموجات فوق الصوتية.

اجريت الدراسه بولاية الخرطوم في عدد من اقسام الموجات فوق الصوتيه في الفتره ما بين مايو 2017الي اغسطس.2017

تحصلت الدراسه علي البيانات والمعلومات من100 من الاشخاص من الذكور والاناث الذين اجرى عليهم فحص الموجات فوق الصوتيه للبطن والكليتين واكدت اصابتهم بالاكياس الكلوية مع اخذ التاريخ الجينى للعائلة عين الاعتبار وباستخدام السونوغرافك الطولي والعرضي لقياس حجم الكيس بالسنتمتر.

وجدت الدراسه وجود علاقه بين ارتفاع ضغط الدم وتكون الاكياس الكلويه.

خلصت الدراسه الي ان العمر والجنس تعتبران من اهم عوامل الخطر لتكون الاكياس الكلويه.

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ADPKD	Autosomal dominant polycystic kidney disease
ARPKD	Autosomal recessive poly cystic kidney disease
ACKD	Acquired cystic kidney disease
AML	Angio myolipoma
MDK	Multi dysplastic kidney
PKD	Poly cystic kidney disease
PCS	Pelvo calceal system
RCC	Renal cell carcinoma
TCC	Transitional cell carcinoma

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Chapter one

Introduction

1.1 Introduction

kidney cyst are round pouches of fluid that form on or in the kidneys renal cysts were common findings in the kidneys encountered in daily routine ultrasound examination. The majority is benign, but they can become complicated in the case of infection, hemorrhage, and ischemia. Sonographic evaluation plays a great role in classification and characterization of these lesions(Emedicine, 2017) .

Cystics kidney disease may be congenital or acquired.congenital disorder may be inherited autosomal dominant disorders or autosomal recessive disorders or have other causes. One third of people older than 50 years develop renal cysts .although most are simple cyst, renal cyst disease has multiple etiology, cystic disease include development (multicystic dysplastickidney)genetic(autosomal polycystic kidney disease),cysts associated with systemic, Its not clear what causes simple kidney cysts. Typically, only one cyst occurs on the surface of the kidney, but can affect one or both kidney Simple cyst aren't the same as the cyst that form with polycystic kidney disease (E medicine, 2017) .

Simple cysts that don't cause sign and symptoms usually don't require treatment. Simple cysts have been associate with high blood pressure. Ultrasound plays a great role in differentiation between all types of renal cystic masses. In previous studies, the frequency of renal cysts increases: with age and represented approximately 40% of all individuals who were investigated with a computerized tomography scan (E medicine,2017).

In literature, the prevalence of renal cysts increased with age and the other risk factors included male gender, renal dysfunction and hypertension (E medicine,2017).

there was association between simple renal cysts and hypertension since small cysts were likely to elevate hydrostatic pressure that compresses the surrounding renal tissue, The renal cysts are asymptomatic in general, but autosomal-dominant polycystic kidney disease (ADPKD) cause pain due to enlargement and hypertention is one of the most common early manifestation (E medicine,2017).

1.2Proplem of the study:

Most of renal cysts are symptomless but may lead to renal failure .

1.3 objectives

1.3.1 General objectives

To study renal cysts by ultrasonography .

1.3.2 Specific objectives

(a) To detect renal cysts by ultrasound .

(b) To classified the renal cysts .

(c) To differentiate the pathology associated with renal cysts.

(d)To study the renal cysts .

(e) To correlate hypertention with the size of renal cysts .

1.4 Overview of the study

This study will consist of five chapters, with chapter one as an introduction which will include :(anatomy, physiology, general pathology of the kidneys , problem of the study, objectives, significance of the study and the overview as end of this chapter) ,Followed by chapter two which is a literature review that includes a comprehensive review of the scholarly literature. The materials and method will be cited in chapter three while Chapter four will include result presentation and finally chapter five will include :(discussion, conclusion, and recommendations).

Chapter two

Literature review

2.1 Theoritcal backround

2.1.1Anatomical view

The urinary system is one of the excretory systems of the body. It consists of the following structures:

• 2 kidneys, which secrete urine .

• 2 ureters, which convey the urine from the kidneys to the urinary bladder .

• urinary bladder where urine collects and is temporarily stored .

• urethra through which the urine is discharged from the urinary bladder to the exterior.

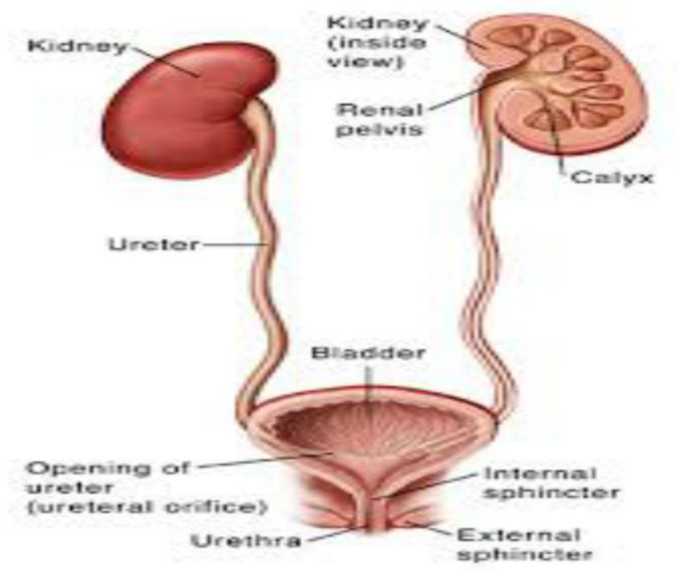

Figure 2.1 anatomical structures of the urinary tract of human(Basic Anatomy,2004).

2.1.1.1 Anatomy of the kidney

The kidneys lie on the posterior abdominal wall, one on each side of the vertebral column, behind the peritoneum and below the diaphragm. (Gross man,Rosenberg,Bowie,1983) .

They extend from the level of the 12th thoracic vertebra to the 3rd lumbar vertebra, receiving some protection from the lower rib cage. The right kidney is usually slightly lower than the left, probably because of the considerable space occupied by the liver.

Kidneys are bean-shaped organs, about 11 cm long, 6 cm wide, 3 cm thick and weigh 150 g. They are embedded in, and renal fat.

held in position by, a mass of fat. A sheath of fibroelastic renal fascia.(Gross man,Rosenberg,Bowie,1983) .

2.1.1.2 Organs associated with the kidneys

As the kidneys lie on either side of the vertebral column each is associated with a different group of structures.(Grossman,Rosenberg,Bowie,2004) .

2.1.1.2.1 Right kidney

Superiorly — the right adrenal gland.

Anteriorly —the right lobe of the liver, the duodenum.

and the hepatic flexure of the colon.

Posteriorly —the diaphragm, and muscles of the posterior abdominal wall.(Grossman,Rosenberg,Bowie,2004) .

2.1.1.2.2 Left kidney

Superiorly — the left adrenal gland

Anteriorly —the spleen, stomach, pancreas, jejunum

and splenic flexure of the colon

Posteriorly —the diaphragm and muscles of the posterior abdominal wall.(Grossman,Rosenberg,Bowie,2004) .

Figure 2.2 Normal ultrasound image for right kidney and associated organs

2.1.1.3 Gross structure of the kidney

• A fibrous capsule, surrounding the kidney .

• The cortex, a reddish-brown layer of tissue immediately below the capsule and outside the pyramids .

• The medulla, the innermost layer, consisting of pale conical-shaped striations, the renal pyramids(Grossman,Rosenberg,Bowie,2004) .

The hilum is the concave medial border of the kidney where the renal blood and lymph vessels found, the ureter and nerves enter The renal pelvis is the funnel-shaped structure which acts as a receptacle for the urine formed by the kidney It has a number of distal branches called calyces, each of which surrounds the apex of renal pyramid. Urine formed in the kidney passes through a papilla at the apex of a pyramid into a minor calyx, then into a major calyx before passing through the pelvis into the ureter.(Grossman,Rosenberg,Bowie,2004) .

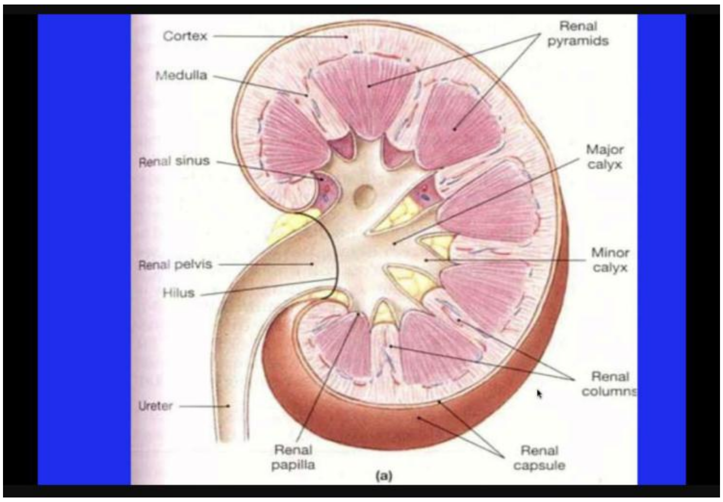

Figure2.3 Show the kidney gross structure(Grossman,Rosenberg,Bowie,2004) .

2.1.1.4 Blood Supply of the Kidneys

The renal artery divides into several segmental branches within the renal sinus.Some branches go posterior to the pelvis while others go anterior to the pelvis. The interlobar arteries enter the parenchyma through the renal columns and extend to the bases of the pyramids.

At the junction of the cortex with the medulla the vessel arches across the base of the pyramid.(Grossman,Rosenberg,Bowie,2004) .

This is known as the arcuate artery, It gives off branches called the interlobular arteries which supply the majority of the cortical nephrons via afferent arterioles.(Grossman,Rosenberg,Bowie,2004) .

In summary, interlobar arteries run through the renal columns and become arcuate arteries as they run between the cortex and medulla at the base of the pyramids. The arcuate arteries give rise to the interlobular arteries which extend through the cortex as far as the capsule.

The nephrons are supplied by afferent arterioles which are branches of the interlobular arteries. (Grossman,Rosenberg,Bowie,2004) .

Venae rectae vessels drain in the nephrons and coalesce to form the arcuate vein. Other small venules flow into the interlobular vein which in turn drains into the arcuate vein. The remainder of the venous drainage of the kidney corresponds to the arteries. The venous blood flow is of course in the opposite direction to the arterial flow. Pulsing of the arcuate artery and vein may be seen at the junction of the base of the pyramid with the cortex.(Grossman,Rosenberg,Bowie,2004) .

2.1.1.5 Supplemental Vessels

The main renal arteries are solitary in 60% of individuals and multiple and smaller in the remainder Renal arteries are more commonly multiple when the kidney is ma positioned or malrotated .

Supplemental renal arteries may course directly into the polar regions of the kidney without coursing through the renal hilum.

Renal veins are usually solitary. (Grossman,Rosenberg,Bowie,2004) .

2.1.1.6 Nerve supply of the kidney

The kidney and nervous system communicate via the renal plexus ,which fibers course along the renal arteries to reach the kidney .Input from the sympathetic nervous system triggers vasoconstriction in the kidney , thereby reducting renal blood flow, the kidney is not though to receive input from the par sympathetic nervous system .sensory input the kidney travels to T10- 11 levels of the spinal cord and sensed in corresponding dermatome,thus , pain in the flank region my be referred from the kidney. (Hopking et – al ,1993) .

2.1.2 Physiology of the kidney

2.1.2.1Functions of the kidney

The kidney participate in whole –body homeostasis .

2.1.2.2 Excretion of wastes

The kidneys excrete avariety of waste products produce by metabolism these include the urine which passes through the ureters to the bladder for storage prior to excretion which contain nitrogenous wastes urea from proteien catabolism and uric acid from neucleic acid metabolism. (Boron WF ,2004) .

The composition of urine reflects the activities of the nephrons in the maintenance of homeostasis. (Grossman,Rosenberg,Bowie,2004).

Waste products of protein metabolism are excreted, electrolyte balance is maintained and the pH (acid-base balance) is maintained by the excretion of hydrogen ions. (Nafar M, 2008). There are three processes involved in the formation of urine:

• Simple filtration .

• Selective reabsorption .

• Secretion .

2.1.2.3 Osmolality regulation

Any significance rise in plasma osmolality is detected by the hypothalamus ,which communicates directly with the posterior pituitary gland . an increase osmolality cause the gland secrete antidiruetic hormone (ADH) ,resulting in water reabsorption by the kidney and an increase in urine concentration ,the two factors work together to return the plasma osmolality to it normal levels. (Boron WF ,2004).

ADH binds principle cells in the collecting ducts that translocate aqua porins to the membrane allowing water to leave the normally impermeable membrane and reabsorbed in to the body by the vasa recta

.thus increasing the plasma volume of the body ,there are two systems that create ahyperosmotic medulla and thus increase the body plasma volume ,urea recycling and the single effect.(B-Green berd, 2009).
Urea is usually excreted as waste product from the kidneys ,when plasma blood volume is low and ADH released the aquaporins that are opened are also permeable to urea ,this allows urea to leave the collecting duct in to the medulla creating hyperosmotic solution that attracts water .urea can then re-enter the nephron and be excreted or recycled again depending on whether ADH is still present or not .
The single effect describes the fact that the ascending thick limb of the loop of Henle is not permable to NaCl .this means that acounter current system is created where by the medulla becomes increasingly concentrating setting up and osmotic gradient for water to follow should the aquaporins of the collecting duct be opened by ADH .(Fransico ,2010).

2.1.2.4 Blood pressure regulation

Long –term regulation of blood pressure predominantly depends upon the kidney. The primarily occurs through maintenance of the extracellular fluid compartment .the size of which depends on the plasma sodium concenteration .although the kidney can not directly sense blood pressure, change in the delivery of sodium and chloride to the distal part of the nephron alter the kidneys secretion of the enzyme rennin. When the extracellular fluid compartment is expanded and blood pressure is high ,the delivery of this ions is increased and rennin secretion is decrease .similary,when the extra cellular fluid compartment is contracted and blood pressure is low,sodium and chloride delivery is decrease and renin secretion is increased in response .(Tariq ,2009).

Rennin is the first in aseries of important chemical messengers that comprise the rennin –angiotensin system ,principally the hormones angiotensin2and aldosterone.(Tariq ,2009).

2.1.2.5 Hormone secretion

The kidney secrete avariety of hormones ,including erythropoietin calcitriol,and rennin erythropoietin is response to hypoxia (low level of oxygen at tissue level)in the renal circulation is stimulates erthropoiesis (production of red blood cell)in the bone marrow.(Hopkins et –al 1993). Calcitriol ,the activated form of vitamin D promotes intestinal absorption of calcium and renal re absorption of phosphate ,part of rennin-angiotensin-aldosterone system ,rennin is an enzyme involved in the regulation of aldosterone levels .(Hopkins et –al 1993).

2.1.3 Pathology of the kidney

2.1.3.1 Renal cystic disease

2.1.3.1.1 Simple Renal Cysts

These are true cysts that have a serous epithelial lining and are fluid filled, benign cortical masses (google,2016) .

They meet all the ultrasound criteria of a simple cyst: they are spherical, anechoic, thin-walled and have accentuated posterior enhancement.

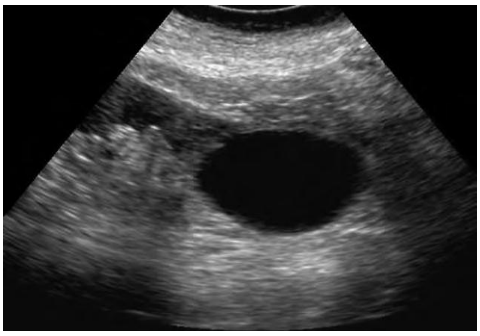

Figure2.4 Simple renal cyst(rumack,Wilson,charbonue,Levine,2011) .

2.1.3.1.2 Atypical Renal Cysts

An atypical renal cyst is any cyst that does not meet the strict criteria of a simple cyst.

Many atypical cysts are simple cysts complicated by hemorrhage or infection(Devin,2005)

2.1.3.1.1 Parapelvic Cysts

Parapelvic cysts are cysts of the renal sinus. Most parapelvic cysts are asymptomatic although they may cause hematuria, hypertension, hydronephrosis or become infected. Generally they are anechoic and exhibit posterior acoustic enhancement(Devin,2005) .

Parapelvic cysts are rarely purely spherical, their margins usually being shaped by the margins of the renal sinus. They can mimic a hydronephrosis.

Figure 2.5 parapelvic renal cyst (Rumack,Wilson,charbonue,Levine,2011) .

2.1.3.1.4 Acquired Uremic Cysts, Adenomas and Carcinomas

Cysts and neoplasms have been identified with remarkable frequency in the end stage kidneys of chronic hemodialysis or peritoneal dialysis patients Cysts(Devin,2005) .

generally do not become visible until the patient has completed 3 years of dialysis.

Thereafter, they increase rapidly in number to a prevalence level approaching 100%.

These cysts are prone to hemorrhage, rupture and the creation of perinephric hematomas(Devin,2005) .

Figure 2.6 Multiple acquire renal cyst(Rumack,Wilson,charbonue,Levine,2011) .

2.1.3.1.5 Multicystic Dysplastic Kidney

Multicystic dysplastic kidney disease (MCDK) is a congenital, nonhereditary, cystic renal disease. It is the most common cause of a palpable abdominal mass in anewborn**.** MCDK is typically unilateral, affecting a single kidney in its entirety, but may be bilateral or segmental. The IVP and nuclear medicine scan would indicate absence of function(Devin,2005) .

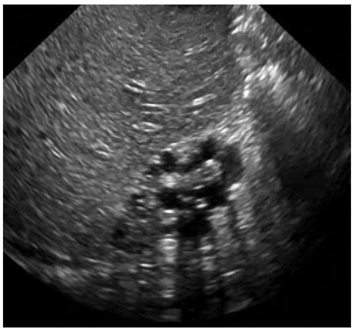

Figure 2.7 multicysticdisplastic kidney disease(Rumack,Wilson,charbonue,Levine,2011) .

2.1.3.1.6 Autosomal Recessive Polycystic Renal Disease (ARPRD)

Autosomal recessive polycystic kidney disease is an inherited disorder characterized by nephromegaly, microscopic or macroscopic cystic dilatation of the renal collecting tubules, and periportal hepatic fibrosis. The renal abnormalities are seen early in life,while the liver pathology becomes predominant with increasing age. ARPRD is associated with pulmonary hypoplasia. The baby typically presents with palpable renal masses or renal insufficiency. There is a high neonatal mortality rate. Early causes of death are from renal insufficiency or respiratory failure associated with pulmonary hypoplasia. “Most patients who survive(Devin,2005) .

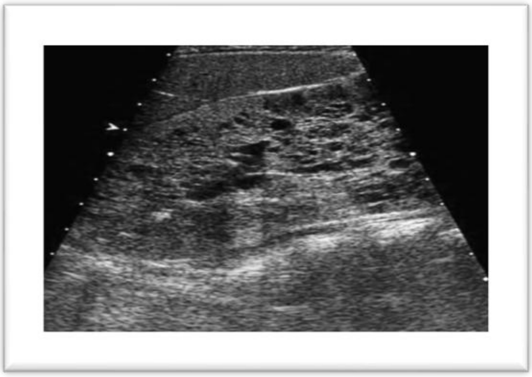

Figure2.8 Autosomal recessive polycystic renal disease(Rumack,Wilson,charbonue,Levine,2011) .

2.1.3.1.7 Autosomal Dominant Polycystic Renal Disease (ADPRD)

This is an autosomal dominant disorder which often lies latent for many years and then manifests itself in the third, fourth, or fifth decades in what had appeared to abnormal renal parenchyma. ADPRD consists of numerous cystic lesions in an enlarged kidney. It is a slowly progressive bilateral disorder that eventually develops into renal failure when the normal parenchyma is depleted.(Devin,2005)

The patient may present with hypertension, flank pain from hemorrhage within a cyst, hematuria or renal failure.

The disorder was formerly called adult polycystic kidney disease (APKD)

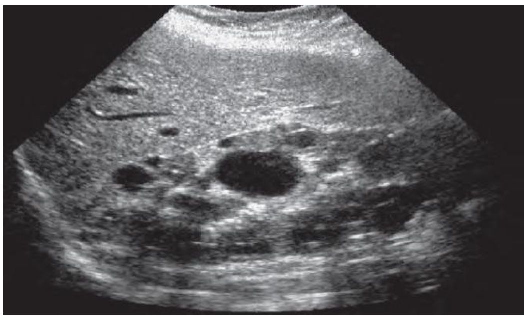

Figure2.9 adult polycystic kidney disease(ADPKD)(Rumack,Wilson,charbonue,Levine,2011) .

2.1.3.1.8 Medullary Cystic Disease

Medullary cystic disease is an hereditary disorder resulting in cysts located within the medullary portions of the kidney. There is a childhood recessive form and an adult dominant form .the columns are sonographically identical to the peripheral cortex.

The **medulla** consists of pyramids which are anechoic structures with their bases adjacent to the renal cortex and their apices directed toward(Devin,2005) .

2.1.3.1.9 Calyceal Diverticulum

This is an outpouching from the calyx. Stasis of urine may occur predisposing the patient to infection and stone formation. The diverticulum can project into the renal parenchyma(and (Devin,2005) .

2.3.2Hydronephrosis

Hydronephrosis refers to dilatation of the renal collecting system most frequently caused by incomplete or complete obstruction(Devin,2005) .

2.3.3Hydroureter

Is dilatation of the ureter also caused by complete or incomplete obstruction(Devin,2005) .

2.3.4 Renal Calculus Disease

Urolithiasis is most prevalent in males aged 20-40 years.1 Calculi can form in any part of the urinary tract but most form in the kidneys. They may be clinically silent or associated with flank pain. Hematuria (gross or microscopic) and renal colic are most often associated with ureteric calculi. Stones can occur within any part of the kidneys - the renal cortex, medulla, vessels, calyces or renal pelvis. Most calculi arise in the collecting system. Stoneformation may be idiopathic1 or associated with stasis (stagnation) of urine, prolonged ingestion of stone forming substances, chronic urinary infections and climate conditions associated with dehydration.5 Stasis also predisposes the patient to infection. Ultrasound demonstrates calculi as highly echogenic structures regardless of chemical composition (Devin,2005) .

Shadow detection posterior to the stone depends on stone size, transducer frequency, and transducer focal zone. Tiny calculi will not shadow if they are smaller than the focal zone (Devin,2005) .

2.3.5 Neoplasm

2.3.5.1Angiomyolipoma (AML)

AML is a benign solid tumor containing variable amounts of blood vessels (angio), smooth
muscle (myo) and fat (lipoma).

The sonographic appearances depend upon the predominance of one of the three components. Typically, AMLs are extremely hyperechoic indicating the predominance of fat however, if muscle or vascular components predominate the lesion may be hypoechoic.

Shadowing is demonstrated in 33% of AMLs (Devin,2005) .

2.3.5.2Oncocytoma

Oncocytoma is a benign solid renal tumor occurring most often in men in their 60's. It isusually asymptomatic and an incidental finding. Sonographically, the tumor is solid, homogeneous and generates low levels of echogenicity. A stellate central hyperechoic scar is seen in about 25% of cases and then only in lesions greater than 3 cm.2 However, “no imaging finding reliably distinguishes this tumor from renal cell carcinoma. Diagnosis is made by surgical excision or biopsy (Devin,2005) .

2.3.6 Malignant lesions

2.3.6.1 Renal Cell Carcinoma (RCC)

This is a primary tumor of the renal parenchyma thought to originate from the renal tubular epithelium. It is also called a hypernephromaor a renal adenocarcinoma (Devin,2005) .

Renal cell carcinomas (RCC) are the most common primary malignant renal parenchymal tumors (86%).3 These tumors occur most frequently in males between the fifth to the seventh decade. They are usually unilateral and clinically silent until they become large (Devin,2005) .

The most common presenting complaints are painless hematuria, dull flank pain and palpable mass. Weight loss, malaise and hypertension may also be associated with RCC (Devin,2005) .

2.3.6.2 Transitional Cell Carcinoma (TCC)

This is a malignancy involving the epithelial lining of the renal collecting system, ureters or bladder. It usually occurs in older age groups between 50 to 70, with a higher incidence in males. Bladder TCC is 50 times more common than renal pelvic TCC because of the large surface area. Painless hematuria is the most common complaint, however if there is ureteral obstruction, there will be flank pain (Devin,2005) .

2.4 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, 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 (Aldrich,2007) .

2.4.1 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 anechoic , 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 (Aldrich,2007) .

2.4.2 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 Snell’s law, which relates the angle of refraction to the speed of sound in that tissue (Aldrich,2004) .

2.4.3 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 (Aldrich,2007) .

2.4.4 B-Mode imaging Controls

2.4.4.1 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 show(Wikipedia,2016) .

2.4.4.2Gain

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 artefactual noise introduced and also a reduction in contrast resolution as all echoes get progressively brighter (Aldrich,2007) .

2.4.4.3 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

2.4.4.4 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 patients 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' artifact is encountered at depth is to use a lower frequency transducer (Wikipedia,2016) .

2.4.4.5 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 artifacts degrade image quality the DR can be reduced to partially eliminate these appearances (Snell,2016).

2.4.4.6 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 structures i.e. a fetal heart (Aldrich,2007) .

2.4.4.7 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' artifact. 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 (Wikipedia,2016) .

2.5 Ultrasound technique

The right kidney is readily demonstrated through the right lobe of the liver. Generally a subcostal approach displays the (more anterior) lower pole to best effect, while an intercostal approach is best for demonstrating the upper pole .The left kidney is not usually demonstrable sagittally because it lies posterior to the stomach and splenic flexure. The spleen can be used as an acoustic window to the upper pole by scanning coronally, from the patient's left side, with the patient supine or decubitus (left side raised), but, unless the spleen is enlarged, the lower pole must usually be imaged from the left side posteriorly. Coronal sections of both kidneys are particularly useful as they display the renal Pelvocalyceal system (PCS) and its relationship to the renal hilum(This section demonstrates the main blood vessels and ureter (if dilated).

As with any other organ, the kidneys must be examined in both longitudinal and transverse (axial) planes. This usually requires a combination of subcostal and intercostal scanning with anterior, posterior and lateral approaches. The operator must be flexible in approach to obtain the necessary results (Jane,2004) .

The bladder should be filled and examined to complete the renal tract scan. An excessively full bladder may cause mild dilatation of the PCS, which will return to normal following micturition (Jane,2004) .

Figure2.10 (A) Sagittal section through the normal right kidney.(Carol A,2016) .

Figure 2.11 (B) show sagittal plane.(Carol A,2016) .

2.6 Normal ultrasound appearances of the kidneys

The cortex of the normal kidney is slightly hypoechoic when compared to the adjacent liver parenchyma, although this is age-dependent.

In young people it may be of similar echogenicity and in the elderly it is not unusual for it to be comparatively hyperechoic and thin. The medullary pyramids are seen as regularly spaced, echo-poor triangular (Jane,2004) .

structures between the cortex and the renal sinus. The tiny reflective structures often seen at the margins of the pyramids are echoes from the arcuate arteries which branch around the pyramids.

The renal sinus containing the PCS is hyperechoic due to sinus fat which surrounds the vessels. The main artery and vein can be readily demonstrated at the renal hilum and should not be confused with a mild degree of PCS dilatation. Colour Doppler can help differentiate.

The kidney develops in the fetus from a number of lobes, which fuse Occasionally the traces of these lobes can be seen on the surface of the kidney, forming fetal lobulation these may persist into adulthood.(Jane,2004) .

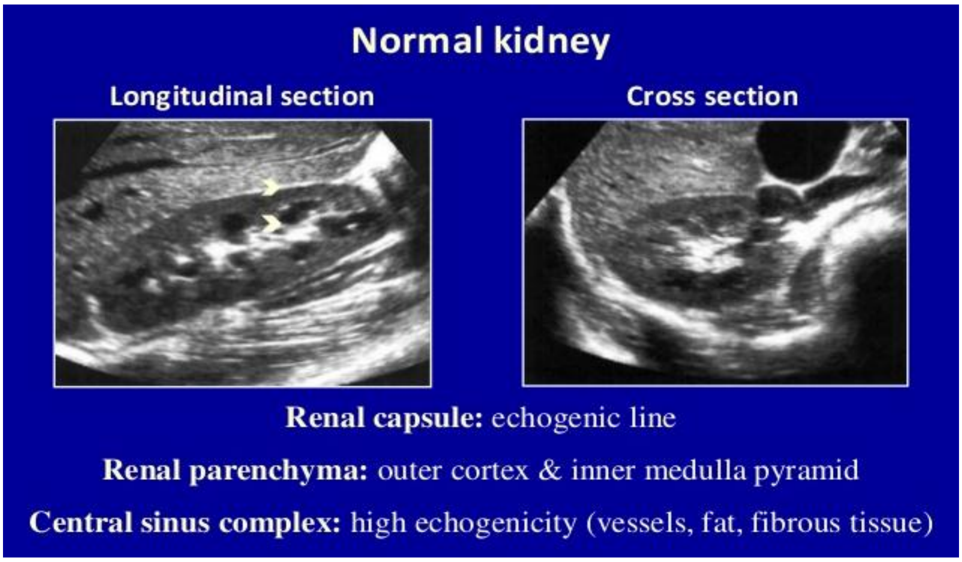

Figure 2.12(A) longitudinal image of normal right kidney.(Rumack,2011) .

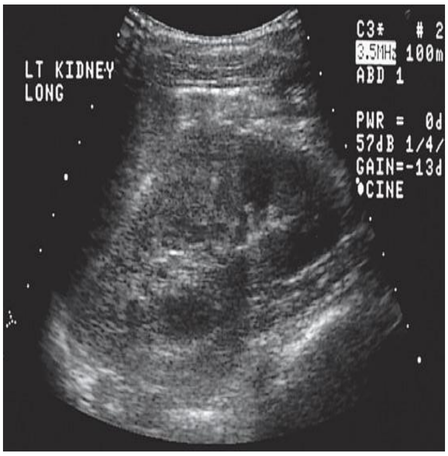

Figure 2.13 (B)longitudinal image of normal left kidney.(Jane,2004) .

2.6.1Age Related Changes In The Adult

The thickness of the renal parenchyma decreases at about 10% per decade after age 20 years.(Devin,2005) .

There is a loss of contrast between the cortex and pyramids as the normal aging process increases cortical and pyramidal echogenicity, but the effect is more obvious in the pyramids, which gradually fade from view as their echogenicity increases (Devin,2005) .

The overall size decreases gradually but is only apparent in the elderly.

2.2 previous study

Simple renal cyst in adult follow up with ultrasound diagnostic ,to assess the sonographic frequency of simple renal cyst in. the authors retrospectively reviewd the result of abdominal sonographic studies of 16,102 patients performed on period between January 1/1985 an December 31/12) Patient with dysplastic kidney, or family history of polycystic kidney disease were excluded from the study the author's review of the sonogram revealed 37 simple cyst in(35) patients (0.22%) the cyst were evenly distributed by age and sex and measure from 1 to 7 cm in maximum diameter. Sixteen cyst (43%) in the upper pole of the right kidney. Follow up sonographic study of 23 cyst in 22 patients up to 50 years show no change in size in 17 cyst (74%) (Carrim ZI, 2004) .

A cross-sectional prospective study conducted from September 2014 to December 2015. A total of 105 patients (78 males and 27 females) have been examined with ultrasound and confirm diagnosed with renal cysts.,The sonographic criteria used for assessing renal cysts were wall-definition, thickness of septa, acoustic enhancement, shape and numbers of cysts, in addition to the genetic history of the family. Results: The incidence of renal cysts is significantly higher in male than female (74% vs. 26%, P = 0.01). Renal cysts were common in patients above 50 years old (80%). Aging was a significant factor of the renal cyst (P = 0.03) and size of the cysts was not significantly associated with age (P = 0.261). The majority of cysts was solitary (66%), unilateral (86%), and located in the right kidney (49%). The incidence of cortical simple renal was 73%, para-pelvic simple cysts was 17%, autosomal-dominant polycystic kidney disease (ADPKD) was 4.76%, and acquired cystic kidney disease (ACKD) was 4.76%. The majority of simple renal cysts were asymptomatic (75%). Hypertension and flank pain were the common symptoms of ADPKD and ACKD. Conclusion: Age and gender were significant risk factors of renal cysts. ADPKD and ACKD were less frequent among Sudanese adults. Hypertension and flank pain were the most common symptoms and signs of ADPKD and ACKD. Ultrasound plays an effective role to classify and assess renal cysts that help in management and follow-up (Terada N ,2002) .

Other study, ninty –one pateint (58fe male and 33 male) .the patients were examined with real time ultrasound device .kidney size,presence ,number and diameter of cysts were examined and presence of hypertention was defined by the administration of anti hypertensive agents ,systolic blood pressure greater than 140mmHg and/or diastolic blood pressure greater than 90 mmHg .result found(20.88%)simple cyst and(4.39%)cortical cyst ,(4.39%)parapelvinic cysts,(10.99%) bilateral renal cysts sixity(60%) of them had hypertention. We found no difference in the presence of simple renal cysts according to the sex. Hyper tension was detected in 30 (32.97%)patients .hypertention was significantly more frequent in patients with simple renal cysts (p<0.041) .simple renal cyst significantly associated with age (p<0.01).wefound association with between simple renal cysts and hypertention (Ekart R , et al 2001).

Chapter Three

Materials And Methods

3.1 Materials

3.1.1 Patient

Study includes 100 Sudanese males and females(72 males and 28 females) ages between 20-100 years in Khartoum state who were examined by ultrasound and confirm diagnosed with renal cysts . which conducted from May 2017 to August 2017 .the inclusion criteria all adults patient referd to ultrasound department for investigating the kidneys and patients under 20 years were excluded from the study .

3.1.2 Machine

Ultrasound machine with curvilinear probe (3-5MHz), coupling gel, examination was performed with high resolution scanner (SSD-500 Aloka medical system CO,ltd,tokyo,japan) and mindary DP10.

3.2 Methods

The songraphic criteria used for assessing renal cysts were wall-difinition ,thickof septa, acoustic enhancement ,shape and number of cysts .

3.2.1 Technique

3.2.1.2 The right kidney survey

Supine position

For the right kidney,the machine setting was adjusted and so the image parameters such as overall gain ,focusing ,and depth . the patient lie supine and place the probe 3.5-5 MHz frequency at the right lower intercostal space in the midaxillary line at 11 o'clock use the liver as your (acoustic window) and aim the probe slightly posteriorly (toward the kidney). Gently rock the probe (up and down or side to side) to scan the entire kidney. , full inspiration to visualize shape and size and echo texture of the kidneys , which allows for subtle movement of the kidney. Obtain longitudinal (long axis) and transverse (short axis) ,also the kidney were scanned in sagittal and coronal section.

3.2.1.2 Left kidney survey

For the left kidney have the patient lie supine or in the right lateral decubitus position coupling gel. Place the probe in the lower intercostal space at 1o'clock. The placement will be more cephalad and posterior than when visualizing the right kidney. Again gently rock the probe to scan the entire kidney. Obtain longitudinal and transverse views Depending on which axis you use to obtain you images, the sonographic shape of the kidney will change. On longitudinal view, the kidney will appear football-shaped and will typically be 9-12 cm in length and 4-5 cm in width (normally within 2 cm of each other). On transverse view, the kidney appears C-shaped. The normal kidney will have a bright area surrounding it which is made ,in addition to oblique and prone position were also needed where possible .

3.2.2 Image interpretation

The sonographic procedure was performed by two expert sonologists who wrote the final report for every patient and there were no interobserver errors .

3.2.3 Data collection

Data was collected from data collection sheet and abdominal ultrasound findings

3.2.4 Data analysis

For the statistical analysis,Microsoft Excel software and statistical package for the social sciences(SPSS Inc., Chicago,IL, USA) version 15 were used .

Chapter Four

Result

Table 4.1 showing the mean, standard deviation, minimum and maximum values according to age , weight, size, systolic and diastolic .

Descriptive Statistics	Min	Max	Mean	Std. Deviation
Age	28.0	81.0	59.060	12.1421
Weight	60.0	105.0	81.200	11.2788
X-Size	1.0	5.8	3.368	1.0376
Y-Size	1.0	6.5	3.346	1.3122
Systolic	120.0	170.0	140.900	19.3373
Diastolic	90	100.0	86.890	11.1436

Table 4.2 **Age** (years) distribution of the study population in relation with renal cysts

Age groups	**Frequency**	**Percent**
28-35.5	5	5.0
36-43.5	7	7.0
44-51.5	16	16.0
52-59.5	21	21.0
60-67.5	23	23.0
68-75.5	21	21.0
76-83	7	7.0
Total	**100**	**100.0**

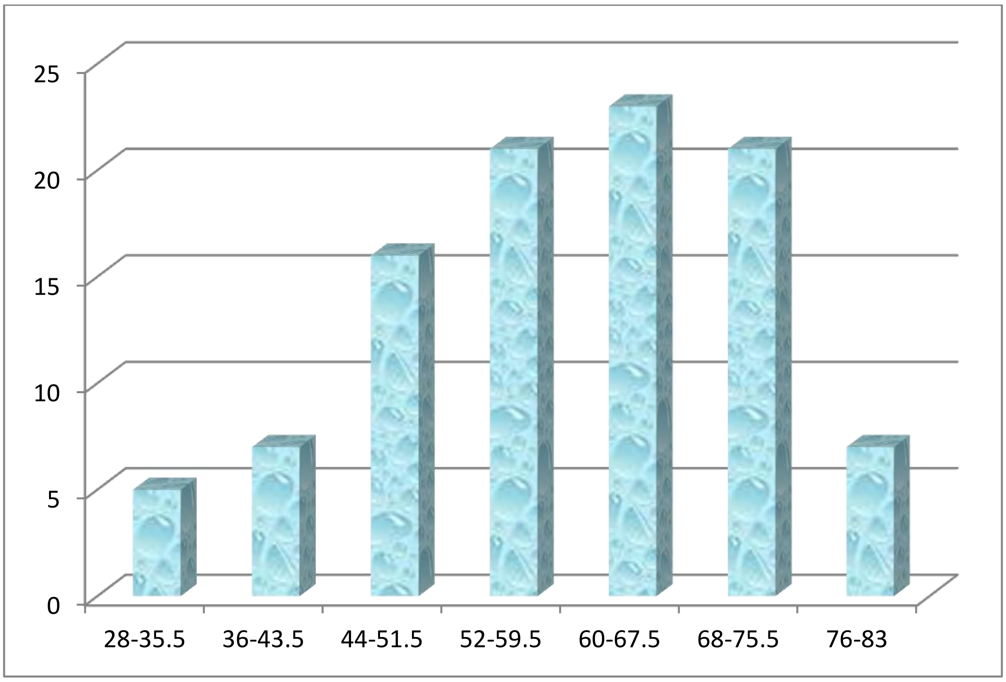

Figure 4.1show **age** frequency

Table 4.3 Show the relationship between the **size** of the cyst and the collected **age** groups

Group Statistics				
	AGE	**N**	**Mean**	**Std. Deviation**
x-size	28-35.5	5	3.500	.6042
	36-43.5	7	3.029	1.2271
	44-51.5	16	3.331	1.1241
	52-59.5	21	3.314	1.0924
	60-67.5	23	3.304	0.9809
	68-75.5	21	3.224	0.9909
	76-83	7	4.500	0.5745

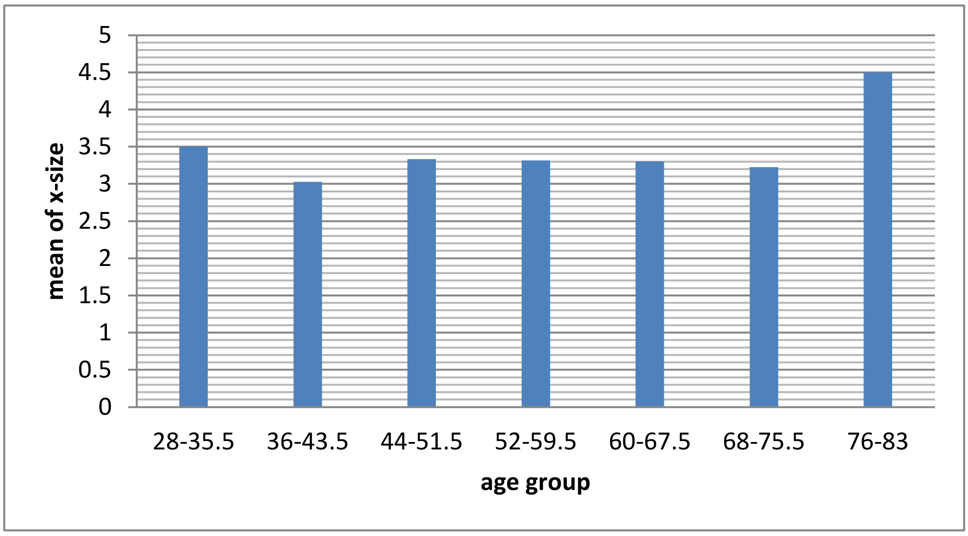

Figure 4.2 Show relationship between **age**(years) and **size** of the renal cysts (cm)

Table 4.4 Frequency distribution of **gender** of the study

gender	Frequency	Percent
male	72	72.0
female	28	28.0
Total	**100**	**100.0**

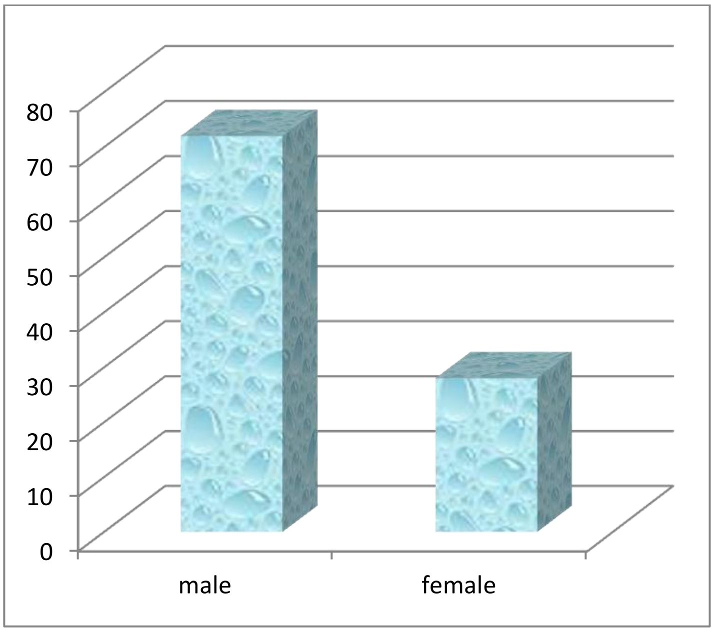

Figure 4.3 **gender** of the study

Table 4.5 Frequency distribution of **location** of renal cysts

locations	Frequency	Percent
left	32	32.0
right	35	35.0
both	33	33.0
Total	**100**	**100.0**

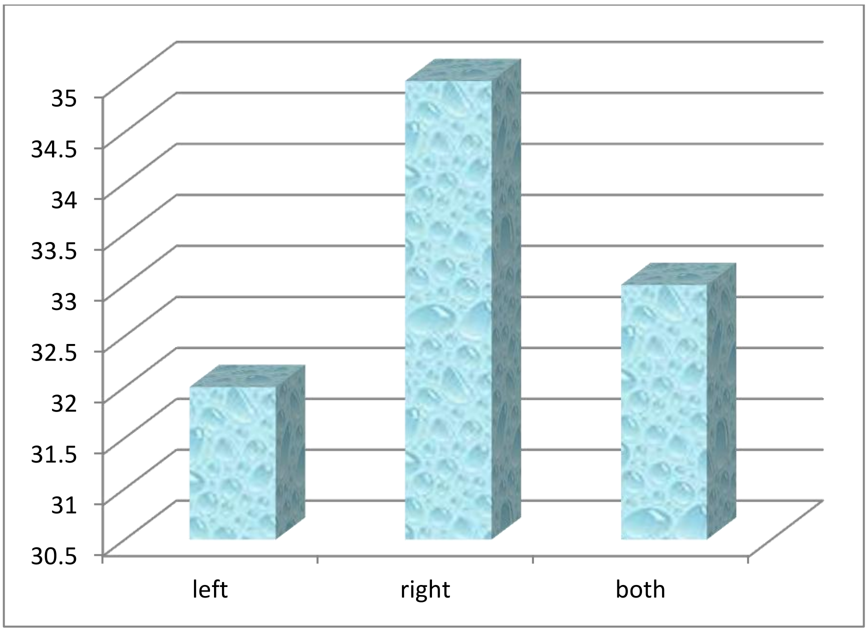

Figure 4.4 distribution of **location** of renal cysts

Table 4.6 Distribution of **other pathology** through 100 patients.

Other finding		Frequency	Percent
Stone		17	17.0
BBH		41	41.0
CRF		7	7.0
Hydronephrosis		6	6.0
Cystitis		8	8.0
Colycystitis		8	8.0
Ascities		8	8.0
Splenomegaly		2	2.0
Total		97	97.0
Missing	System	3	3.0
Total		**100**	**100.0**

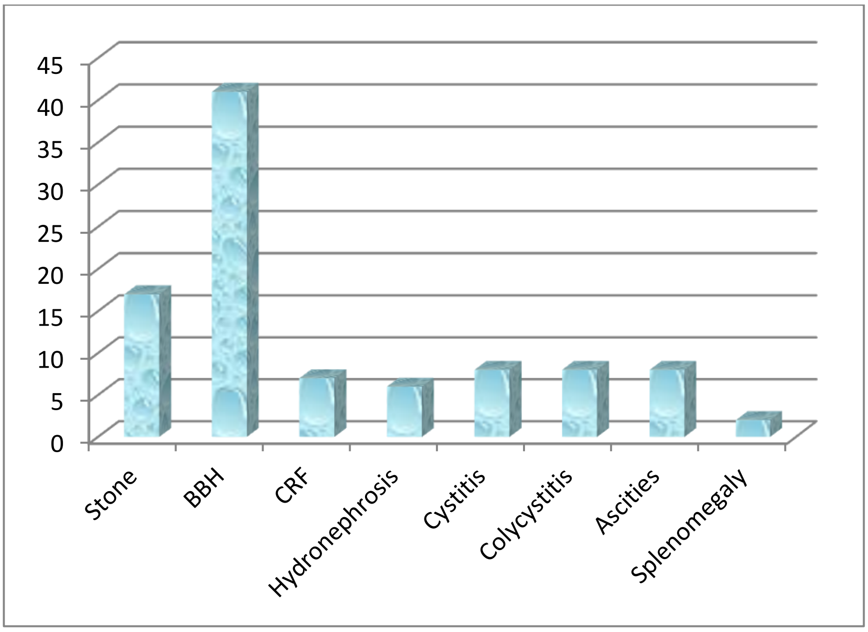

Figure 4.5 Show **other pathology** associated with renal cysts

Table 4.7 Frequency distribution of **Number** of renal cysts

Number	Frequency	Percent
solitary	65	65.0
multiple	35	35.0
Total	**100**	**100.0**

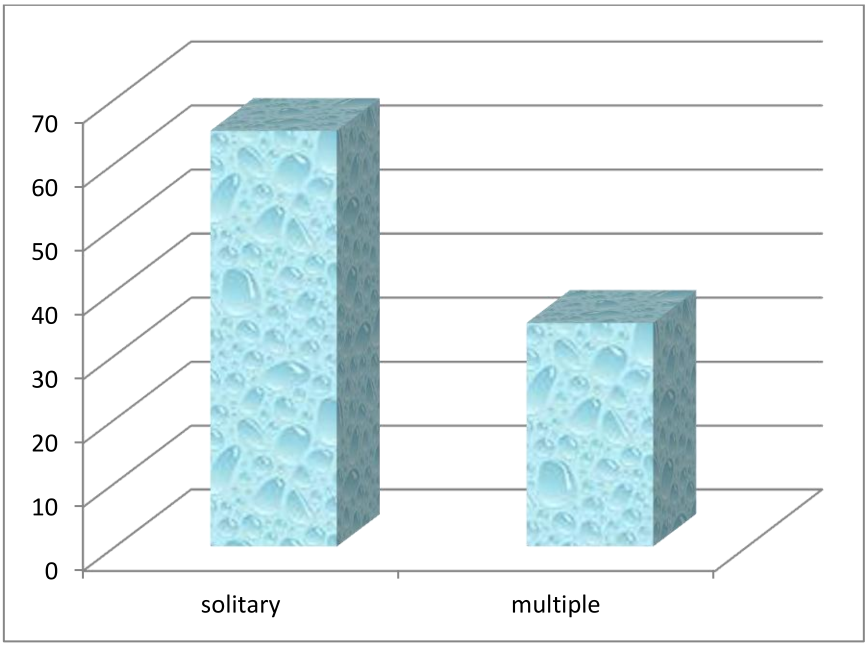

Figure 4.6 Show **Number** of cysts of the study

Table 4.8 Showing the distribution of **echogencity**

Echogencity	Frequency	Percentage
Hyperechoic	11	11.0
Hypoechoic	86	86.0
Isoechoic	3	3.0
Total	**100**	**100.0**

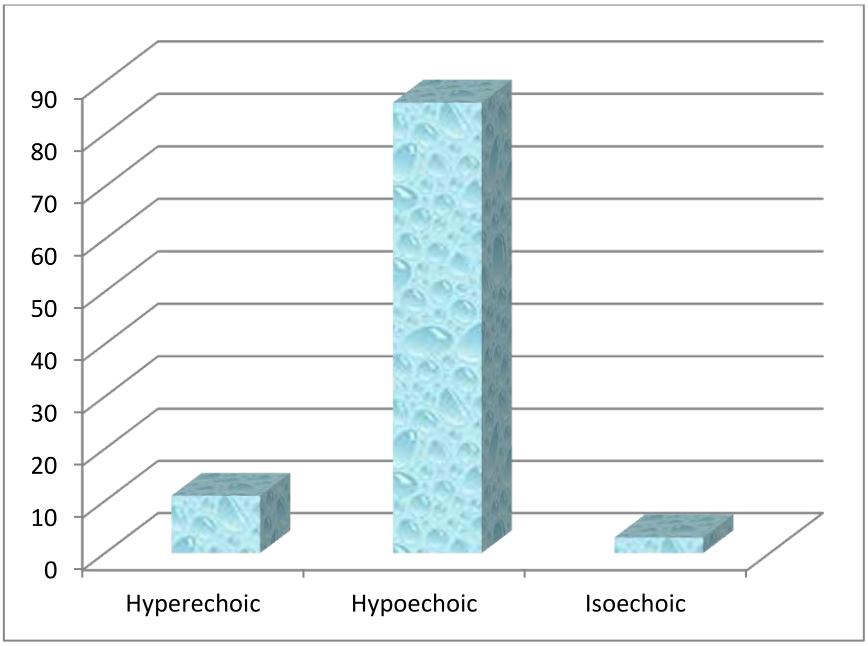

Figure: 4.7 Showing the distribution of **echogencity**

Table 4.9 Show the distribution of **cystic criteria**

Cystic criteria	Frequency	percentage
Ovoid shape	89	89
Thin wall	89	89
Post. wall inhancement	89	89
Absence of int. echoes	89	89
Multiple	9	9
Uniloculated	87	87
Bilateral	8	8

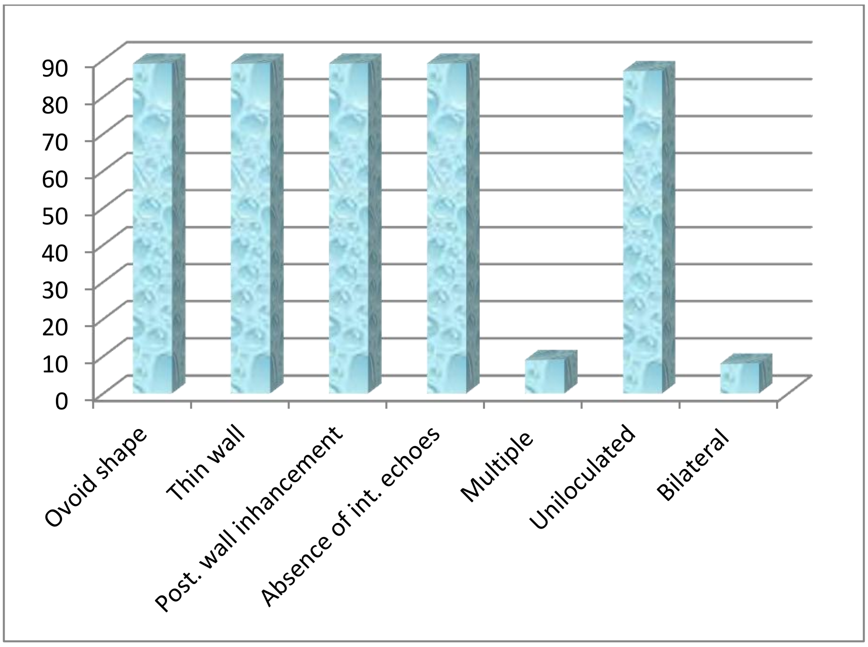

Figure: 4.8 Show the distribution of **cystic criteria**

Table 4.10 Show **location** of renal cysts

location	**Frequency**	**percentage**
Cortical	66	66.0
Medullary	7	7.0
Parenchymal	24	24.0
Para pelvic	3	3.0
Total	**100**	**100.0**

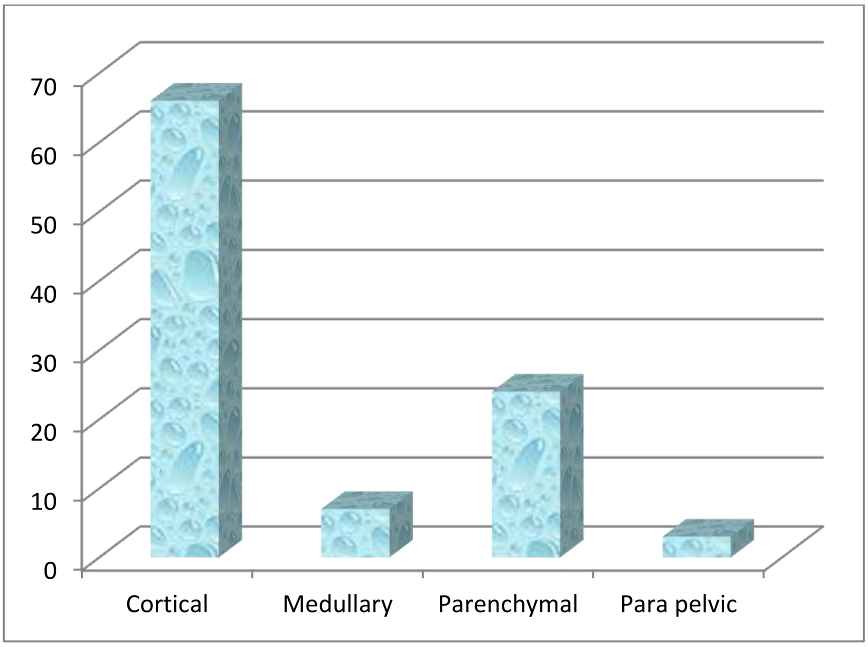

Figure: 4.9 Show **location** of renal cysts

Table 4.11 Show **size** of cysts

Size of cysts(mm)	**Frequncy**	**Percentage**
10-20 mm	25	25.0
20-30 mm	14	14.0
30-40 mm	35	35.0
40-50 mm	10	10.0
50-60 mm	5	5.0
90-100 mm	3	3.0
Variable size	8	8.0
Total	**100**	**100.0**

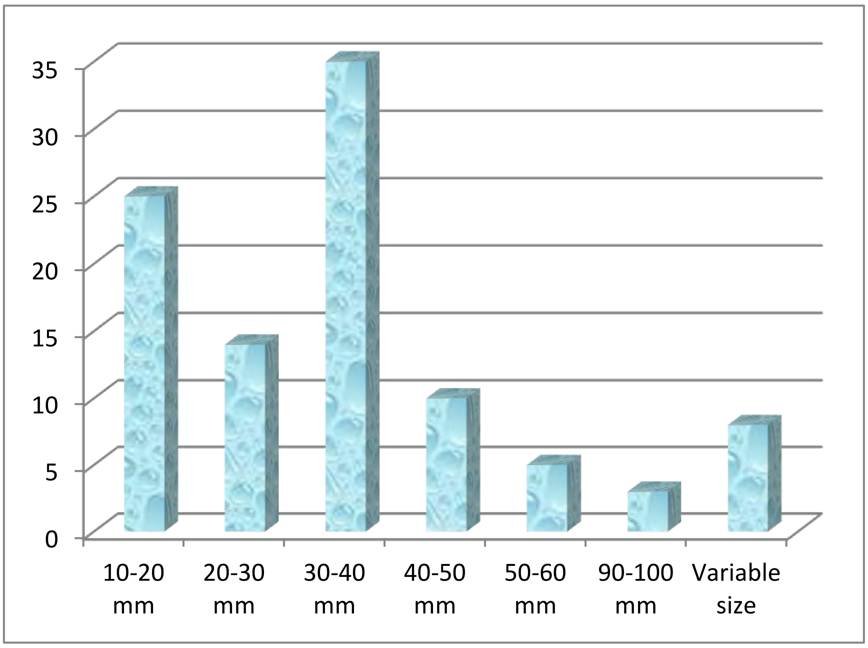

Figure: 4.10 Show **size** of cysts

Table 4.12 Show **classification** of cysts

Type of cyst	**Frequency**	**percentage**
Simple cyst	89	89.0
Aquired cyst	2	2.0
APKD	3	3.0
A typical cyst	5	5.0
septest	1	1.0
Total	**100**	**100.0**

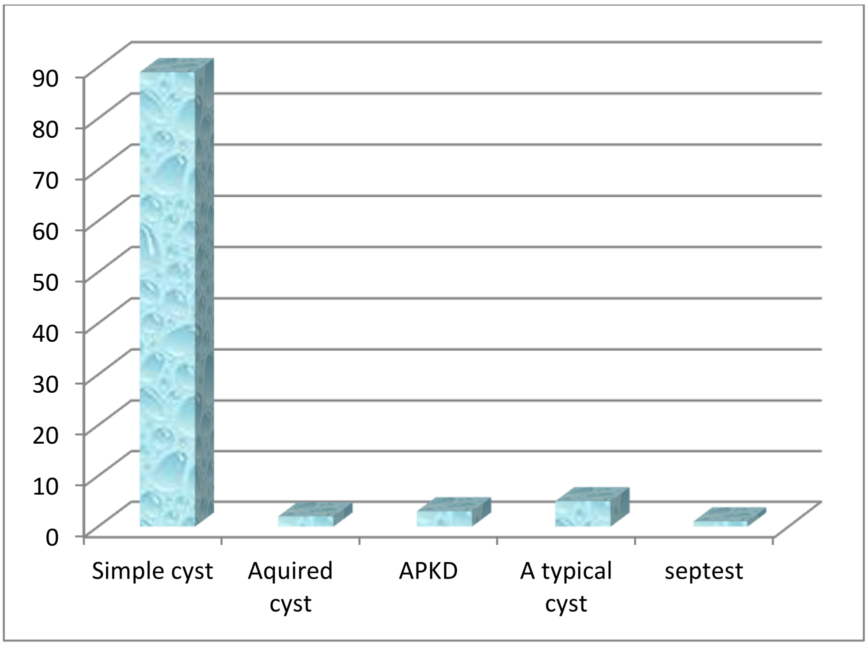

Figure: 4.11 Show **classification** of cysts

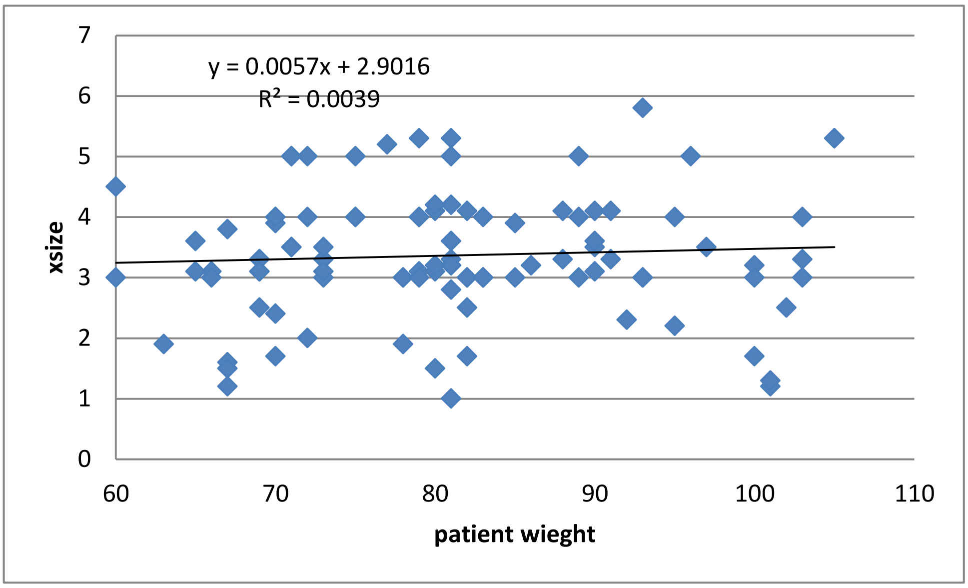

Figure 4.12 Scatter plot Show the correlation between **wieght** by kg (horizontal) with **x-size** by cm (vertical)

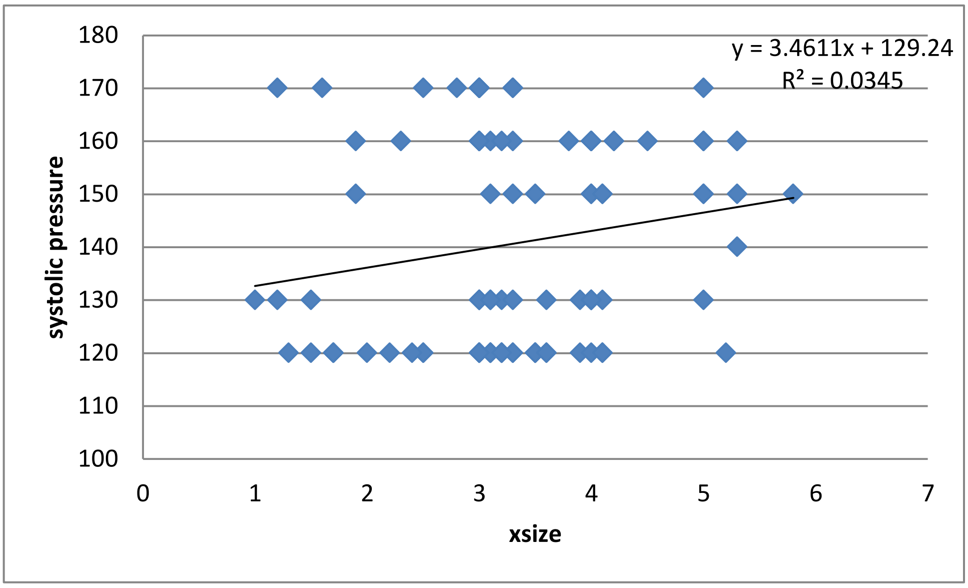

Figure 4.13 Scatter plot Show the correlation between **x-size** by cm (horizontal) and **systolic pressure** by mmHg (vertical) .

Chapter five

Discussion, conclusion and Recommendation

5.1 Discussion

This study which was carried out on 100 patients in which renal cysts was identified sonographically the data collected from peoples ages ranged between 20-83 years .72% were male patients and 28% were females patients. So male more affected than females with(mean standard deviation , for age (59.060±12.1421) ,for weight (81.200 ±11.278) ,x-size (3.368±1.0367),y-size (3.346 ±1.3122) , systolic (140.900 ±19.3313) ,diastolic (86.890±11.1436) respectively (Table (4-1)(Table 4-4).

Regarding to the collected age of patients the most frequent age group is (60-67,5) (23%) . As stated by Carrim ZI , 2004(Table 4-3)(figure 4-2).

The study showed simple renal cysts is the common diagnosed ,this result was the same result as Carrim ZI ,2004,(Table 4-8).

The study found strong correlation between age and size of cyst (p=0.96) this result was mismatch with the study which done by Terada N ,2002(Table 4-3)(Figure 4-2).

On this study we observed the right kidney is the most common location of renal cysts, the incidence of bi lateral is lesser than uni lateral(33% vs67%) and the renal cyst involved cortex more than pelvic ,this result was same as the study which done by Carrim ZI ,2004 (Table 4-5)(Figure 4-4)(Table 4-9) .

Along this series 86% of cases are diagnosed as simple cysts which represent the most common differential diagnosis of renal cysts

Followed by 3% APKD ,3% hemorrhagic cyst,5% atypical cyst, 2% acquire cyst ,1% septets cyst ,this result was agree the study which done by Terada N ,2002 (Table 4.12) .

In this study the size of renal cyst was measured , we observed the size of the majority cyst is (3-4 cm)(table 4.11) .

There were (90 of 100) Were cortical and parenchymal cyst (7 of 100) were medullary cyst (3 of 100) were para pelvic cyst. Previous study confirmed that, the upper pole is the most common site , this result was agree the study which done by Carrim ZI 2004 (Table (4-10) .

Benign prostatic hyperplasia is the most common concomitant with simple renal cyst during this study , there was 8 cases showed cystitis ,17 cases for renal stone,8 cases for cystitis ,8 cases for acities , 8 cases for cholecystities,6 cases for hydronephrosis and 2 cases for Splenomegaly , other cases U.B stones, renal enlargement, poor CMD, increase renal size ,and G.B stones (Table 4-6)(Figure (4-5) .

In yhis study we found that the solitary cysts more common than multiple cysts (65% vs 35%)this result was match with the study which done by Terada N ,2002(Table 4-8)(Figure 4-7).

On this study there is adirectional relation between size of cyst and patient weight ,x-size increase by 0,0005 cm for every one kg for patient weight(R2=0.003)(Figure 4-8).

The study show strong degree of correlation between size cyst and systolic pressure but the exact mechanism between simple renal cysts and hypertention is not known (R2=0.034) this result was match with study which done by Ekart R ,et al ,2001(Figure 4-9).

The study confirm the ovoid shape ,absence of internal echoes ,thin wall and posterior wall acoustic enhancement is most common cystic criteria (Table 4-9) .

5.2 Conclusion

Simple cysts were more common than other types of renal cysts, the most common site is cortical cyst, the least common site is parpelvinic cysts.

The incidence of simple solitary cysts was higher than multiple cysts, and the prevalence of renal cysts was higher in male than female.

The ADPKD and ACKD were less common in Sudanese adults. Age and gender were common risk factors associated with renal cysts. ,this study has shown 3 cases of ADPKD.

Most renal cysts in this study were unknown causes, and other causes were CRF and APKD. the renal cyst involved the right kidney more than the left kidney.

7 patients were CRF who have been a duration of dialysis more than 3 years have renal cyst.

The size of renal cyst appears to have been related to the risk factor of hypertention in the result of this study.

Routine ultrasound screening for adults is advisable to detect the renal cysts and avoid the progression of complication.

5.3 Recommendation :

The worth mentioned recommendation could be as followes:

1.Care must be taken when detacting a simple renal cyst, centrally echo free with sharp outlines and posterior acoustic enhancement.

2.The differentiation of renal cysts need to variabl adjustment of ultrasound intensity.

3. Belive more that diagnostic ultrasonography should be the first line test owing to its safety and availability.

4.every patient in third decade should be scan to exclude ADPKD to decrease the complication of the disease.

5.simple cyst no needed to follow up, other cyst (ADPKD,multicystic) to avoid the complication.

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Appendix 1

Data sheet

No	Age	Gender	Size	RT kid		LT kid		Number of cyst	H.T	Other findings
				Cort.	Para.	Cort.	Para.			

Appendix 2

Images of the research

Image 1:male 72 years old ; two simple cyst at upper pole of right kidney large one measuring (3*3.6cm).small one measuring (1.3*1.2cm).

image2:male 70 years: three simple cyst in upper,middle and lower pole of right kidney, measuring(4*4.3*2cm1.5*1.6 cm).

Image 3:femal 63 years old; lower pole acquire cyst measuring 2*2 cm.

Image4: male 80 years old;simple renal cyst measuring (3.5*3.7 cm) at upper pole of the right kidney.

Image5:male 70 years old ;simple renal cyst measuring(2*2cm) in upper pole of right kidney.

image 6:male 50 years old;septat cyst in lower pole of righ kidney, Measuring (3.1*2.8cm).

Image 7:male 56 years old;simple renal cyst measuring 5*5cm in lower pole of right kidney.

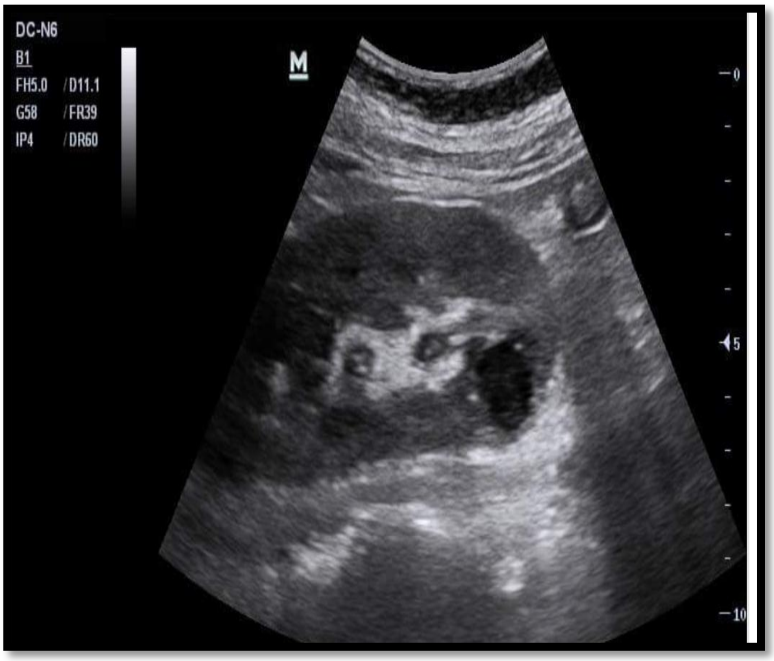

Image8: male 50 years old; simple cyst 4*3cm in size at lower pole of left kidney.

Image9:male 70 years old;simple cyst at upper pole of left kidney.

Image10:female60 years old ; multiple simple cysts at upper pole of right kidney of variable size.

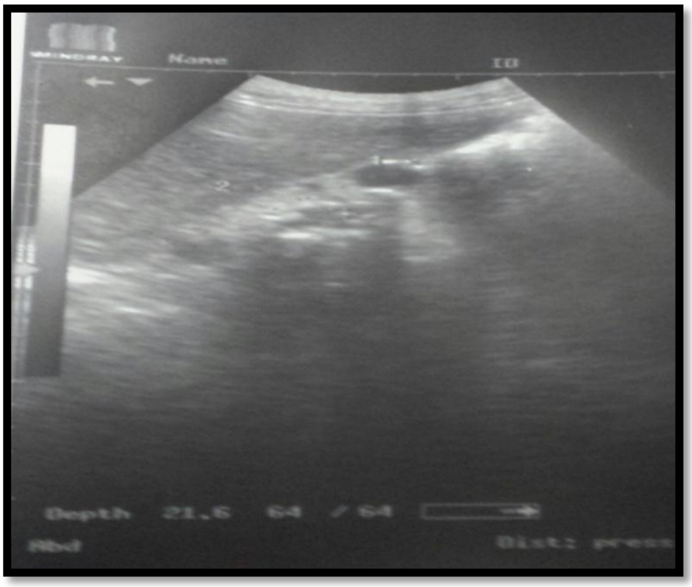

Image11: femal 56 years old; simple cyst in lower pole of right kidney

Image12:femal 63 years old; simple renal cyst in mid pole of right kidney measuring(3*3cm).

Image13:male 55 years ; cortical simple renal cyst of left kidney 3.2*3.6cm in size.

Image14: male 50 years old; simple cyst at upper pole of right kidney 5.8* 6.4cm in size.

Image15: male 60 years old ;2simple cyst at mid pole of left kidney, Measuring((1.7*1.8)(1.4*1)cm) .

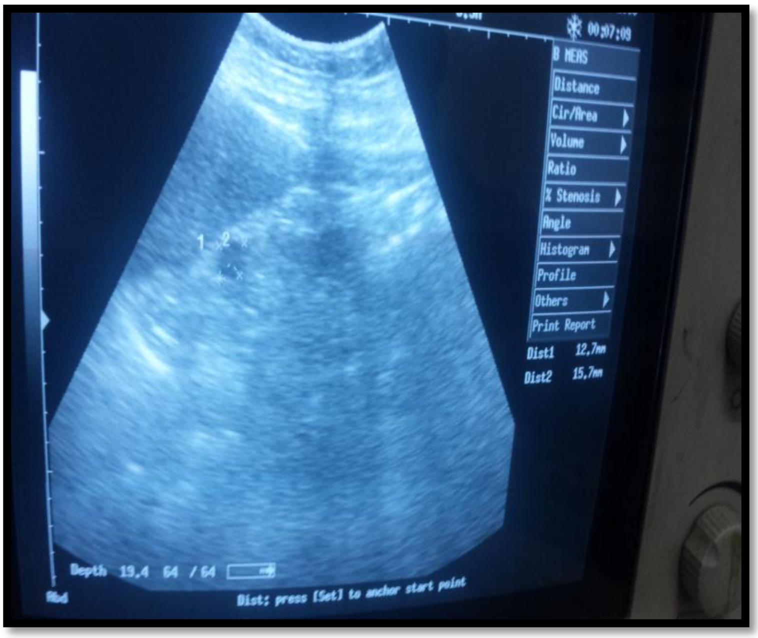

Image:16 male 70 years old ; 2 simple cysts in lower and mid pole of right kidney, measuring(2*2 cm) (1.6*1.7 cm).

Image 17:male 56 years old ; simple cortical cyst of right kidney(3*3 in size).

Image17:male 56 years old ; simple cyst at cortex of right kidney, measuring(I,6*1.8 cm)

Image18:same patient above; simple renal cyst of left kidney measuring 1.2*1.5 cm), bilatral renal cyst.(

Image19: male55 years old ; big simple cyst at lower pole of left kidney

Image20:male 56 years old ; simple cyst at mid pole of left kidney, measuring (5.4*4.8 cm).

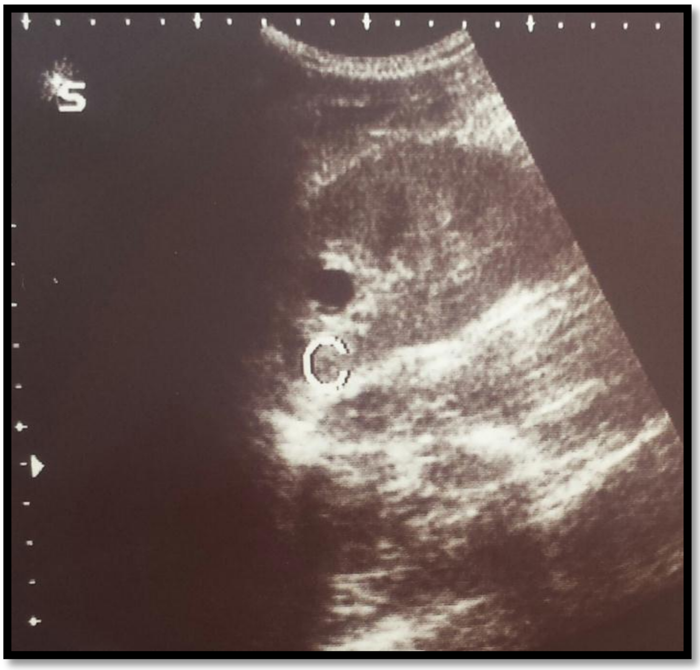

Image21: male 50 years old at upper pole of right kidney ,measuring 2*2cm).   (

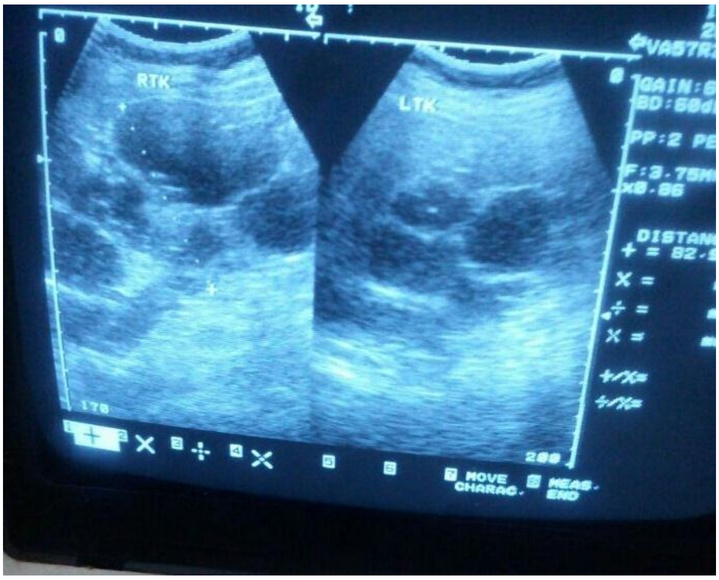

Image22:male 62 years old ,adult polycystic kidney disease (ADPKD) in a both kidneys

Image23: male 60 years old ;two simple cyst at upper pole of right kidney.

Image 24: male 70 years old ; two simple cyst at mid pole of left kidney, measuring (2*2cm 1.5*1.5cm).

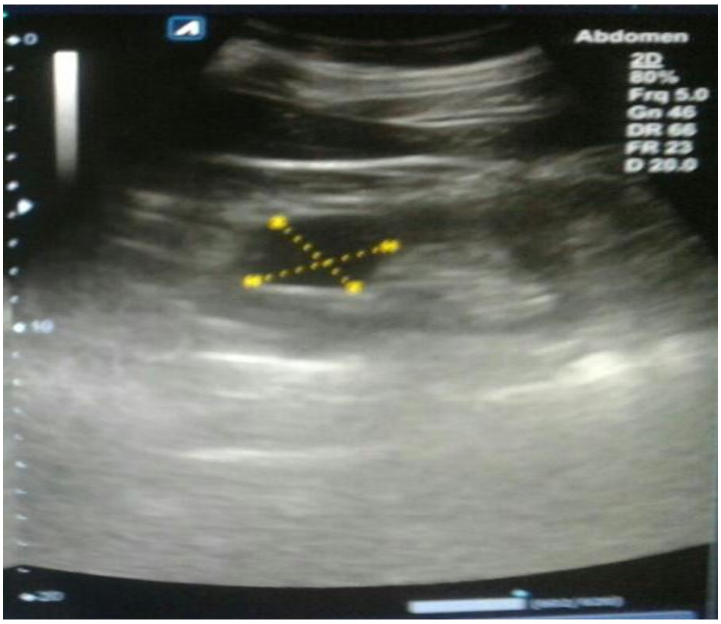

Image 25: male50 years old; simple cyst at mid pole of right kidney,measuring (3.3*2.9cm)

Image26:male 80 years old; acquire cyst at upper ,lower pole of right kidney.

Image27:male 55 years old; simple cyst at mid pole of right kidney.

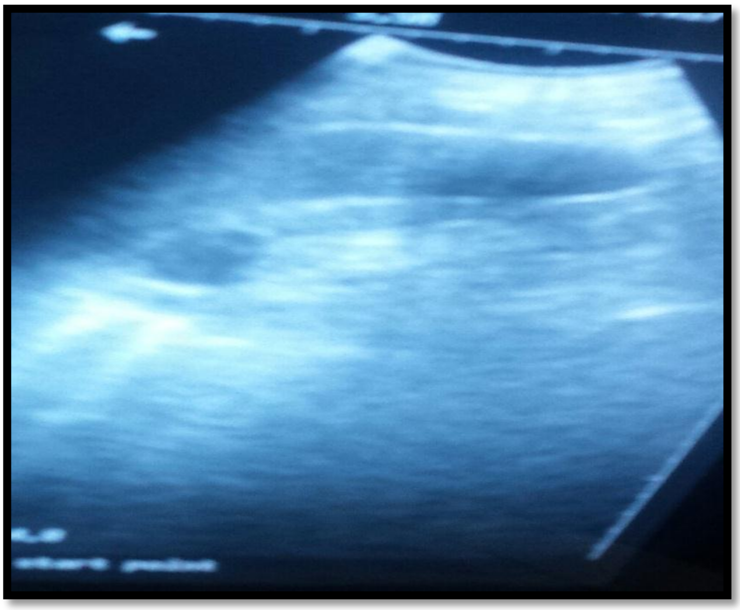

Image 28: male 50 years old ; simple cyst at upper pole of right kidney measuring(2.5*2.5 cm).

Image 29:male 60 years old ;2simple cortical cysts at lower an pole of right kidney* small one is exophytic measuring (2*2cm) largest one measuring 5*5cm) .

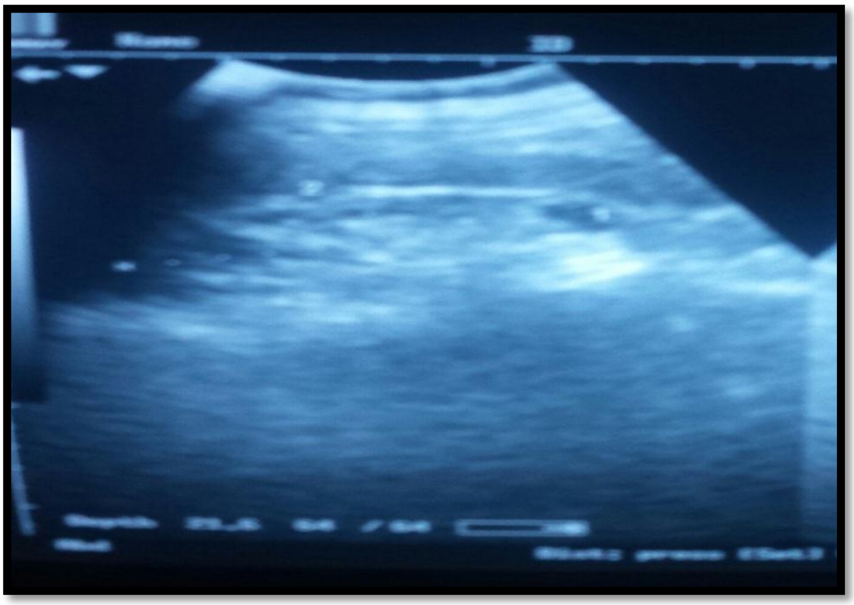

Image:30 femal 56 years old; small simple cyst at lower pole of right kidney