Sudan University Of Science & Technology

College Of Graduate Studies

The Role Of Ultrasonography In The Evaluation Of Chronic Renal Failure In White Nile State (Sudan)

دور التصوير بالموجات فوق الصوتية في تقويم الفشل الكلوي المزمن – في ولاية النيل الأبيض[السودان]

Thesis Submitted for Partial Fulfillment of the Requirements of M.S.c Degree In Medical Diagnostic Ultrasonography

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الآيــــــــــة

بسم الله الرحمن الرحيم

قال تعالي : (وَقُل رَّبِّ زِدْنِي عِلْمًا)

صدق الله العظيم ،،،

سورة طه الآية (114)

Dedication

To my loving father and mother

To my wife

to all who help me to achieving this reach

Acknowledgments

- *This research would not possible without the contributions , encorragement and guidance of*
- *Dr Salah Ali Fadl Alla the superviser.*
- *diagnostic medical sonographers.*
- *Kosti renal center for dialysis and transplantation .*

Abstract

This descriptive study Was conducted Via the selection of one hundred patients in the WhiteNile State , Kosti teaching Hospital , renal unit (Sudan), during the period from the first of october2015 to the end of October 2016. The aim of this study was to know the role of

ultrasonography in the evaluation of chronic renal failure. The researcher analyzed all the results and compared them to the previous studies .The study results showed that ultrasonography has agood role in the evaluation of chronic renal failure, and the disease is more common in the elderly male with low socio-economic status than female with high soco-economic ststus in the study area.

The study suggested that all patients with renal impairment should undergo ultrasonography before being investigated by other modalities.

The study recommended that further studies with large samples in the future could be done in the same topic to know more about the role of ultrasonography in the evaluation of chronic renal failure,in sudan in general

مستخلص الدراسة

هي دراسة وصفية تم من خلالها اختيار مائه عينة لمرضى الفشل الكلوي المزمن ولاية النيل الأبيض , وحدةغسيل الكلى , بمستشفى كوستي التعليمي [السودان] في الفترة من أول اكتوبر2015 حتي نهاية أكتوبر2016. وكان الهدف من الدراسة معرفة دورالتصوير بالموجات الفوق الصوتية في تقويم مرض الفشل الكلوي المزمن . وقد

قام الباحث بتحليل كل النتائج ومقارنتها بالدراسات السابقة. ولقد اوضحت الدراسة أن للتصوير بالموجات فوق الصوتية دور كبير في تقويم مرض الفشل الكلوي المزمن , كما ان المرض اكثر شيوعا عند كبار السن من الرجال دون النساء و في المجتمعات ذات الوضع الاجتماعي المعيشي المتدني اكبر منها مقارنة بذوات الوضع الاجتماعي المعيشي الافضل في منطقة الدراسة .

وقد اقترحت الدراسة بان جميع مرضي الكلي يجب إخضاعهم للكشف بالموجات فوق الصوتية قبل تعرضهم لوسائل الفحص الاخري . كما أوصت الدراسة بعمل بحوث أخرى في المستقبل باختيار عينات اكبر من مجتمع الدراسة لمعرفة الكثير عن دور التصوير بالموجات فوق الصوتية في تقويم مرض الفشل الكلوي المزمن في السودان بصورة عامة.

List of Abbreviations

Abreviation	Meaning
CRF	*Chronic renal failure*
WHO	*World Health Organization*
CT	*Computerized Tomography*

US	*Ultrasound*
L2	*Second lumber vertebrae*
IVC	*Inferior Vena Cava*
UPJ	*Urethroprostatic junction*
PCS	*Pelvic Calyceal System*
LVH	*Left Venticular hypertrophy*
LVD	*Left Venticular dilatation*
LK	*Left kidney*
RK	*Right kidney*
LRV	*Left renal vein*
SMA	*Superior mesenteric artery*

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Chapter one

1-1 Introduction:

Chronic renal failure is a common disease now a days And it is a severe condition that reduces life expectancy and typically progresses to end-stage renal disease (ESRD) and a need for renal replacement therapy. The prevalence of ESRD requiring treatment varies internationally from 600 to 1200 per million and is increasing steadily in most countries, with an estimated annual increase of 8%. In a large proportion of cases, CRF evolves from known renal or systemic diseases, but in some cases the pathogenesis remains unknown. [Rodile,1992]

chronic renal failure appear in ultrasound with strict criteria , so it is early diagnosed by ultrasound and the true cut needle biopsy of the kidney is performed under sonographic guidance ,skills , proper training an experience is mandatory to making an accurate .diagnosis from ultrasound images. [Robbin,1999].

Ultrasound recognized as an important adjunct to clinical examinations in case of patients with many common illness .

The (WHO) " goal of health for all " recommended that many of ultrasound examinations will performed at the first referral level , it is now a routine examination in obstetrics and gynecology .[Palmer,1995]

As there is no ionizing radiation , it should be the proffered method of imaging when ever its aid to reach a diagnosis . Although CT scanning has superseded ultrasound in many aspects of diagnosis , still ultrasound remains very useful , easy , safe , quick , noninvasive ,and available .[Jeffry ,2002]

1-2 The problem of the study :

The problem of the study is that many patients who used to come to White Nile State hospitals usually come with clinical symptoms of chronic renal failure without being investigated by ultrasound.

1-3 Objectives of the study :

1-3-1 General objectives :

To study the role of ultrasonography in evaluation of chronic renal failure.

1-3-2 Specific objectives :

1--To detect chronic renal failure in many patients coming with different renal complaints in White Nile state population (Sudan) .

2-To asses if there a relation between the disease (CRF) and the patients gender , age , occupations ,residence and socioeconomic status .

Chapter two

Literature review

2-1 Theatrical back ground

2-1-1 Renal anatomy

2-1-1 -1 Renal gross Anatomy :

The kidneys are bean-shaped structures and weigh about 150 g in the male and about 135 g in the female. They are typically 10-12 cm in length, 5-7 cm in width, and 2-3 cm in thickness.

The relationship of neighboring organs to the kidneys is important, as described below:

Superiorly, the suprarenal (adrenal) glands sit adjacent to the upper pole of each kidney

On the right side, the second part of the duodenum (descending portion) abuts the medial aspect of the kidney

On the left side, the greater curvature of the stomach can drape over the super medial aspect of the kidney, and the tail of the pancreas may extend to overlie the renal hilum

The spleen is located anterior to the upper pole and is connected by the splenorenal (lienorenal) ligaments

Inferiorly to these organs, the colon typically rests anteriorly to the kidneys on both sides

Posteriorly, the diaphragm covers the upper third of each kidney, with the 12th rib most commonly crossing the upper pole

The kidneys sit over the psoas (medially) and the quadratus lumborum muscles (laterally)[Richard,1998]

The images below further depict kidney anatomy and positioning

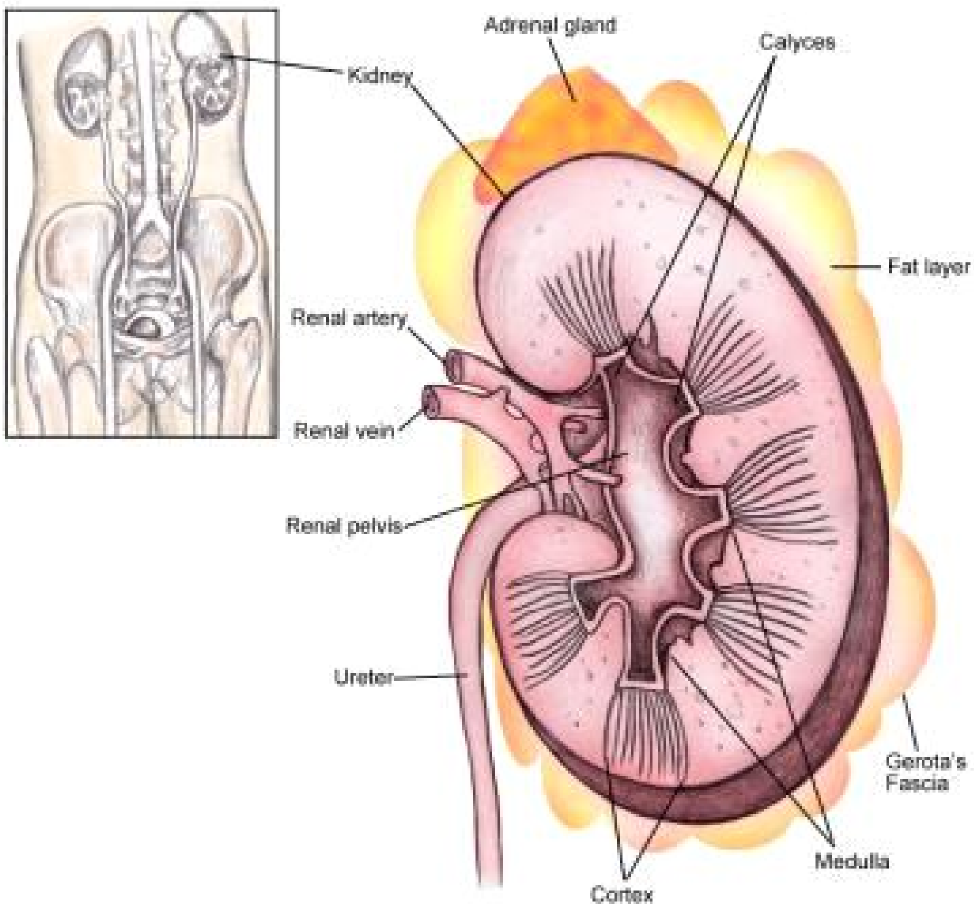

FIG NO (2-1)Renal anatomy, renal fascia.

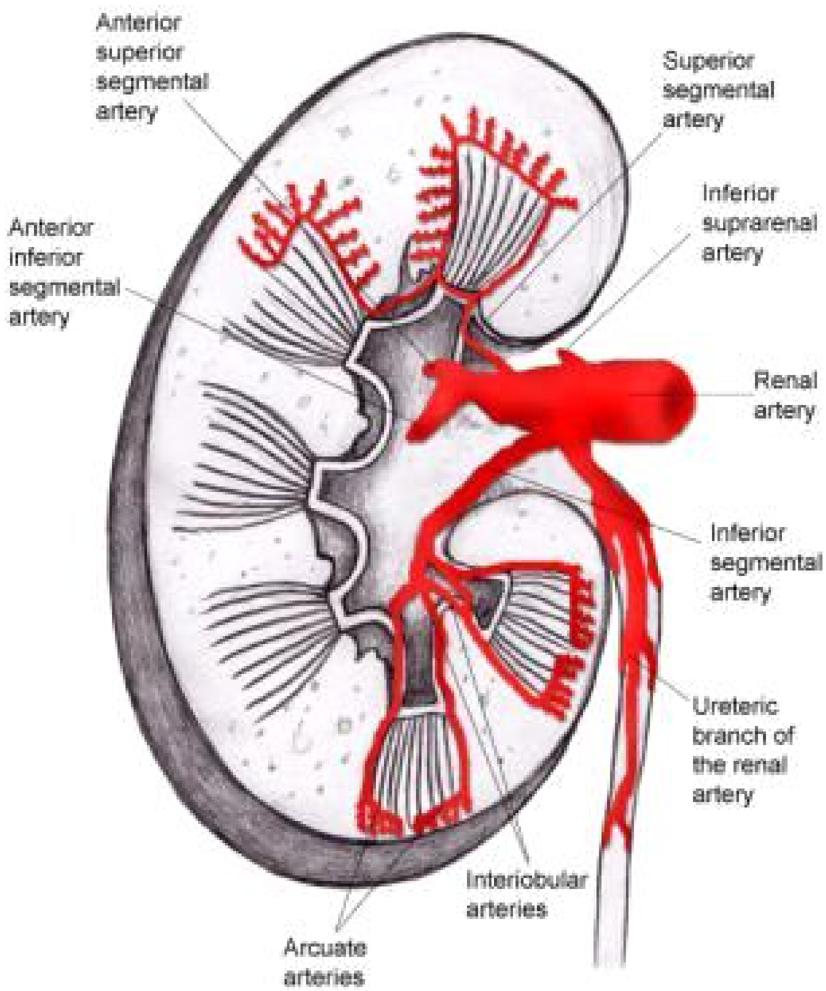

FIG NO (2-2)Intrarenal arteries.

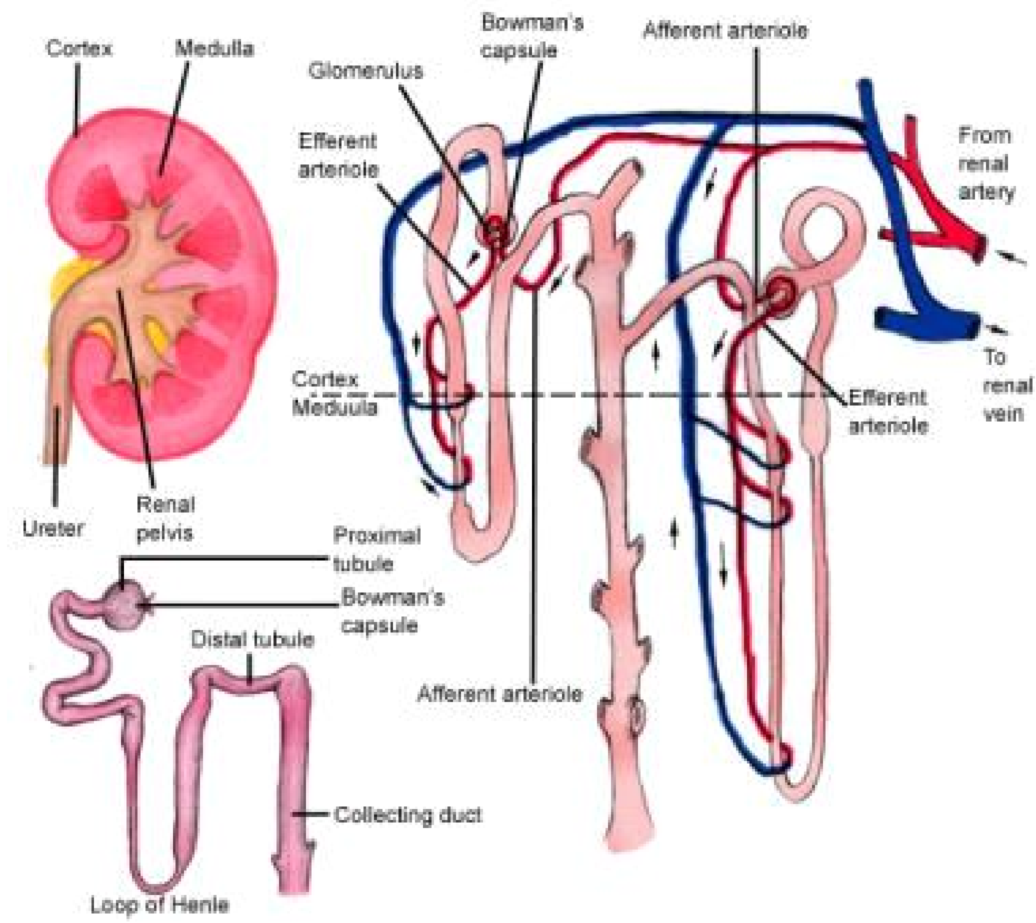

FIG NO (2-3) shows Microanatomy of the nephron.

2-1-1-2 Renal Vasculature

The kidneys receive approximately 20% of the cardiac output. The blood supply to the kidneys arises from the paired renal arteries at the level of L2. They enter into the renal hilum, the passageway into the kidney, with the renal vein anteriorly; the renal artery; and the renal pelvis posterior.

The first branch off of the renal artery is the inferior suprarenal artery. The renal artery then branches off into 5 segmental branches. The posterior segmental artery supplies most of the posterior kidney, with the exception of the lower pole. The anterior branches are the superior segmental artery, anterior superior segmental artery, anterior inferior segmental artery, and inferior segmental artery. These arteries branch into interlober arteries, which travel in a parallel fashion in between the major calyces and then branch further into arcuate arteries that run within the cortex across the bases of the renal pyramids.

They then radiate into interlobular arteries, which extend into the cortex of the kidney to finally become afferent arterioles, then peritubular capillaries to efferent arterioles. Some of the terminal branches of the interlobular arteries become perforating radiate arteries, which supply the renal capsule. Renal pelvic and superior ureteric branches also originate from the renal artery and supply the upper portion of the collecting system (see the image below).

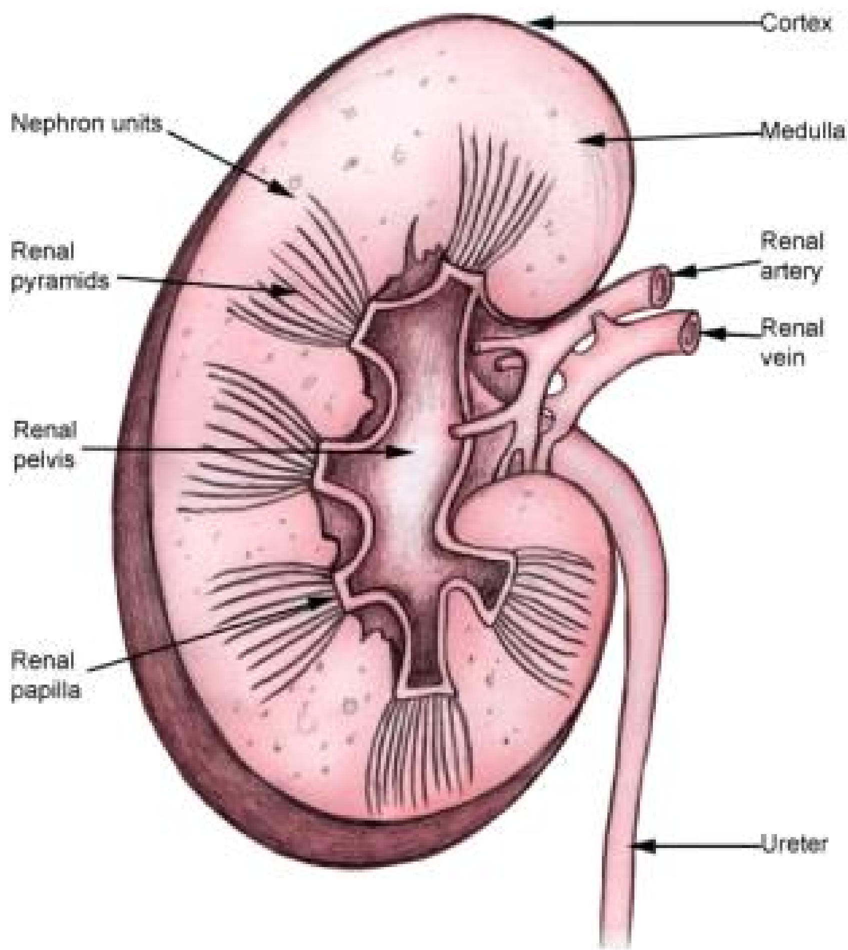

FIG NO (2-4) shows Anatomy of collecting system.

The renal veins drain the kidneys in a similar distribution, and the renal vein is generally anterior to the renal artery at the hilum. The left renal vein is longer than the right as it crosses the midline to reach the inferior vena cava (IVC). Generally, the left gonadal vein drains into the left renal vein inferiorly, while the left suprarenal vein drains into the superior aspect of the renal vein at approximately the same level. Posterior, the left second lumbar vein typically drains into the left renal vein as well. The left renal vein then crosses under the origin of the superior mesenteric artery to reach the IVC. On the right side, the renal vein and gonadal vein drain separately and directly into the IVC.[Elfred ,1996]

2-1-1-3 Renal lymphatics

The lymphatic drainage parallels the venous drainage system. After leaving the renal hilum, the left primary lymphatic drainage is into the left lateral aortic lymph nodes, including nodes anterior and posterior to the aorta between the inferior mesenteric artery and the diaphragm. On the right, it drains into the right lateral caval lymph nodes.[Harold Elius,1989]

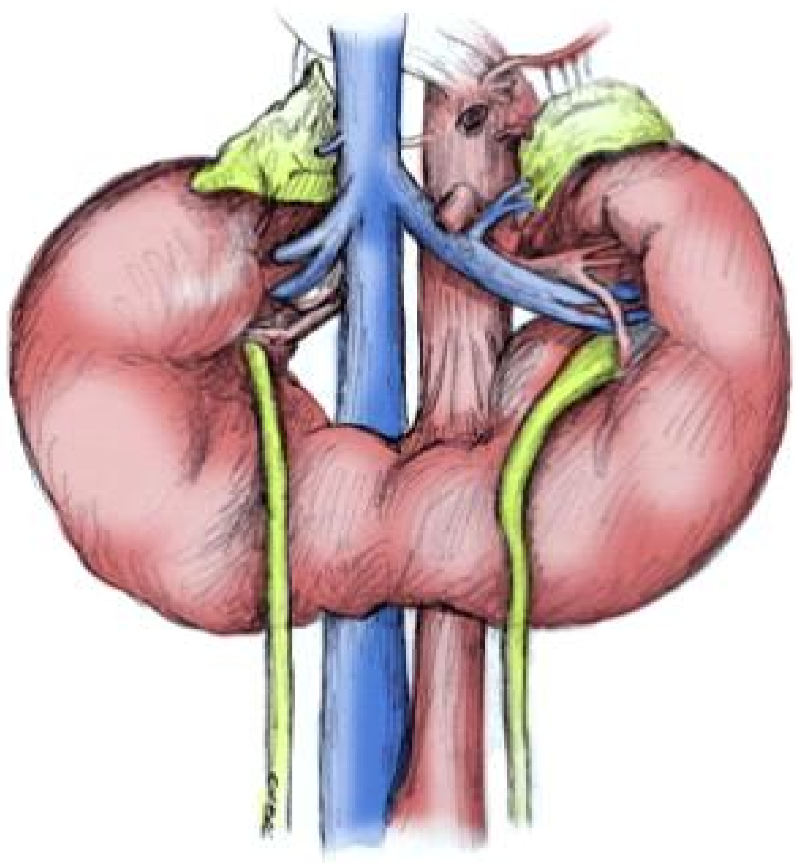

FIG NO (2-5) SHOWS Horseshoe kidney.

2-1-1-5 Renal nerve anatomy/autonomic innervations

The kidney receives autonomic supply via both the sympathetic and parasympathetic portions of the nervous system. The preganglionic sympathetic nervous innervations to the kidneys arises from the spinal cord at the level of T8-L1. They synapse onto the celiac and aorticorenal ganglia and follow the plexus of nerves that run with the arteries. Activation of the sympathetic system causes vasoconstriction of the renal vessels. Parasympathetic innervation arises from the 10th cranial nerve (X), the vagus nerve, and causes vasodilation when stimulated

The kidney is divided into the cortex and medulla. Renal pyramids in the medullary areas are separated by the cortical tissue called renal columns of Bertin.[Richard,1998]

2- 1-1-5 RENAL ANATOMICAL VARIANTS

2-1-1 -5-1 Duplex kidney :

This tern is used to describe a spectrum of possible appearance , from two separate kidneys with sepa-rate collecting systems and division of the pelvicalyceal system at the renal hilum . The latter is more difficult to recognize on ultrasound , but the two moieties of the pelvicalyceal system are separated by zone of normal renal cortex which invaginates the kidney – a hypertrophied column of Bertin (see below) .

Duplex kidney is the most common congenital renal abnormality . It may be associated with other anomalies such as reflux , ectopic ureteric orifice or ureterocele , and may predispose the patient to infection or obstruction of the upper moiety or , rarely the lower moiety . The main issue for the sonographer here is that one moiety may be mistaken on ultrasound for the entire kidney , especially if bowel gas overlies part of the kidney , and the operator must ensure that both renal poles are properly demonstrated . A chronically odstructed moiety in an adult patient may masquerade as a renal cyst or as fluid-filled bowel .

The main renal artery and vein may also be duplicated , which can occasionally be identified using colour or power Doppler .[jane bates,2011]

2-1-1-5-2 Ectopic kidneys :

The kidney normally ascends from the pelvis into the renal fossa during its course of development During this migration it rotates inwards so that the renal hilum faces medially .A failure of this mechanism causes the kidney to fall short of its normal position , remaining in the pelvis , i.e a pelvic kidney . Usually it lies on the correct side , however , occasionally it can cross to the other side lying inferior to its normally placed parter – crossed renal ectopia . Frequently it may fuse with the lower pole of the other kidney – crossed fused renal ectopia – resulting in what appears to be a very long unilateral organ . [janebates2011]

2-1-1-5-3 Horseshoe kidneys :

In the horsechoe kidney , the lie one on each side of the abdomen but their lower poles are fused by a connecting band of renal tissue , or isthmus , which lies anterior to the aorta and IVC . The kidneys tend to be rotated and lie with their lower poles medially .

It may be difficult to visualize the isthmus due to bowel gas anterior to it , but a horseshoe kidney should always be suspected when the operator is unable to confidently identify the lower poles or the kidneys , or when the lower pole seems unusu-ally anterior and medial.

When the isthmus can be seen , it is important not to confuse it with other , abdominal masses such as lymphadenopathy . CT is occasionally per-formed because of this and normally clarifies the findings.[janebates2011]

2-1-1-5-4 Extrarenal pelvis :

Not infrequently , the renal pelvis projects outside the kidney , medial to the renal sinus . This is best seen in a transverse section through the renal hilum . It is frequently "baggy" containing containing anechoic urine , which is prominently demonstrated on the ultrasound scan . The importance of rec-ognizing the extra – renal pelvis lies in not confusing it with dilatation of the PCS , or with a para-pelvic cyst or collection [janebates2011]

2-1-1-5-5 Hypertrophied column of Bertin :

The septum of Bertin is an invagination of renal cortex down to the renal sinus . It occurs at the junctions of original fetal lobulations and is present in Duplex system, (see above) dividing the two moieties particularly prominent , hypertrophied columns of Bertin may mimic a renal tumour . It is usually possible to distinguish between the two as the column of Bertin does not affect the renal outline and has the same acoustic characteristics as the adjacent cortex .

Colour or power Doppler are helpful in reveal-ing the normal , reglas vascular pattern (as opposed to the chaotic renal tumours) . If doubt persists , par-ticularly in a symptomatic column of Bertin from differentiates a prominent column of Bertin from tumour . An isotope scan can be also be helpful dem-onstrating normally functioning renal tissue .

These are areas of renal cortex , which from a bulge in the renal outline . Like the hypertrophied column of Bertin , a hump may mimic a renal mass . Careful scanning can usually solve the dilemma as the cortex remains constant in thickness . The most usual manifestation is the splenic hump on the left kidney , which is a flattening of the upper pole with a lateral prominence just below the margin of the spleen .

Humps are basically a variation in the shape of the kidney rather than an area of hypertrophied tissue .[Janes Bates 2011]

2-1-2 Renal Physiology :

The functional renal unit is the nephron, which is composed of the following:

The renal corpuscle: glomerulus and Bowman capsule

Proximal convoluted tubules (PCT, located in the renal cortex)

Descending loop of Henle (LOH)

Ascending limb (which resides in the renal medulla, leading to the thick ascending limb) Thick ascending limb Distal convoluted tubule

Collecting duct (which opens into the renal papilla)

Blood from the afferent glomerular arteriole passes through the juxtamedullary apparatus to the glomerulus. The glomerulus is a network of capillaries that filters blood across Bowman capsule into the proximal convoluted tubule.

The glomerulus contains podocytes and a basement membrane allowing water and certain solutes to be filtered across. This filtrate then reaches the PCT, which reabsorbs glucose and various electrolytes along with water as the filtrate passes through. Meanwhile, after being filtered at the glomerulus, the blood passes into the efferent glomerular arteriole and then descends into the renal pyramid (see the images below).

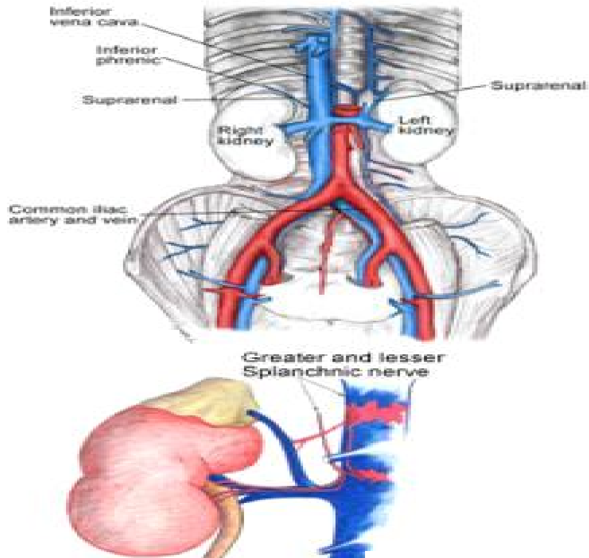

FIG NO : (2-6) Kidneys.

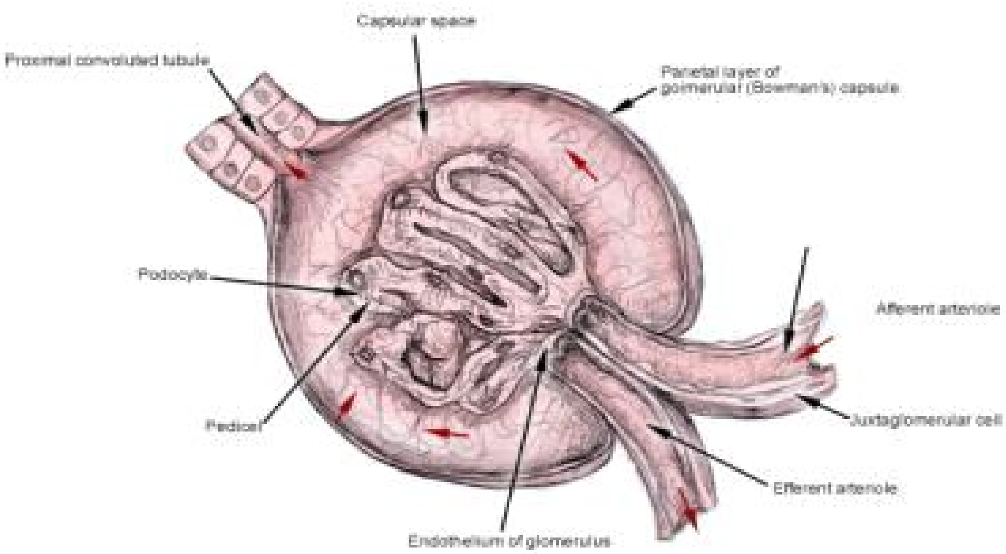

FIG NO (2-7) shows Renal corpuscle.

The renal tubular system is uniquely structured in order to maximize its physiologic function. One of its primary functions is to concentrate urine accordingly to the body's hydro-osmotic state (either hyperosmotic or hypo-osmotic). A hyperosmotic state results in the excretion of hyperosmotic urine, and the reverse is true for when the body is in a hypo-osmotic state. The kidney is able to carry out this function by 2 mechanisms: the action of antidiuretic hormone on the medullary collecting ducts and the phenomenon termed countercurrent multiplication.

Countercurrent multiplication is responsible for keeping the medullary interstitial osmotic concentration higher than the renal tubular osmotic concentration. When the iso-osmotic fluid from the proximal tubule enters the descending limb, the osmotic concentration gradient forces water to move out of the descending limb. By the time the tubular fluid reaches the bottom of the loop of Henle, it has a higher osmotic concentration than the interstitial medullary fluid in the ascending limb. Hyperosmolar tubular fluid entering the ascending limb causes NaCl to be reabsorbed back into the medullary interstitium passively. Once the tubular fluid reaches the thick ascending limb, more ions are reabsorbed into the medullary interstitium actively.

The ion channel responsible for active transport in the thick ascending limb is the Na/K/2Cl transporter. The Na/K/2Cl active ion transporter is responsible for establishing a 200-mOsm/L concentration gradient between the tubular fluid and the interstitial fluid. The repetitive activity of active transport in the thick ascending limb, along with the passive reabsorption of NaCl in the ascending limb, adds more solute to the medulla in excess of water. This process causes a progressive increase in osmotic concentration from the corticomedullary junction (approximately 300-mOsm/L) into the deeper medullary interstitium (approximately 1200-mOsm/L). The elevated interstitial osmotic concentration helps concentrate urine entering the collecting tubules and ducts by increasing water reabsorption.

The vasa recti are a network of capillary vessels that mimic the structure of the loop of Henle. The main function of the vasa recti is to supply the renal medulla its metabolic needs while protecting the countercurrent exchange of the renal tubular system. This is accomplished by low medullary blood flow, allowing the renal medulla to receive the nutrients it needs while also preventing significant losses of solute from the medullary interstitium. In addition, the vasa recti have their own countercurrent exchange mechanism, preventing the washout of solutes from the medullary interstitium.

Once the filtrate gets to the collecting ducts in the medulla of the kidney, they converge to a renal papilla, which represents the tip or apex of the renal pyramid. Urine then collects in typically 9-12 minor calyces, which then converge into 3-4 major calyces (significant variation is possible).

The major calyces then empty into the renal pelvis, which passes urine through the ureteropelvic junction (UPJ) and into the ureter, which then propels urine distally to the bladder through peristalsis. The ureter may course posterior to the renal artery (or a lower pole branch) at its superior point, cross over the psoas muscle, and then pass posterior to the gonadal vessels. As it proceeds further distally, it passes over the iliac vessels and into the pelvis, finally traversing an intramural tunnel into the bladder and ending at the urethral orifice on the trigone of the bladder.[chafferjee ,1990]

2-1-3 Renal pathology :

The kidney is affected by avast multitude of pathological disorders including congenital and hereditary lesions e.g : congenital cystic kidneys

, acute renal trauma , vascular disorders e.g : renal artery stenosis and thrombosis , renal cystic diseases , renal calculus diseases , renal calcification e.g : nephrolithiasis involving the collecting system and nephrocalcinosis which affects the renal cortex in 5% and the medulla in 95% , hydronephrosis , renal obstructive disorders , nephroplastic kidney diseases , the benign type of which include intra – renal medullary fibroma , cortical adenomas , angiomayolipoma , pelvis villous papillary tumors and renin- producing tumors .

The malignant tumors comprised renal cell carcinoma (adenocarcinoma) , nephroplastoma , transitional cell tumors , renal lymphoma leukemia , metastis to the kidneys .

The medical renal diseases include urinary tract infection and pyelonephritis , glomerulonephritis , nephroticsyndrome , collagen renal diseases , amyloidosis , sickle cell disease , tubulointerstitial disease (acute renal and acute tubular necrosis , tubulointerstitial injury due to drugs , toxins , systemic disease and chronic renal failure) . (Roddie**,** 1992]

2-1-4 Clinical feature of Chronic Renal Failure :

Early identification and active management of patients with renal impairment in primary care can improve outcomes

The number of patients with end stage renal disease is growing worldwide. About 20-30 patients have some degree of renal dysfunction for each patient who needs renal replacement treatment. Diabetes and hypertension are the two most common causes of end stage renal disease and are associated with a high risk of death from cardiovascular disease.

Mortality in patients with end stage renal disease remains 10-20 times higher than that in the general population. The focus in recent years has thus shifted to optimising the care of these patients during the phase of chronic kidney disease, before the onset of end stage renal disease. This review summarises current knowledge about the various stages of chronic renal disease, the risk factors that lead to progression of disease, and their association with common cardiovascular risk factors. It also provides strategies for intervention at an early stage of the disease process, which can readily be implemented in primary care, to improve the overall morbidity and mortality associated with chronic renal disease.[Wlliam Boyed,1984]

2-1-4-1 Diagnosis

Chronic renal failure is defined as either kidney damage or glomerular filtration rate less than 60 ml/min for three months or more. This is invariably a progressive process that results in end stage renal disease.

Serum creatinine is commonly used to estimate creatinine clearance but is a poor predictor of glomerular filtration rate, as it may be influenced in unpredictable ways by assay techniques, endogenous and exogenous substances, renal tubular handling of creatinine, and other factors (age, sex, body weight, muscle mass, diet, drugs).[3]Glomerular filtration rate is the "gold standard" for determining kidney function, but its measurement remains cumbersome. For practical purposes, calculated creatinine clearance is used as a correlate of glomerular filtration rate and is commonly estimated by using the Cockcroft-Gault formula or the recently described modification of diet in renal disease equation .[Robbin,1993]

2-1-4-2 Stages of chronic renal disease

Chronic renal disease is divided into five stages on the basis of renal function. Pathogenesis of progression is complex and is beyond the scope of this review. However, renal disease often progresses by “common pathway” mechanisms, irrespective of the initiating insult. In animal models, a reduction in nephron mass exposes the remaining nephrons to adaptive haemodynamic changes that sustain renal function initially but are detrimental in the long term. [FleischerJame, 1999].

2-1-4-3 Early dettection

Renal disease is often progressive once glomerular filtration rate falls by 25% of normal. Early detection is important to prevent further injury and progressive loss of renal function.

Patients at high risk should undergo evaluation for markers of kidney damage (albuminuria , abnormal urine sediment, elevated serum creatinine) and for renal function (estimation of glomerular filtration rate from serum creatinine) initially and at periodic intervals depending on the underlying disease process and stage of renal disease. Potentially reversible causes should be identified and effectively treated if a sudden decline in renal function is observed.[Robbin ,1999]

2-1-4-4 Risk factors of chronic renal faluier :

2-1-4-4-1 Diabetes

Diabetes is a common cause of chronic renal failure and accounts for a large part of the growth in end stage renal disease in North America. Effective control of blood glucose and blood pressure reduces the renal complications of diabetes.

Meticulous control of blood glucose has been conclusively shown to reduce the development of microalbuminuria by 35% in type 1 diabetes (diabetes control and complications trial) and in type 2 diabetes (United Kingdom prospective diabetes study). Other studies have indicated that glycaemic control can reduce the progression of diabetic renal disease. Adequate control of blood pressure with a variety of antihypertensive agents, including angiotensin converting enzyme inhibitors, has been shown to delay the progression of albuminuria in both type 1 and type 2 diabetes. Recently, angiotensin receptor blockers have been shown to have renoprotective effects in both early and late nephropathy due to type 2 diabetes. shows strategies for managing diabetic nephropathy.[CarloMatson,1998]

2-1-4-4-2 Hypertension

Hypertension is a well established cause, a common complication, and an important risk factor for progression of renal disease. Controlling hypertension is the most important intervention to slow the progression of renal disease.[w4]

Any antihypertensive agents may be appropriate, but angiotensin converting enzyme inhibitors are particularly effective in slowing progression of renal insufficiency in patients with and without diabetes by reducing the effects of angiotensin II on renal haemodynamics, local growth factors, and perhaps glomerular permselectivity. Non-dihydropyridine calcium channel blockers have also been shown to retard progression of renal insufficiency in patients with type 2 diabetes. Recently, angiotensin receptor blockers (irbesartan and losartan) have been shown to have a renoprotective effect in diabetic nephropat.hy, independent of reduction in blood pressure. Early detection and effective treatment of hypertension to target levels is essential . The benefit of aggressive control of blood pressure is most pronounced in patients with urinary protein excretion of >3 g/24 hours.[Jeffry ,1993]

2-1-4-4-3 Proteinuria

Proteinuria, previously considered a marker of renal disease, is itself pathogenic and is the single best predictor of disease progression. Reducing urinary protein excretion slows the progressive decline in renal function in both diabetic and non-diabetic kidney disease.

Angiotensin blockade with angiotensin converting enzyme inhibitors or angiotensin receptor blockers is more effective at comparable levels of blood pressure control than conventional antihypertensive agents in reducing proteinuria, decline in glomerular filtration rate, and progression to end stage renal disease. [Carol, 1996]

2-1-4-4-4 Intake of dietary protein

The role of dietary protein restriction in chronic renal disease remains controversial. The largest controlled study initially failed to find an effect of protein restriction, but secondary analysis based on achieved protein intake suggested that a low protein diet slowed the progression. However, early dietary review is necessary to ensure adequate energy intake, maintain optimal nutrition, and avoid malnutrition.[Inderbir, 1989]

2-1-4-4-5 Dyslipidaemia

Lipid abnormalities may be evident with only mild renal impairment and contribute to progression of chronic renal disease and increased cardiovascular morbidity and mortality. A meta-analysis of 13 controlled trials showed that hydroxymethyl glutaryl coenzyme A reductase inhibitors (statins) decreased proteinuria and preserved glomerular filtration rate in patients with renal disease, an effect not entirely explained by reduction in blood cholesterol.Inderbir ,1989]

2-1-4-4-6 Phosphate and parathyroid hormone

Hyperparathyroidism is one of the earliest manifestations of impaired renal function, and minor changes in bones have been found in patients with a glomerular filtration rate of 60 ml/min. Precipitation of calcium phosphate in renal tissue begins early, may influence the rate of progression of renal disease, and is closely related to hyperphosphataemia and calcium phosphate (Ca×P) product. Precipitation of calcium phosphate should be reduced by adequate fluid intake, modest dietary phosphate restriction, and administration of phosphate binders to correct serum phosphate. Dietary phosphate should be restricted before the glomerular filtration rate falls below 40 ml/min and before the development of hyperparathyroidism. The use of vitaminD supplements during chronic renal disease is controversial.[Jeffry ,1990]

2-1-4-4-7 Smoking

Smoking, besides increasing the risk of cardiovascular events, is an independent risk factor for development of end stage renal disease in men with kidney disease. Smoking cessation alone may reduce the risk of disease progression by 30% in patients with type 2 diabetes. [Jane Bates ,2011]

2-1-4-4-8 Anaemia

Anaemia of chronic renal disease begins when the glomerular filtration rate falls below 30-35% of normal and is normochromic and normocytic. This is primarily caused by decreased production of erythropoietin by the failing kidney,[23] but other potential causes should be considered. Whether anaemia accelerates the progression of renal disease is controversial. However, it is independently associated with the development of left ventricular hypertrophy and other cardiovascular complications in a vicious cycle .

Perpetuating triad of chronic kidney disease, anaemia, and cardiovascular disease (LVH=left ventricular hypertrophy; LVD=left ventricular dilatation)

Treatment of anaemia with recombinant human erythropoietin may slow progression of chronic renal disease but requires further study. Treatment of anaemia results in partial regression of left ventricular hypertrophy in both patients with pre-end stage renal disease and patients receiving dialysis and has reduced the frequency of heart failure and hospitalisation among patients receiving dialysis.

Both National Kidney Foundation and European best practice guidelines recommend evaluation of anaemia when haemoglobin is <11 g/dl and consideration of recombinant human erythropoietin if haemoglobin is consistently <11 g/dl to maintain a target haemoglobin of >11 g/dl. [Wliam Boyd ,1984]

2-1-4-4-9 Prevention or attenuation of complications and comorbidities

- **Malnutrition**

The prevalence of hypoalbuminaemia is high among patients beginning dialysis, is of multifactorial origin, and is associated with poor outcome. Hypoalbuminaemia may be a reflection of chronic inflammation rather than of nutrition in itself. Spontaneous intake of protein begins to decrease when the glomerular filtration rate falls below 50 ml/min. Progressive decline in renal function causes decreased appetite, thereby increasing the risk of malnutrition. [Jeffry,1995]

2-2 previous studies

2-2-1 Age Affects Outcomes in Chronic Kidney Disease

Chronic kidney disease (CKD)—or chronic renal failure (CRF), as it was historically termed—is a term that encompasses all degrees of decreased renal function, from damaged–at risk through mild, moderate, and severe chronic kidney failure. CKD is a worldwide public health problem. In the United States, there is a rising incidence and prevalence of kidney failure, with poor outcomes and high cost .

CKD is more prevalent in the elderly population. However, while younger patients with CKD typically experience progressive loss of kidney function, 30%% of patients over 65 years of age with CKD have stable disease,CKD is associated with an increased risk of cardiovascular disease and chronic renal failure. Kidney disease is the ninth leading cause of death in the United States.[Ohare,2005]

2-2-2 Socio-economic status and chronic renal failure:

Low socio-economic status is associated with an increased risk of chronic renal failure. The moderate excess was not explained by age, sex or occupation. Thus socioeconomic status appears to be an independent risk indicator for chronic renal failure in Sweden.[Robbin,2002]

Chapter three

Materials and methods :

3-1 Methods :

3-2-1 study design

It is descriptive study in which the researcher selected one hundred patients with different renal problems to find out how many of them were suffering from chronic renal failure and the classical sonographic appearance of chronic renal failure in the selected cases .

.3-1-2 the study area

The area of study is diagnostic centre at Kosti teaching hospital , White Nile State (Sudan) .

3-1-3 The study duration :

Is joining to be carried out during the period from October the first 2015, – to the end of October 2016 .

3-1-4 **Study population :**

All patients complaining of renal symptoms referred to the above mentioned center .

3-1-5 Study team :

The team consist of me (the author) , Dr. Alla Aldeen Abas (nephrologists) , Ali Ahmed and Mohammed Basher (lab technician) .

3-1-6 Ultrasound technique :

The kidney are best evaluated with ultrasound by first obtaining an LS of the kidney , including the upper and lower poles , with the kidney roughly perpendicular to the beam . This may necessary to scan from the positions , and it using various angles and patient positions , and it may be necessary to scan from the posterior aspect . Finding the maximum length at the start of the procedure , by twisting the probe to include both poles , enables the operator to establish the lie of the kidney and provides a good starting point from which to fully and carefully evaluate the organ . In this way the operator is less to miss pathol-ogy or underestimate renal length .

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 (LK) is not usually demonstrable in a true sagittal plane 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 pelvi-cayceay system 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 and the operator must be flexible in his/her approach to obtain the necessary results .

The bladder should be filled and examined to complete the renal tract scan . An excessively full bladder may cause mild dilatation of the pelvical-yceal system , which will return to normal follow-ing micturition . [janebates,2011]

3-1-6-1 Investigation protocols :

The following technique was applied to allow visualization of both kidneys and pelvic ureter .

- **Patients preparation** : none .

Transducer (curved) for mid large patient 3.5 MHZ & 5MHZ for very thin patient .

- **Patient position :**

Supine , left lateral oblique , left lateral decubitus .

- **Initial approach RT kidney :**

Longitudinal section – patient supine , transducer positioned directly below the costal margin in the mid clavicular line , beam postioning slightly cephalic . Respiratory maneuver deep inspiration and protrusion of antier abdominal wall .

- **Scanning procedure :**

Spread out gel with patient's skin , patient in quite respiration , survey the area , went to initial scanning position , initial respiratory maneuver , transducer moved smoothly along the costal margin , angling slightly to words the lateral edge of the liver . Sometimes repertory maneuver or patient position (oblique or decubitus changed) . Located upper pole of the kidney – stop – look – located lower pole of the kidney – stop – look – rotate transducer to join upper and lower poles . The transducer moved cephalic or caudal to position the kidney in the center of display . Beam angled slightly from side to side sweeping through the long section of the kidney . The last step was repeated two or three times , focusing on center of collecting system image was appear in long section and was measured by bipolar distance .[Wiliam Boyd .1984]

- **Scanning approach :**
- **Transverse section :**

Assessed angulations and position of transducer in long section transducer rotated 90° , maintain angulation .

- **Scanning procedure :**

Transducer swept cephalic and caudal to assess central collecting system . Image was appeared in transverse section at mid portion of the kidney .

- **Problem solving – right kidney :**

When air in the right hepatic flexure of the colon obscures kidney changed respiratory maneuver and watched renal movement . Also changed patient position (wall use gravity to pull loops artier and moved kidney out from under the ribs). Positioned transducer above the iliac crest and employ coronal , If the kidney is not visualized used either inter costal approach using right lobe of liver as caustic window .[Wliam Boyd ,1984]

- **Problem solving – left kidney :**

Air in the left hepatic flexure of colon obscures kidney : transducer moved to amore postior approach . Also changed respiratory maneuver , patient position (gravity pulls kidneys for ward) , transducer position at the iliac crest , moved antier and angled back slightly .[Wiliam Boyd,1984]

3-1-6-2 Normal ultrasound appearances of the kidneys:

The cortex of the normal kidney is slightly hypoe-choic when compared to the adjacent liyer paren-chma , 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 thinner . The medullary pyramids are seen as regularly spaced , hypoechoic (not echo-free) triangular strucaures between the cortex and the renal sinus . The tiny reflective struc-tures often seen at the margins of the pyramids are echoes from the arcuate which branch around the pyramids .

The renal sinus containing the pelvicalyceal system is hyperechoic due to sinus fat which sur-round 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 pel-vicalyceal dilatation . Colour Doppler can help differentiate .

The kidney develops in the fetus from a number of lobes that fuse together . Occasionally the traces of these lobes can be seen on the surface of the kidney , forming fetal lobulations ; these may persist into adulthood . The issue for the sonographer is being able to recognise these as normal variations , as distinct from a renal mass ,or renal scarring . [janebates,2011]

3-1-6-3 Normal ultrasound appearances of the lower renal tract:

When the bladder is distended with urine , the walls are thin , regular and hyperechoic . The walls may appear thickened or trabeculated if the bladder lesion . The ureteric orifsbeices can be demonstrated in a transvers section at the bladder base . Ureteric jets can easily be demonstrated with colour Doppler at this point and normally occur between 1.5 and 12.4 times per minute (a mean of 5.4 jets per minute) from each side .

It is useful to examine the pelvis for other masses , e.g related to the uterus causing prox-mal dilatation . The prostate is demonstrated transabdominally angling caually through the full bladder . The investigation of choice for the prostate is transrectal ultrasound , however , an approximate idea of its size can be gained from transabdominal scanning .

When prostatic hypertrophy is suspected , it is useful to perform a post-mictruition bladder volume measurement to determine the residual volume of urine .[Janebates,2011] .

3-1-6-4 Measurements :

The normal adult kidney measures between 9 cm and 12 cm in length . A renal length outside the normal rage may be an indication of a pathological process and measurements should therefore form part of the protocol of renal scanning . Tech-nigue is extremely important if the renal length is not to be underestimated (see above) . Obtaining the maximum renal length may involve an inter-costal scan with rib shadowing over the central portion of the kidney , or may necessitate scanning from the posterior of the patient . A subcostal section , which foreshortens the kidney , often underestimates the length and it is more accurate to measure a coronal or posterior longitudinal section with the beam perpendicular to the renal axis .

The cortical thickness of the kidney is generally taken as the distance between the capsule and the margin of the medullary pyramid . This varies between individuals and within individual kidney , and tends to decrease with age .

The bladder volume can be estimated for most purposes by taking the product of three perpendicular measurements and multiplying by 0.56 .

Bladder volume (ML) = Length × width × Ap diameter(cm)× 0.56 [Janebates,2011]

3-1-6-5 Haemodynamic :

The vascular tree of the kidney can be effectively demonstrated with colour Doppler . By manipulating the system sensitivity and using a low PRF , small vessels can be demonstrated at the periphery of the kidney .

Demonstration of the extrarenal main artery and vein with colour Doppler is most successful in the renal hilum and tracing the artery back to the aorta or the vein to the IVC . The best Doppler signal – i.e , the highest Doppler shift frequen-cies – are obtained when the direction of the vessel is parallel to the beam , and taken on suspended respiration . The LRV is readily demonstrated between the SMA and aorta by scanning just below the body of the pancreas in transverse section . The origins of the renal arteries may be seen arising from the aorta in a coronal section .

The normal adult renal vasculature is of low resistance with a fast , almost vertical systolic upstroke and continuous forward end diastolic flow . Resistance generally increases with age . The more peripheral arteries are of lower velocity with weaker Doppler signals , and are less pulsatile than the main vessel . (Jane Bates,2011).

3-1-7 **Method of data collection :**

The study will follow the scientific method to collect the related information from different sources namely references , text books , internet service and patients data collecting sheet after told them and keeping their privacy.

3-1-7-1 Lab Data :

Urine analysis was performed by lab technician for all patients include in the study .

Serum creatinine and blood urea levels were performed on those suspected to have chronic renal failure .

3-1-7-2 ultra Sound evaluation :

All patients include in the study were scanned by me (the author) and all positive renal ultra sound findings (pathology) was rescanned by sinologist to confirm the diagnosis .

3-1-7-3 patients data sheet

3-1-8- methods of Data Analysis :

The data was statistically performed by using computer programs mainly SPSS version 14 .

3-2 Materials :

3-2 Equipments (material) :

The equipment use in the study include Shemadzu just vision 200 , esote my lab 50 X vision , esote my lab 20 X vision , sonoscape A5 and sonoscape A6 .

Chapter Four

Results

This study was carried out on one hundred patients complaining of renal impairment and who differ in age , gender ,residence, occupations ,and socio-economic status that were evaluated by ultrasound

Table 4-1 shows the patient's ages.

Age in year	Percent
21- 30	5
31-40	40
41-50	4
51-60	6
61-70	45
Total	100

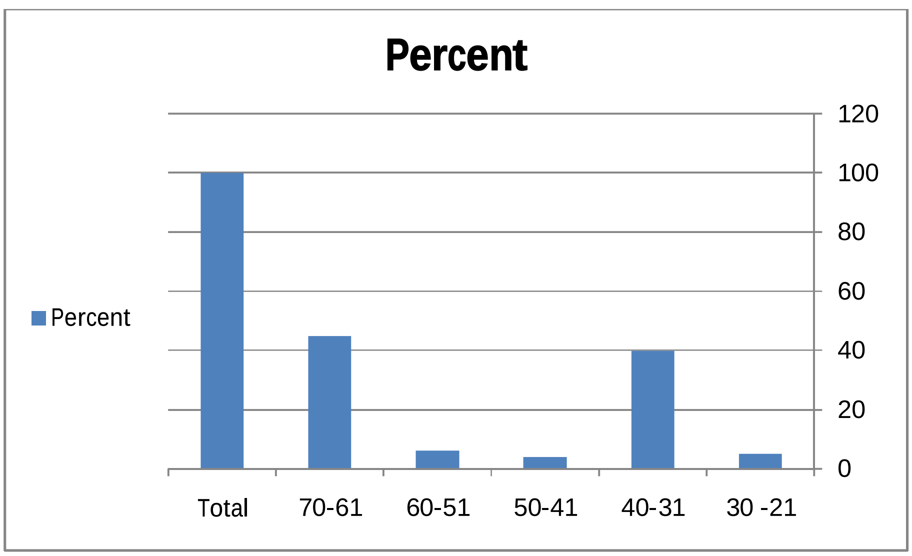

Fig .No(4-1) shows the patient's ages.

Table (4-2) shows patients gender.

Patient gender	Percent
Male	71
Female	29
Total	100

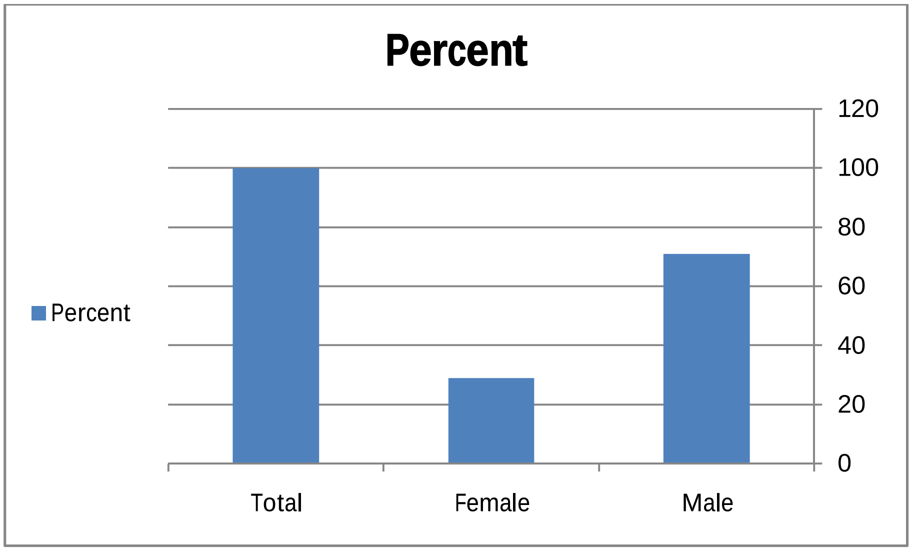

Fig .No(4-2)shows patients gender

Table (4-3) shows the patients residence.

The Residence	Percent
Elgazera Aba city	56
Rabak city	26
Kosti city	10
Surrounding area	8
Total	100

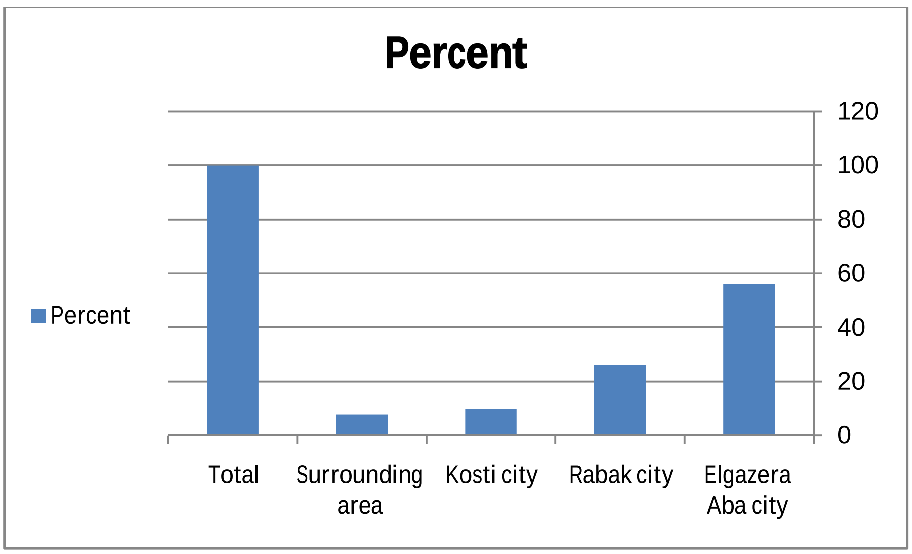

Fig .No(4-3)shows patients residence

Table (4-4) shows the patients occupations.

The occupation	**Percent**
Famers	28
House wife	22
Labors	17
Non skilled employee	10
Skilled employee	11
Business man	12
Total	100

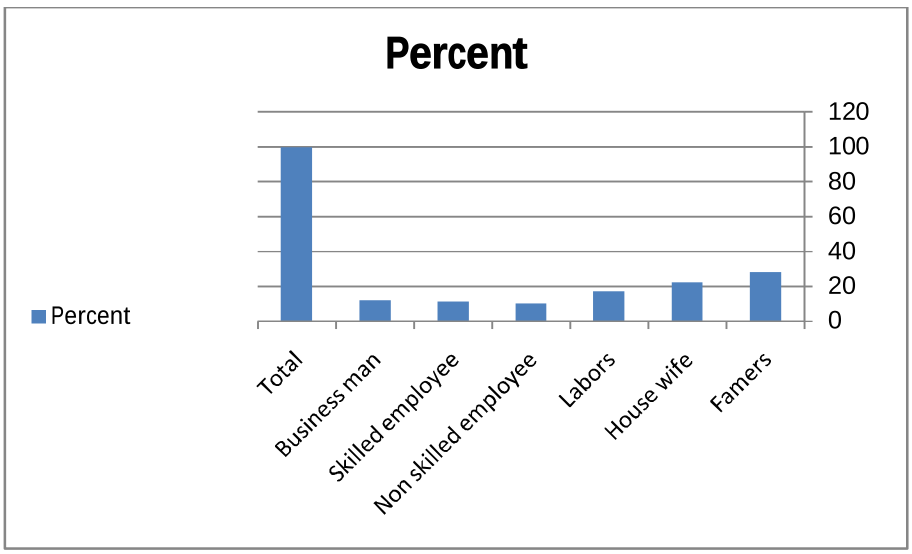

Fig .No(4-4)shows patients occupations

Table (4-5) shows the clinical symptoms of the patients.

Clinical symptoms	**Percent**
Haematurea	15
Lions pain	11
Vomiting	12
Face puffiness	14
Anorexia	9
Bon aches	13
Urgency	8
Poly urea	7
Burning micturation	12
Cough	10
Total	100

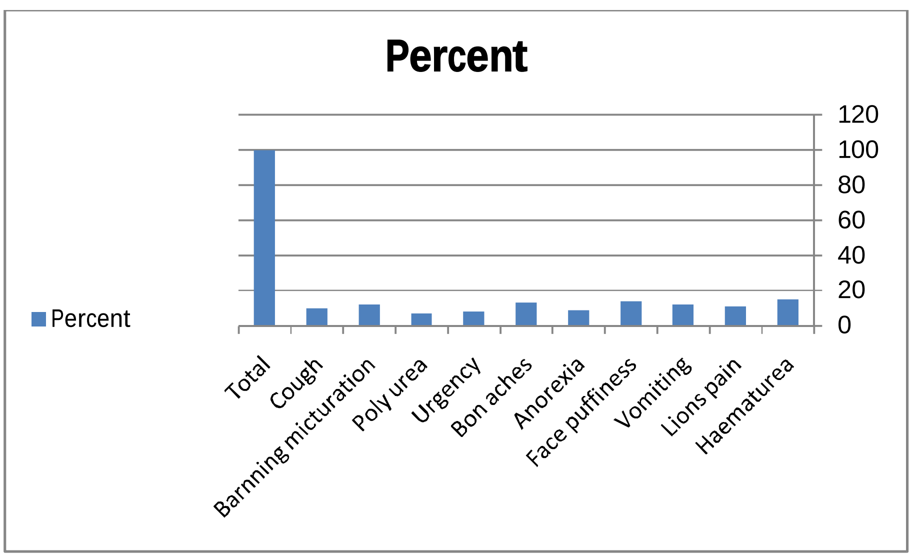

Fig .No(4-5) shows the clinical symptoms of the patients

Table No[4-6] shows patients urinary disorders

Urinary disorders	Percent
Poly cystic kidney disease	19
Renal stones	33
hydronephrosis	13
Renal cyst	5
Increase serum creatinine	25
Increase pus cells in urine	5
total	100

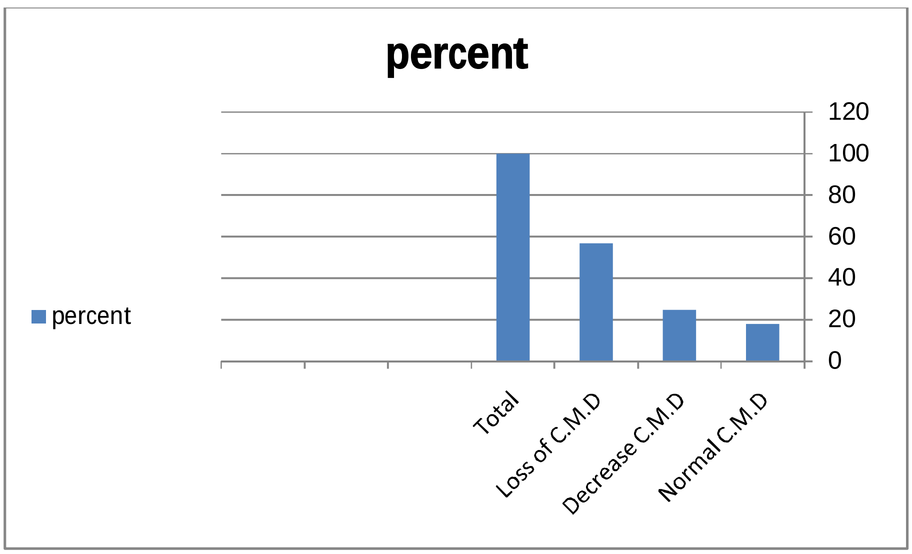

Fig No[4-6] shows patients urinary disorders

Table (4-7)show ultrasound appearance of the patients kidneys size

Kidney size	**Percent**
Normal size	25
Average size	11
Shrinking kidneys	57
Hypoplasia	7
Total	100

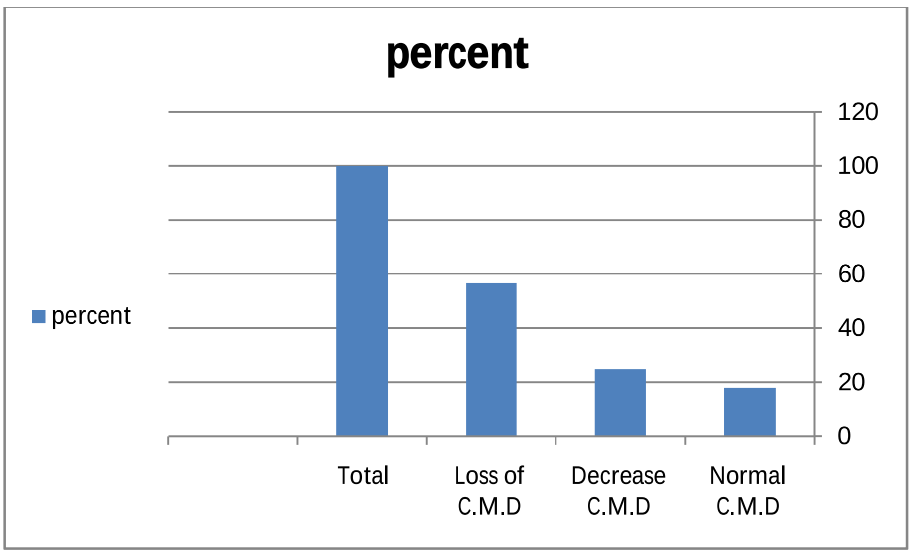

Fig (4-7) show ultrasound appearance of the patients kidneys size

Table [4-8] shows ultrasound appearance of corticomedullary diffrentiation [C.M.D] of the kidneys

Ultrasound appearance	percent
Normal C.M.D	18
Decrease C.M.D	25
Loss of C.M.D	57
Total	100

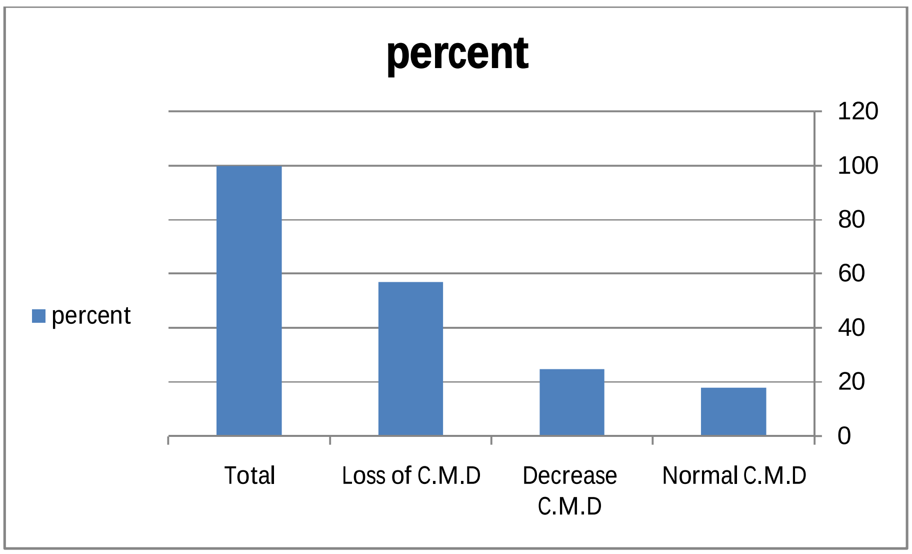

Fig [4-8] shows ultrasound appearance of corticomedullary diffrentiation [C.M.D] of the kidneys

Chapter Five

Discussion, Conclusion, Recommendations, References And Appendix

5-1 Discussion :

From the collective finding data of this study the more effected age lied between (61-70) year as shows in table (4-1]. this means chronic renal failure affected the elderly people more than other age group, and this result was consist with D.AnnO.Hare [2oo8]. The study explained that chronic renal failure is more common in males (71%) than females (29%) as shown in table (4-2) .and this result may due to increase risk factor to male than female .this result was consist with D.AnnOhare[2007 U.S.A].

According to the residences Aljazeera aba patients are more affected (56%) than , Rabak City (26%) , Kosti City (10) and surrounding area (8%) as shown in table (4-3) . and this may due to drinking polluted water from Aslaia and Kenana sugar factories.

The farmers patients in this study are more affected (28%) than, house wives (22%) , labors (17%) , non skilled employees (10%), skilled employees (11%) and business men (12%) as shows in table (4-4) .and this result was not consist with previous studies .

Patients with chronic renal failure were came with different .urinary disorders and the more common are the increase of serum creatinine 25 % ,polycystic kidney disease 19% , renal stones 33% , ,hydronephrosis 13%, renal cyst 5 % and increase pus cells in urine 5% that showing in table (4-6) .

The study was explained that patients with low socio-economic status are more affected than who’s with high socio-economic status. And this result was consist with D.Robbin [2002, Sweden].

Study explained that 57 % of the patients were presented with shrinking kidneys, loss of corticomedally differentiation [C.M.D] in ultrasound and increased serum creatinine in urine as shown in table [4-8] .This result is atypical features of chronic renal failure. The study showed that (25%) of the patients presented with normal kidney size and decrease [C.M.D] And this result consider as a features of Acute renal failure, and (18%) of the patient presented with normal C.M.D and normal kidneys size with pus cells in urine as well as others simple masses and this was classified as either inflammatory or hiridatry disorders.

5-2 conclusion :

The aim of that descriptive study was to know the role of ultrasonography in evaluation of chronic renal failure .the researcher was analyzed all the results and compared it to previous studies. the study was explained that ultasonography is available , relatively low cost and absence of ionizing radiation with a good role in evaluation of chronic renal failure .

5-3 Recommendations :

- The study recommended that ultrasound examinations should be a routine examination when there is suspicion of renal impairment.

- All patients with risk factor to chronic renal must be undergo ultasonography before being investigated by other modalities.

- The study recommended that further studies with large sample must be made in the same topic to know more about the role of ultrasonography in evaluation of chronic renal failure.

5-4 References :

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5-5 Appendix

Patients collecting data sheet

1.patients number [ ]

2.Patients age [ ]

3.Patients gender a. male [ ] b. female[ ]

4.Patients occupation

a. biasness man [ ] b. farmer [ ]c. house wife[ ] d. labers [ ] d .others [ ]

5.patients socio-economic status

a. high [ ] b. low [ ]

6.ultrasound a appearance of the kidneys size

a. normal [ ] b. decrease[ ] c. shrinking [ ] d. hypoplasia [ ]

7.Corticomedullay differentiation of the kidneys on ultrasound [C.M.D]

a. normal [ ] b. decrease [ ] c .loss [ ]

8.labrotary test for urea and creatinine

a. normal [ ] b. high [ ]