Chapter One

1.1: Introduction:

The term diabetes mellitus describes a metabolic disorder of multiple etiologies characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both. The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs. Diabetes mellitus may present with characteristic symptoms such as thirst, polyuria, blurring of vision, and weight loss. In its most severe forms, ketoacidosis or a non-ketotic hyperosmolar state may develop and lead to stupor, coma and, in absence of effective treatment, death. Often symptoms are not severe, or may be absent, and consequently hyperglycemia sufficient to cause pathological and functional changes may be present for a long time before the diagnosis is made. The long-term effects of diabetes mellitus include progressive development of the specific complications of retinopathy with potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with risk of foot ulcers, amputation, Charcot joints, and features of autonomic dysfunction, including sexual dysfunction. People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebro-vascular disease. (WHO 1995)

There are three main types of diabetes:

- Type 1 diabetes: results from the body's failure to produce insulin, and presently requires the person to inject insulin. (Also referred to as insulin-dependent diabetes mellitus IDDM, and juvenile diabetes.)
- Type 2 diabetes: results from insulin resistance, a condition in which cells fail to use insulin properly, sometimes combined with an absolute insulin deficiency. (Formerly referred to as non-insulin-dependent diabetes mellitus NIDDM, and adult-onset diabetes.)

- Gestational diabetes: is when pregnant women, who have never had diabetes before, have a high blood glucose level during pregnancy. It may precede development of type 2 DM. (http://www.diabetesbluecircle.org/)

The kidney acts as a filter of the blood, removing the wastes from the blood. Over years of high blood sugar levels, damage occurs to the fine blood vessel walls in the kidney filters, and these filters become leaky the earliest sign of diabetic damage to kidneys is protein in the urine. A urine and blood test is performed to check for this. The presence of microalbuminuria, or an albumin : creatinine ratio greater than 2.5 in a diabetic is suggestive of diabetic kidney damage (diabetic nephropathy). Further damage to the fine filters in the kidney can lead to blood leaking into the urine. Usually only a small amount of blood leaks, too small amount to see with the eye, and requires laboratory testing, or looking at a urine sample under a microscope. (www.kidney.net.nz**)**

During DM, the blood vessels in the kidney become leaky. These leaky vessels will allow the flow/loss of proteins in the urine. Some of the vessels may collapse and results in more pressure on those that remains under this increased work load. The remaining blood vessels will also be damaged, finally leading to kidney failure. Thus, the person may have to go on dialysis or undergo a kidney transplant. The first symptoms are related to the direct effects of high blood sugar levels. When the blood sugar level rises above 160 to 180 mg/dL, sugar spills into the urine. When the level of sugar in the urine rises even higher, the kidneys excrete additional water to dilute the large amount of sugar. Because the kidneys produce excessive urine, people with diabetes urinate large volumes frequently (polyuria). The excessive urination creates abnormal thirst (polydipsia). Because excessive calories are lost in the urine, people lose weight. To compensate, people often feel excessively hungry. Other symptoms include blurred vision, drowsiness, nausea, and decreased endurance during exercise. (www.medscape.com).

Diabetes is one of the most common causes of CKD, and can produce damage in the kidneys, heart, eyes ,blood vessels and nerves . One way in which diabetes causes damage is by exposing organs and tissues to high blood sugar levels over prolonged periods of time. Therefore, strict blood sugar control is vitally important in minimizing organ damage from diabetes. This is achieved by a

combination of dietary control and the use of oral medications and/or insulin. Careful dietary restriction and constant monitoring of blood sugars are essential .Diabetic kidney disease takes many years to develop. In some people, the filtering function of the kidneys is actually higher than normal in the first few years of their diabetes. Over several years, people who are developing kidney disease will have small amounts of the blood protein albumin begin to leak into their urine. This first stage of CKD is called microalbuminuria. The kidney's filtration function usually remains normal during this period. As the disease progresses, more albumin leaks into the urine. This stage may be called macroalbuminuria or proteinuria. As the amount of albumin in the urine increases, the kidneys' filtering function usually begins to drop. The body retains various wastes as filtration falls. As kidney damage develops, blood pressure often rises as well. Overall, kidney damage rarely occurs in the first 10 years of diabetes, and usually 15 to 25 years will pass before kidney failure occurs. For people who live with diabetes for more than 25 years without any signs of kidney failure, the risk of ever developing it decreases (National Kidney and Urologic Diseases Information Clearinghouse, NIH Publication No. 08-3925 September 2008)

Diabetes and chronic kidney disease (CKD) are two clinical entities with important medical and socio-economical implications. Diabetic prevalence is growing and considering that 40% in western countries, over of type II diabetics are at risk for developing diabetic nephropathy 45% of all patients in renal replacement therapy are diabetics. Therefore, continuous researches are made in order to diagnose early kidney damage in diabetes. Microalbuminuria is diabetic as the „gold standard" for the diagnostic of DN, according with the K-DOQI criteria for DN, published in diabetic 2007 in American Journal of Kidney Diseases. In this important paper it is mentioned that imagistic examinations are important for evaluation of early diabetic kidney disease. (www.kidney.org*/professionals/kdoqi/*).

Ultrasound is one of the most used imagistic examinations in nephrology. In order to establish a precise diagnosis in acute or chronic kidney disease, Renal ultrasound has become the standard imaging modality in the investigation of kidneys because it offers excellent anatomic detail, requires no special preparation of patients .it is readily available and does not expose the patient to radiation or contrast agent.

Ultrasound is used to determine the site and size of the kidney and to detect focal lesions, the presence of renoparenchymatous disease, however most glomerular diseases cannot be further sub classified. Exceptions are primarily renovascular disorders like hypertensive nephrosclerosis, diabetic nephropathy or renal vaculities which can be suspected if the intrarenal resistance index value is increased. (Radermacher J (2003) Ultrasonography of the kidney and the renal vessels Part I). In this study we use the ultrasound to describe the shape, measure the size and general kidney appearance the echogenicity of diabetic patient.

1.2: Problem of the study:

The ultrasound is one of best modality that used in diagnosis of kidney disease, Diabetic mellitus has severe effect on kidney, which can lead to loss their function, by changing its manner of both secretion and execration of filtered blood component, examination of diabetic mellitus patient kidney earlier it is important in diagnosis and treatment.

1-3 Objectives:

The general objective of this study is to evaluate the diabetic mellitus effect on the kidney in order to predict early management of the effect.

Specific objectives

- To measure kidney size, parenchymal thickness in diabetic patient.
- To evaluate shape and echotexture.
- To correlate between the diabetes duration, age and the effect.

1.4: Significance of study:

The study was highlight on evaluation of the effect received by kidney in diabetic patient using ultrasound examination by measuring of the kidney size and evaluation of morphological characteristic of kidney in duration of the diabetes Miletus therefore prediction of the early management of these effect.

1.5 material and methods:

1.5.1 Material:

1. Ultrasound Machine:

Ultrasound machine which used in this study were Esaote MyLab7™40 and General electric logic7 contain phased , convex, linear, Doppler pencil and endocavitary probes. Multi-frequency broadband transducers (up to 15 MHz).color flow map, power, continues and pulsed wave Doppler technique.

2. **Data sheet**

Done by mater collecting data sheet

1-5-2 Methodology:

This study is a practical study, will include samples of 50 patients.

1-5-3 the study area:

The study done in Elshafa medical center in Khartoum & Elfasial specialized hospital.

1-5-4 Duration of the study:

The duration of the study is six month.

1-6: Overview of the study:

This study consists of five chapters; with chapter one is an introduction introduce briefly this thesis and contained (introduction, problem of study also contain general objective, specific objectives, significant of study and overview of the study). Chapter two is literature review which includes theoretical background and the previous study about the kidney ultrasound finding in patient with diabetes Miletus. Chapter three was describe the methodology (material, method) that used in this study. Chapter four included result presentation; chapter five is discussion, conclusion and recommendations for future scope in addition to references and appendices.

Chapter Two

Literature review

Firstly we will review the embryology, anatomy, physiology, ultrasound technique for kidneys and sonographic features of kidney and secondly the pathological features in this organ in diabetic patient and previous studies.

2-1 embryology of the kidney:

Kidney development, or nephrogenesis, describes the embryologic origins of the kidney, a major organ in the urinary system. It is often considered in the broader context of the development of the urinary and reproductive organs.

2-1-1 Phases:

The development of the kidney proceeds through a series of successive phases, each marked by the development of a more advanced kidney: the pronephros, mesonephros, and metanephros. The pronephros is the most immature form of kidney, while the metanephros is most developed. The metanephros persists as the definitive adult kidney.

This filtrate flows through the mesonephric tubule and is drained into the continuation of the pronephric duct, now called the mesonephric duct or Wolffian duct. The nephrotomes of the pronephros degenerate while the mesonephric duct extends towards the most caudal end of the embryo, ultimately attaching to the cloaca. The mammalian mesonephros is similar to the kidneys of aquatic amphibians and fishes.

Pronephros: The pronephros develops in the cervical region of the embryo. During approximately day 22 of human gestation, the paired pronephros appear towards the cranial end of the intermediate mesoderm. In this region, epithelial cells arrange themselves in a series of tubules called nephrotomes and join laterally with the pronephric duct. This duct is fully contained within the embryo and thus cannot excrete filtered material outside the embryo; therefore the pronephros is considered nonfunctional in mammals.

Mesonephros: The development of the pronephric duct proceeds in a cranial-to-caudal direction. As it elongates caudally, the pronephric duct induces nearby intermediate mesoderm in the thoracolumbar area to become epithelial tubules

called mesonephric tubules. Each mesonephric tubule receives a blood supply from a branch of the aorta, ending in a capillary tuft analogous to the glomerulus of the definitive nephron. The mesonephric tubule forms a capsule around the capillary tuft, allowing for filtration of blood.

Metanephros: During the fifth week of gestation, the mesonephric duct develops an outpouching, the ureteric bud, near its attachment to the cloaca. This bud, also called the metanephrogenic diverticulum, grows posteriorly and towards the head of the embryo. The elongated stalk of the ureteric bud, called the metanephric duct, later forms the ureter. As the cranial end of the bud extends into the intermediate mesoderm, it undergoes a series of branchings to form the collecting duct system of the kidney. It also forms the major and minor calyces and the renal pelvis.The portion of undifferentiated intermediate mesoderm in contact with the tips of the branching ureteric bud is known as the metanephrogenic blastema. Signals released from the ureteric bud induce the differentiation of the metanephrogenic blastema into the renal tubules. As the renal tubules grow, they come into contact and join with connecting tubules of the collecting duct system, forming a continuous passage for flow from the renal tubule to the collecting duct. Simultaneously, precursors of vascular endothelial cells begin to take their position at the tips of the renal tubules. These cells differentiate into the cells of the definitive glomerulus. In humans, all of the branches of the ureteric bud and the nephronic units have been formed by 32 to 36 weeks of gestation. However, these structures are not yet mature, and will continue to mature after birth. Once matured, humans have an estimated one million nephrons (approximately 500,000 per kidney).

Migration: After inducing the metanephric mesenchyme the lower portions of the nephric duct will migrate caudally (downward) and connect with the bladder, thereby forming the ureters. The ureters will carry urine from the kidneys to the bladder for excretion from the fetus into the amniotic sac. As the fetus develops, the torso elongates and the kidneys rotate and migrate upwards within the abdomen which causes the length of the ureters to increase.

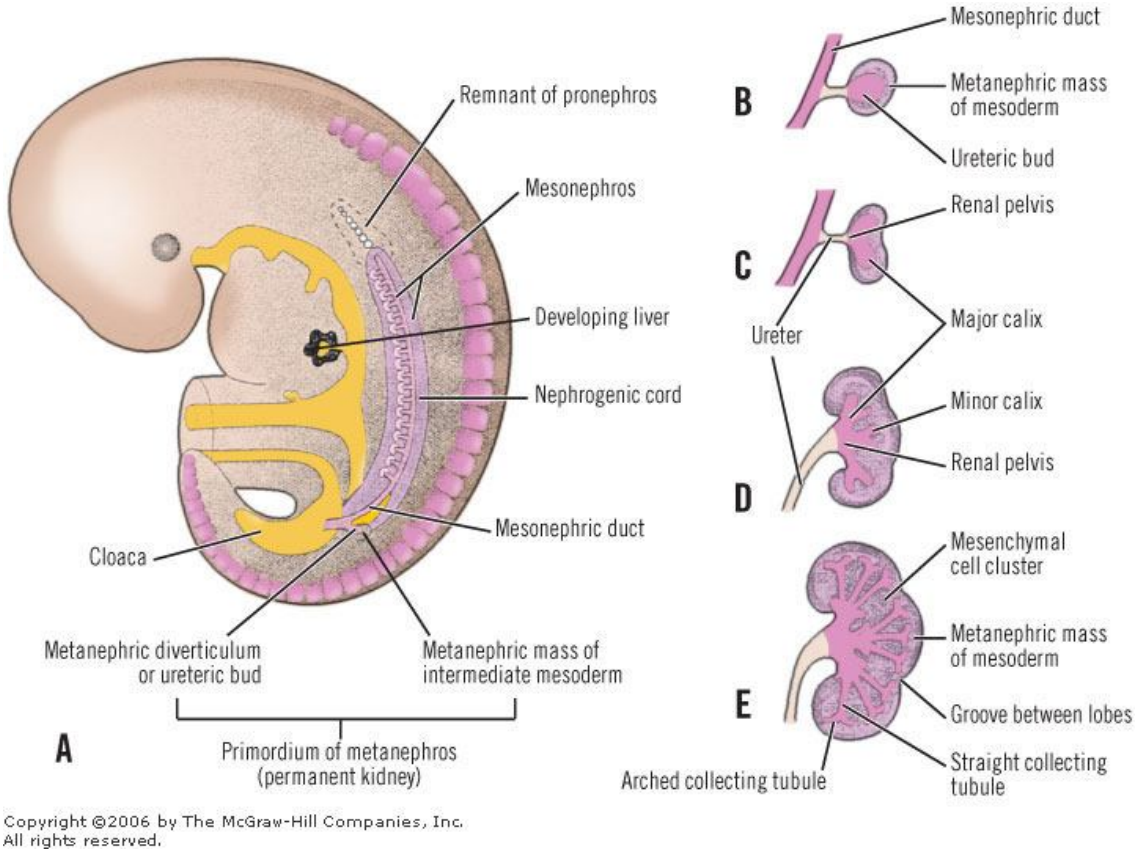

Figure (2.1): shows the developmental process of the kidney

2-2-Anatomy of the kidney:

Kidneys are paired retroperitoneal organs situated in the posterior part of the abdomen on each side of the vertebral column, the upper pole of each kidney lies opposite the twelfth thoracic vertebra, and the lower pole lies opposite the third lumbar vertebra. The right kidney is usually slightly more caudal in position. The weight of each kidney ranges from 125 g to 170 g in the adult male and from 115 g to 155 g in the adult female. The kidney is approximately 11 cm to 12 cm in length, 5.0 cm to 7.5 cm in width, and 2.5 cm to 3.0 cm in thickness. Located on the medial or concave surface of each kidney is a slit, called the hilus,

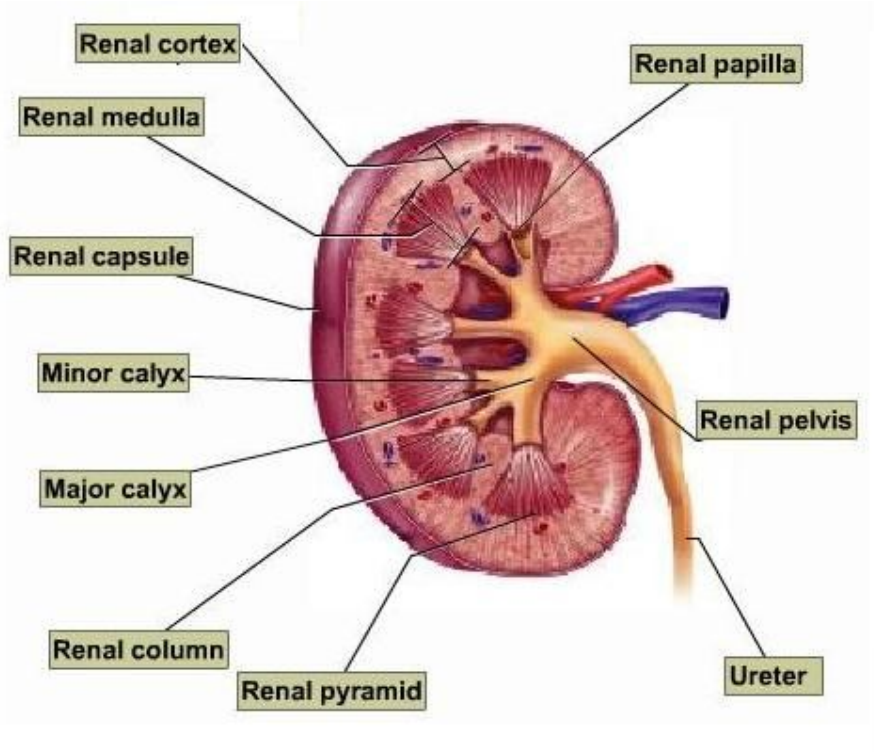

Figure 2.2 anatomy of the kidney

Through which the renal pelvis, the renal artery and vein, the lymphatics, and a nerve plexus pass into the sinus of the kidney. The organ is surrounded by a tough fibrous capsule, which is smooth and easily removable under normal conditions. The kidneys receive blood from the renal arteries, left and right, which branch directly from the abdominal aorta. Despite their relatively small size, the kidneys receive approximately 20% of the cardiac output. (Walter et al., (2004)) each kidney is supplied normally by a single renal artery, although the presence of one or more accessory renal arteries is not uncommon. The renal artery enters the hilar region and usually divides to form an anterior and a posterior branch. Three segmental or lobar arteries arise from the anterior branch and supply the upper, middle, and lower thirds of the anterior surface of the kidney. the posterior branch supplies more than half of the posterior surface and occasionally gives rise to a small apical segmental branch. However, the apical segmental or lobar branch arises most commonly from the anterior division. No collateral circulation has been demonstrated between individual segmental or lobar arteries or their subdivisions. Not uncommonly, the kidneys receive aberrant arteries from the superior

mesenteric, suprarenal, testicular, or ovarian arteries. True accessory arteries that arise from the abdominal aorta usually supply the lower pole of the kidney.

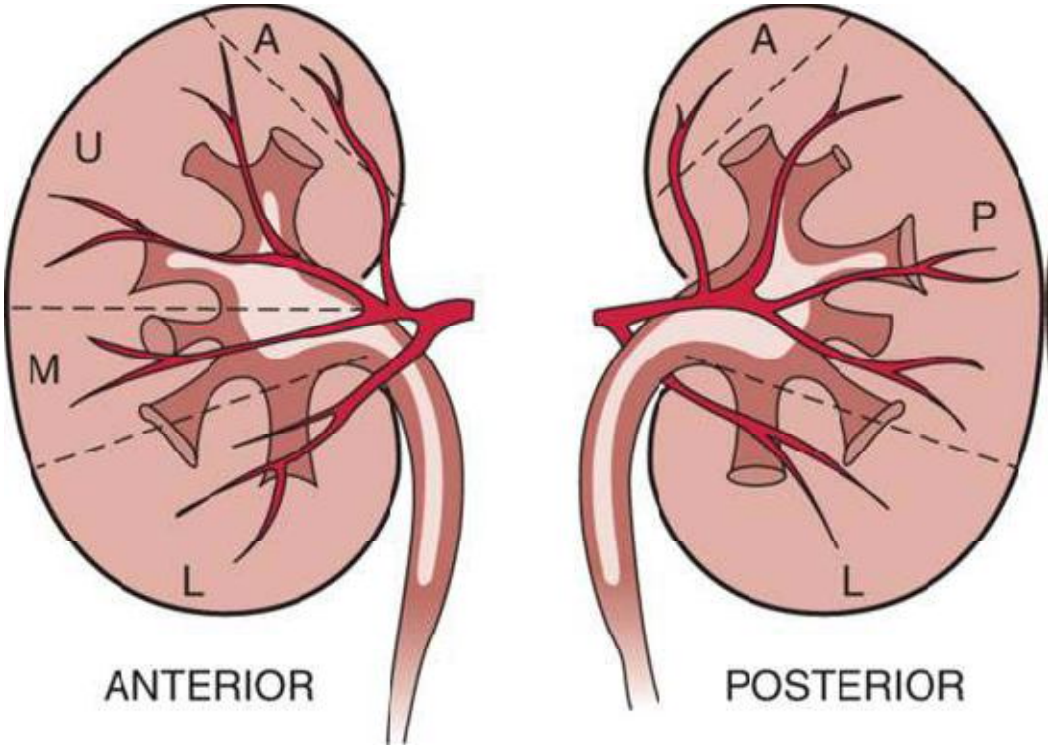

FIGURE 2-3 Diagram of the vascular supply of the kidney.

Two distinct regions can be identified on the cut surface of a bisected kidney: a pale outer region, the cortex, and a darker inner region, the medulla. This is divided into 8 to 18 striated conical masses, the renal pyramids. The base of each pyramid is positioned at the corticomedullary boundary, and the apex extends toward the renal pelvis to form a papilla. On the tip of each papilla are 10 to 25 small openings that represent the distal ends of the collecting ducts (of Bellini). These openings form the area cribrosa, the renal cortex is about 1 cm in thickness, forms a cap over the base of each renal pyramid, and extends downward between the individual pyramids to form the renal columns of Bertin. from the base of the renal pyramid, at the corticomedullary junction, longitudinal elements termed the “medullary rays of Ferrein” extend into the cortex. Despite their name, the medullary rays are actually considered a part of the cortex and are formed by the collecting ducts and the

straight segments of the proximal and distal tubules. The renal pelvis is lined by transitional epithelium and represents the expanded portion of the upper urinary tract. In humans, two and sometimes three outpouching, the major calyces, extend outward from the upper dilated end of the renal pelvis. From each of the major calyces, several minor calyces extend toward the papillae of the pyramids and drain the urine formed by each pyramidal unit. In mammals possessing a unipapillate kidney, the papilla is directly surrounded by the renal pelvis. The ureters originate from the lower portion of the renal pelvis at the ureteropelvic junction, and in humans they descend a distance of approximately 28 cm to 34 cm to open into the fundus of the bladder. The walls of the calyces, pelvis, and ureters contain smooth muscle that contracts rhythmically to propel the urine to the bladder. (www.mdconsult.com)

The nephron:

The functional unit of the kidney is the nephron. Each human kidney contains about 0.6 × 10 to 1.4 × 10nephrons, which contrasts with the approximately 30,000 nephrons in each adult kidney. The essential components of the nephron include the renal or Malpighian corpuscle (glomerulus and Bowman's capsule), the proximal tubule, the thin limbs, the distal tubule, and the connecting tubule. The origin of the nephron is the metanephric blastema. although there has not been universal agreement on the origin of the connecting tubule, it is now generally believed to derive from the metanephric blastema. The collecting duct system, which includes the initial collecting tubule, the cortical collecting duct (CCD) in the medullary ray, the outer medullary collecting duct (OMCD), and the inner medullary collecting duct (IMCD), is not, strictly speaking, considered part of the nephron because embryologicaly it arises from the ureteric bud. However, all of the components of the nephron and the collecting duct system are interrelated functionally.

Two main populations of nephrons are recognizable in the kidney: those possessing a short loop of Henle and those with a long loop of Henle. The loop of Henle is composed of the straight portion of the proximal tubule (pars recta), the thin limb segments, and the straight portion of the distal tubule (thick ascending limb, or pars recta). The length of the loop of Henle is generally related to the position of its parent glomerulus in the cortex. most nephrons originating from superficial and mid cortical locations have short loops of Henle that bend within the inner stripe of the outer medulla close to the inner medulla. A few species, including humans, also possess cortical nephrons with extremely short loops that never enter

the medulla but turn back within the cortex. Nephrons originating from the Juxtamedullary region near the corticomedullary boundary have long loops of Henle with long descending and ascending thin limb segments that enter the inner medulla. many variations exist, however, between the two basic types of nephrons, depending on their relative position in the cortex. The ratio between long and short loops varies among species. Humans and most rodents have a larger number of short-looped than long-looped nephrons.

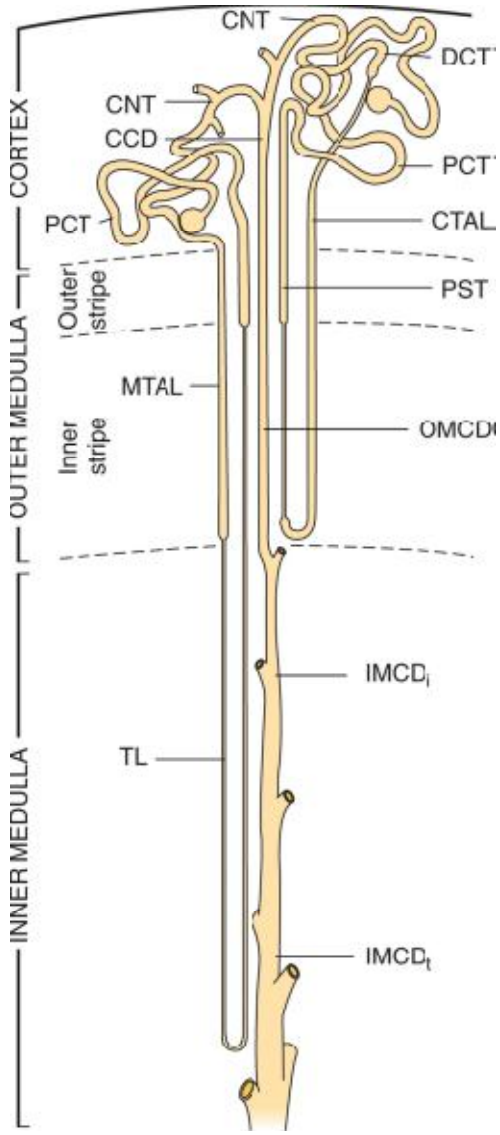

FIGURE 2-4: Diagram illustrating superficial and Juxtamedullary nephron.

On the basis of the segmentation of the renal tubule, the medulla can be divided into an inner and an outer zone, with the outer zone further subdivided into an inner and an outer stripe. The inner medulla contains both descending and ascending thin limbs and large collecting ducts, including the ducts of Bellini. In the inner stripe of the outer medulla, thick ascending limbs are present in addition to descending thin limbs and collecting ducts. The outer stripe of the outer medulla contains the terminal segments of the pars recta of the proximal tubule, the thick ascending limbs (partes rectae of the distal tubule), and collecting ducts. The division of the kidney into cortical and medullary zones and the further subdivision of the medulla into inner and outer zones are of considerable importance in relating renal structure to the ability of an animal to form maximally concentrated urine. (www.mdconsult.com)

Renal Corpuscle (Glomerulus): The renal corpuscle is composed of a capillary network lined by a thin layer of endothelial cells; a central region of mesangial cells with surrounding mesangial matrix material; the visceral epithelial cells and the associated basement membrane; and the parietal layer of Bowman's capsule with its basement membrane, Between the two epithelial layers is a narrow cavity called Bowman's space, or the urinary space. Although the term renal corpuscle is more precise anatomically than the term glomerulus when referring to that portion of the nephron composed of the glomerular tuft and Bowman's capsule, the term glomerulus is employed throughout this chapter because of its common use. The visceral epithelium is continuous with the parietal epithelium at the vascular pole, where the afferent arteriole enters and the efferent arteriole exits the glomerulus. The parietal layer of Bowman's capsule continues into the epithelium of the proximal tubule at the so-called urinary pole.

The average diameter of the glomerulus is approximately 200 mm in the human kidney and 120 mm in the rat kidney. However, glomerular number and size vary significantly with age and gender as well as birth weight. The average glomerular volume has been reported to be 3 to 7 million mm in humans and 0.6 to 1 million mm in the rat. In the rat, Juxtamedullary glomeruli are larger than glomeruli in the superficial cortex. However, this is not the case in the human kidney The glomerulus is responsible for the production of an ultrafiltrate of plasma. The filtration barrier between the blood and the urinary space is composed of a fenestrated endothelium, the peripheral glomerular basement membrane (GBM), and the slit pores between the foot processes of the visceral epithelial cells The mean area of filtration surface per glomerulus has been reported to be 0.203 mm in the human kidney and 0.184 mm

in the rat kidney. Endothelial Cells The glomerular capillaries are lined by a thin fenestrated endothelium The endothelial cell nucleus usually lies adjacent to the mesangial, away from the urinary space, and the remainder of the cell is irregularly attenuated around the capillary lumen the endothelium is perforated by pores or fenestrae, which in the kidney range from 70 nm to 100 nm in diameter Thin diaphragms have been observed extending across these fenestrae and electron microscopic studies using a modified fixation method reported the presence of filamentous sieve plugs in the fenestrae .The function of these plugs remains to be established and it is not known whether they represent a significant barrier to the passage of macromolecules. Recent studies have confirmed the presence of electron-dense filamentous material in the fenestrae and also demonstrated a thick filamentous surface layer on the endothelial cells. Non fenestrated, ridge-like structures termed cytofolds are found near the cell borders. (www.mdconsult.com)

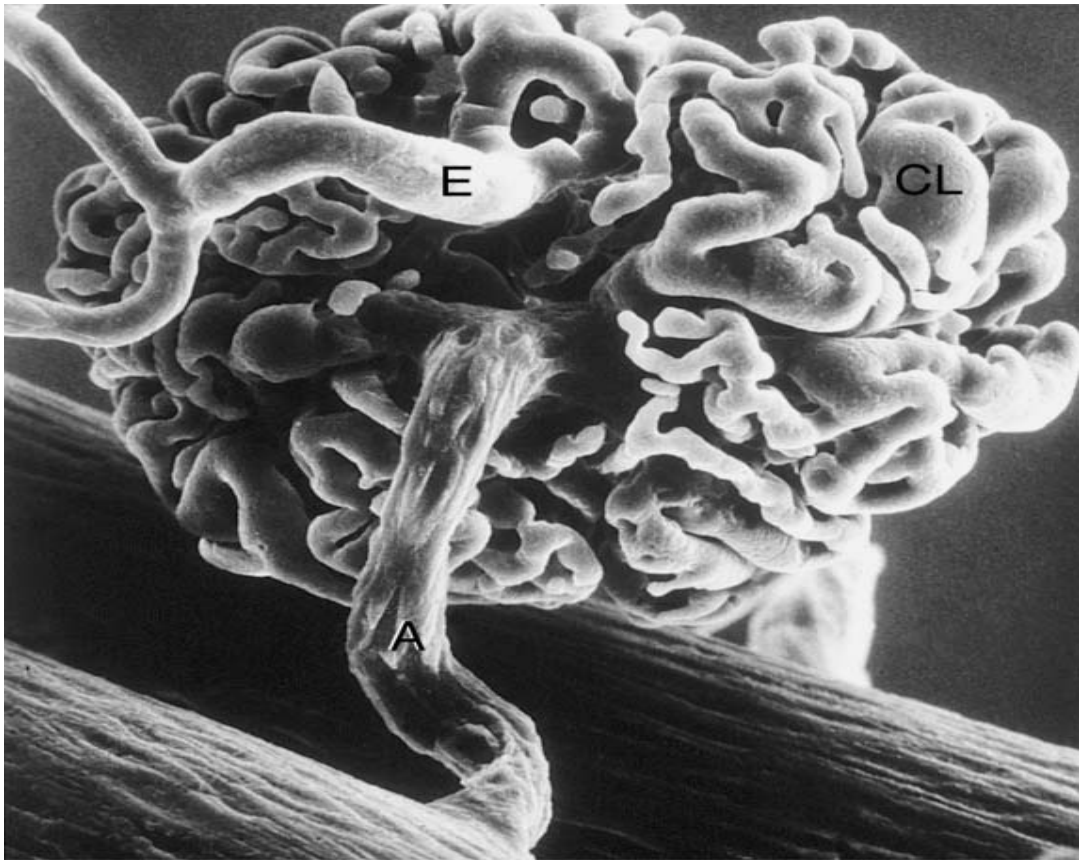

Figure 2-5 Scanning electron micrograph of a cast of a glomerulus with its many capillary Loops (CL) and adjacent renal vessels.

Juxtaglomerular Apparatus:

The juxtaglomerular apparatus is located at the vascular pole of the glomerulus, where a portion of the distal nephron comes into contact with its parent glomerulus. It has a vascular and a tubule component. The vascular component is composed of the terminal portion of the afferent arteriole, the initial portion of the efferent arteriole, and the extraglomerular mesangial region. The tubule component is the macula densa, which is that portion of the thick ascending limb that is in contact with the vascular component. The extraglomerular mesangial region, which has also been referred to as the polar cushion (polkissen) or the lacis, is bounded by the cells of the macula densa, the specialized regions of the afferent and efferent glomerular arterioles, and the mesangial cells of the glomerular tuft (the intraglome-rular mesangial cells). Within the vascular component of the juxtaglomerular apparatus, two distinct cell types can be distinguished: the juxtaglomerular granular cells, also called epithelioid or the myoepithelial cells, and the agranular extraglomerular mesangial cells, which are also refer-red to as the lacis cells or pseudo-meissnerian cells of Goormaghtigh. (www.mdconsult.com)

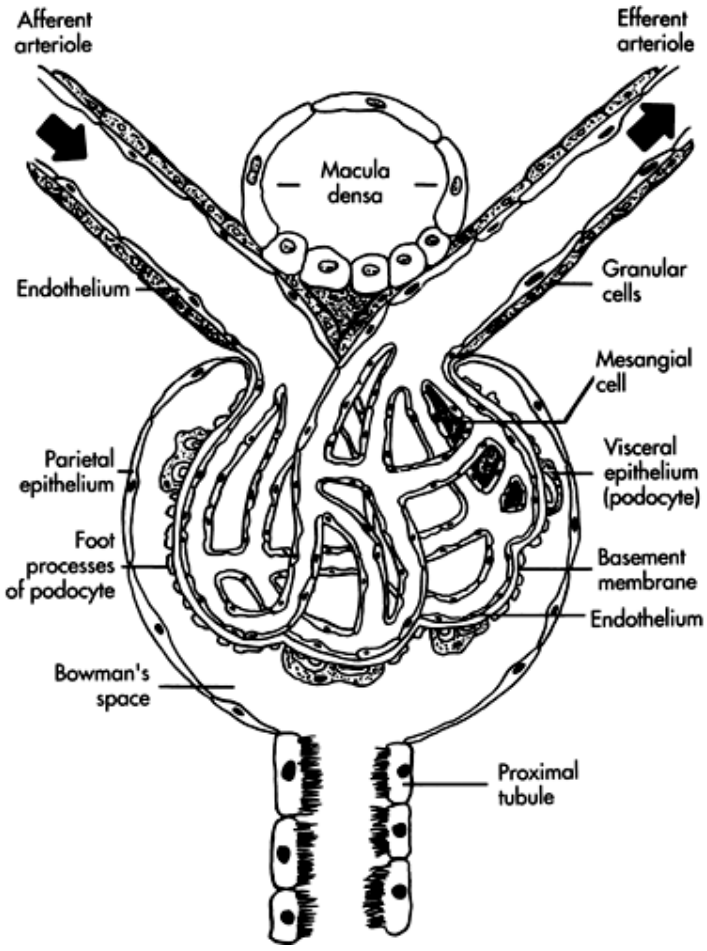

Figure 2-6 : diagram shows the component of Juxtamedullary apparatus

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2-2-physiology:

The kidney participates in whole-body homeostasis, regulating acid-base balance, electrolyte concentrations, extracellular fluid volume, and regulation of blood pressure. The kidney accomplishes these homeostatic functions both independently and in concert with other organs, particularly those of the endocrine system. Various endocrine hormones coordinate these endocrine functions; these include renin, angiotensin II, aldosterone, antidiuretic hormone, and atrial natriuretic peptide, among others. Many of the kidney's functions are accomplished by relatively simple mechanisms of filtration, reabsorption, and secretion, which take place in the nephron. Filtration, which takes place at the renal corpuscle, is the process by which

cells and large proteins are filtered from the blood to make an ultrafiltrate that eventually becomes urine. The kidney generates 180 liters of filtrate fluid on a day, while reabsorbing a large percentage, allowing for the generation of only approximately 2 liters of urine. Reabsorption is the transport of molecules from this ultrafiltrate and into the blood. Secretion is the reverse process, in which molecules are transported in the opposite direction, from the blood into the urine. (www.Wikipedia-org/wiki/kidney,(2012).

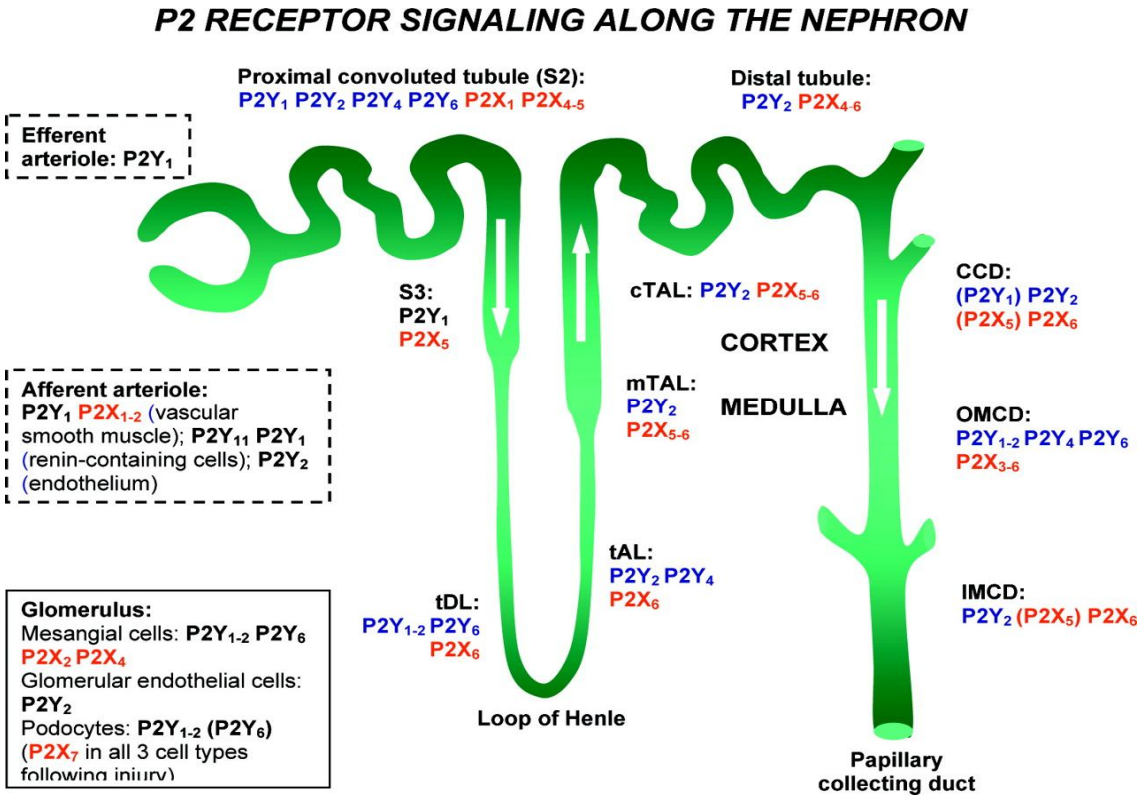

Figure 2-7: diagram shows p2 receptor signaling along the nephron

2-3- ultrasound Technique of kidney:

The examination begins with the patient in the supine position. Scans are performed in the sagittal and transverse planes from the anterior approach using the liver and spleen as acoustic windows. Various maneuvers may enhance demonstration of the kidneys: left lateral decubitus or lateral oblique positions for the right kidney and right lateral decubitus or lateral oblique positions for the left kidney. Coronal longitudinal and transverse scans may also be obtained and are recommended for evaluating the renal pelvis and proximal ureter on hydronephrotic patients.

The highest frequency transducer permitting adequate penetration is used. This is usually in the 3 to 5 MHz range. A phased array sector probe with its small footprint permits subcostal and intercostal scanning.

2-4-Normal Sonographic Appearances of Kidney:

The kidney is an ellipsoid structure when demonstrated in its long axis as (figure 2-30) which demonstrate right kidney. The capsule is an echogenic white boundary separating the kidney from adjacent structures anteriorly and the musculature posteriorly, the renal cortex is homogeneous, fine textured and poorly echogenic, the cortex is equal to, or less echogenic than the normal liver, the medulla consists of pyramids which are anechoic structures with their bases adjacent to the renal cortex and their apices directed towards the renal sinus, the renal sinus is the most echogenic portion of the adult kidney. This echogenic area is called the central echo complex. In the non hydrated state the renal pelvis is collapsed. (Gilani S.A (2003)

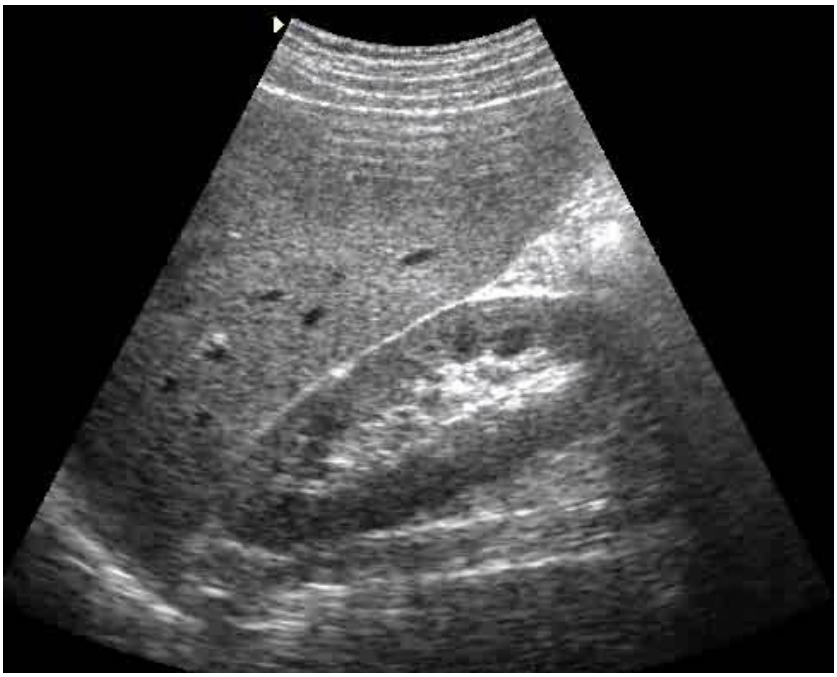

Figure 2-8 Sonographic appearance of normal right kidney.

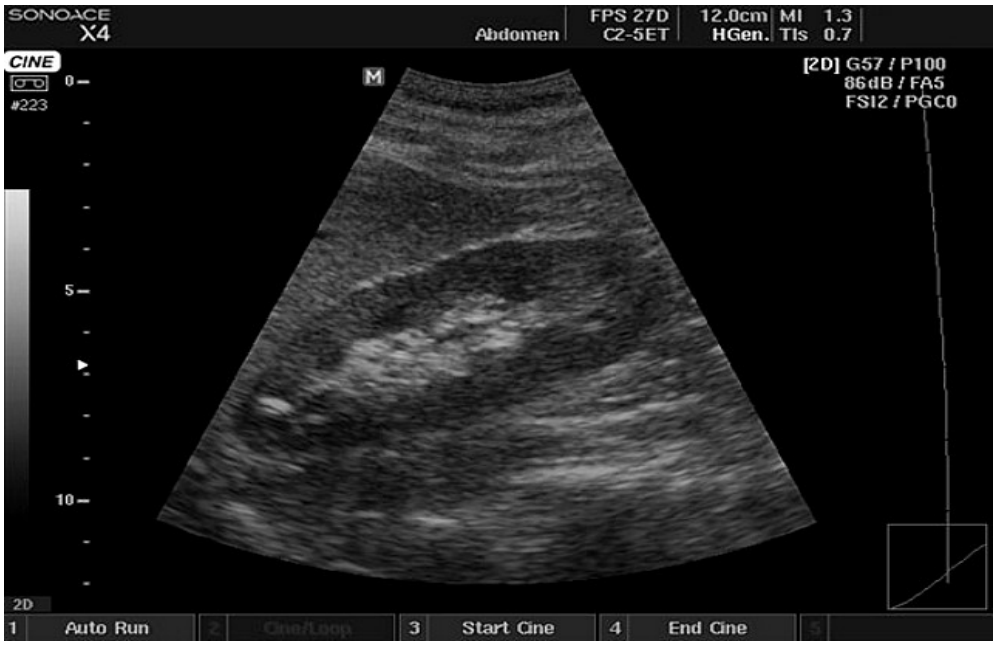

Figure 2-9 Sonographic appearance of normal left kidney.

2-5 Normal Renal Measurements:

The size of the kidneys is affected by age, sex (greater in men than in women), and body size; furthermore, the left kidney is slightly larger than the right in most individuals.

The normal renal length in females ranges from 9.5 to 12.1 cm and in males from 10.1 to 12.6 cm. Therefore, the normal adult kidney should measure 9-13 cm in length, 2.5 to 3.5 cm3,4 in thickness and 4 to 5 cm in width3,4.These are good average measurements for exam purposes.

Body habitus and age should be considered since a single measurement could misrepresent the patient's condition. A 10 cm long kidney is a normal renal length; however, it is likely to be abnormal in a 20 year old male who is 6 feet tall and weighs 200 pounds.

Parenchymal thickness is 11-18 mm in the male and 11-16 mm in the female (Gilani S.A (2003).

2-5-1 Age Related Changes in the Adult:

1. "The thickness of the renal parenchyma decreases at about 10% per decade after age 20 years.

2. 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.

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

2-6-Diabetic nephropathy:

Diabetic nephropathy (*nephropatia diabetica*), also known as Kimmelstiel-Wilson syndrome, or nodular diabetic glomerulosclerosis and intercapillary glomerulonephritis, is a progressive kidney disease caused by angiopathy of capillaries in the kidney glomeruli. It is characterized by nephrotic syndrome and diffuse glomerulosclerosis. It is due to longstanding diabetes mellitus, and is a prime indication for dialysis in many Western countries.(Berkman, James; *et al.* (1973)).

The syndrome can be seen in patients with chronic diabetes (usually less than 15 years after onset) after about 5 years in type 1 diabetes. Clinical nephropathy secondary to glomerular disease usually manifests 15–25 years after diagnosis of diabetes and affects 25-35% of patients under the age of 30 years. It is the leading

cause of premature death in young diabetic patients.(between 50 and 70 years old) The disease is progressive and may cause death two or three years after the initial lesions, and is more frequent in men. Diabetic nephropathy is the most common cause of chronic kidney failure and end-stage kidney disease in the United States. People with both type 1 and type 2 diabetes are at risk. The risk is higher if blood-glucose levels are poorly controlled. Furthermore, once nephropathy develops, the greatest rate of progression is seen in patients with poor control of their blood pressure. Also people with high cholesterol level in their blood have much more risk than others. . (www. Wikipedia-org/wiki/diabetic-nephropathy).

2-6-1 Cause:

The word diabetes means "passing through", referring to the polyuria (abnormal increase of urine production), a symptom historically present in those affected by the disease. When the level of blood glucose rises beyond the kidney's capacity to reabsorb glucose from the renal ultrafiltrate, glucose remains diluted in the fluid, raising its osmotic pressure and causing more water to be carried out, thus, increasing the excreted urine volume. The increased volume dilutes the sodium chloride in the urine, signaling the macula dense to release more renin, causing vasoconstriction, a survival mechanism to retain water by passing less blood through the kidneys. Because the kidney is nurtured exclusively by the blood it filtrates, the vasoconstriction also reduces the nutrients supplied to it, causing infarct of its tissues and reduction of renal function. (Www.Wikipedia-org/wiki/diabetic-nephropathy).

2-6-1-Pathophysiology:

The earliest detectable change in the course of diabetic nephropathy is a thickening in the glomerulus. At this stage, the kidney may leak more serum albumin (plasma protein) than normal in the urine (albuminuria), and this can be detected by sensitive medical tests for albumin. This stage is called “microalbuminuria”. As diabetic nephropathy progresses, increasing numbers of glomeruli are destroyed by progressive nodular glomerulosclerosis. Consequently, urine albumin increases to the point that it may be detected by ordinary urinalysis techniques. At this stage, a kidney biopsy generally clearly shows diabetic nephropathy.

2-6-2-Signs and symptoms:

Kidney failure provoked by glomerulosclerosis leads to fluid filtration deficits and other disorders of kidney function. There is an increase in blood pressure (hypertension) and fluid retention in the body plus a reduced plasma oncotic pressure causes edema. Other complications may be arteriosclerosis of the renal artery and proteinuria.

Throughout its early course, diabetic nephropathy has no symptoms. They develop in late stages and may be a result of excretion of high amounts of protein in the urine or due to renal failure . edema: swelling, usually around the eyes in the mornings; later, general body swelling may result, such as swelling of the legs , foamy appearance or excessive frothing of the urine (caused by the proteinuria) ,unintentional weight gain (from fluid accumulation) , anorexia (poor appetite) ,nausea and vomiting , malaise (general ill feeling) , fatigue., headache and generalized itching.

The first laboratory abnormality is a positive microalbuminuria test. Most often, the diagnosis is suspected when a routine urinalysis of a person with diabetes shows too much protein in the urine (proteinuria). The urinalysis may also show glucose in the urine, especially if blood glucose is poorly controlled. Serum creatinine and BUN may increase as kidney damage progresses.

A kidney biopsy confirms the diagnosis, although it is not always necessary if the case is straightforward, with a documented progression of proteinuria over time and presence of diabetic retinopathy on examination of the retina of the eyes.

2-6-3-Treatment:

The goals of treatment are to slow the progression of kidney damage and control related complications. The main treatment, once proteinuria is established, is ACE inhibitor drugs, which usually reduces proteinuria levels and slows the progression of diabetic nephropathy.

Blood-glucose levels should be closely monitored and controlled. This may slow the progression of the disorder, especially in the very early ("microalbuminuria") stages. Medications to manage diabetes include oral hypoglycemic agents and insulin injections. As kidney failure progresses, less insulin is excreted, so lesser doses may be needed to control glucose levels.

Diet may be modified to help control blood-sugar levels. Modification of protein intake can affect hemodynamic and nonhemodynamic injury.

High blood pressure should be aggressively treated with antihypertensive medications, in order to reduce the risks of kidney, eye, and blood vessel damage in the body. It is also very important to control lipid levels, maintain a healthy weight, and engage in regular physical activity.

Dialysis may be necessary once end-stage renal disease develops. At this stage, a kidney transplantation must be considered. Another option for type 1 diabetes patients is a combined kidney-pancreas transplant.

C-peptide, a by-product of insulin production, may provide new hope for patients suffering from diabetic nephropathy(Wahren J, al. (2007))..

2-6-4-Prognosis:

Diabetic nephropathy continues to get gradually worse. Complications of chronic kidney failure are more likely to occur earlier, and progress more rapidly, when it is caused by diabetes than other causes. Even after initiation of dialysis or after transplantation, people with diabetes tend to do worse than those without diabetes.

2-6-5-Complications:

Possible complications include: hypoglycemia (from decreased excretion of insulin) (insulin isn't secreted by the kidneys) (decreased excretion of insulin would cause hyperglycaemia) , rapidly progressing chronic kidney failure , end-stage kidney disease , hyperkalemia , severe hypertension , complications of hemodialysis , complications of kidney transplant , coexistence of other diabetes complications , peritonitis (if peritoneal dialysis used) and increased infections.

2-7-Previous study:

J F Platt, et.al (1994) aims to compare Doppler ultrasonography (US) with conventional clinical and laboratory tests in evaluation of diabetic renal disease. The method used contained Ninety-eight patients with diabetes mellitus underwent renal Doppler (resistive index [RI] measurement) US examination. US data were compared with clinical variables and follow-up data. The main finding of this study was; Thirty-four diabetic patients without nephropathy had a mean RI of 0.62 +/- 0.09, which was not significantly different from the mean RI of 0.64 +/- 0.09 in 23 patients with early diabetic nephropathy. Patients with established nephropathy had a mean RI of 0.83 +/- 0.11, which was significantly ($P < .001$) higher than in the other two groups. Renal RI correlated highly with serum creatinine concentration ($r = .64$) and creatinine clearance rate ($r = .80$). An elevated RI (> or = 0.70) was associated with impaired renal function, increased proteinuria at 24 hours, and poor outcome. Absent diastole (RI = 1.0), observed in 7% of patients, was an ominous sign: Five of seven patients underwent dialysis or transplantation shortly after US therefore; RI is typically elevated in established nephropathy but is often normal in the early clinical stages of disease. Renal Doppler US provides an accurate indication of renal function in diabetic nephropathy but does not offer a great advantage over conventional tests.

Ishimura et.al (1997) stated that the intra-renal hemodynamic abnormalities in diabetic nephropathy measured by duplex Doppler sonography. Intrarenal hemodynamics were studied by duplex Doppler sonography in 112 in-patients with type II diabetes mellitus (DM; 65 males, 47 females, 58 ±13 years old). The resistive index (RI) and pulsatility index (PI) of the interlobar arteries were calculated. The patients were divided into four groups: group I consisted of patients with urinary albumin excretion (UAE) < 20 μg/min (N = 42), group II with 20 ≦ UAE < 200 (N = 28), group III with UAE ≧ 200 (N = 25), and group IV with

serum creatinine ≥ 1.5 mg/dl (N = 17). Both RI and PI values in groups II, III, and IV were significantly higher than those in the controls (age- and sex-matched healthy persons, N = 37; $P < 0.001$), and those in group IV were significantly higher than those in groups I, II, and III ($P < 0.0001$). Multiple regression analysis revealed that RI values in DM patients were significantly affected by creatinine clearance, age, and duration of diabetes ($R^2 = 0.554$, $P < 0.0001$). When intima-medial thickness (IMT) of the femoral and carotid arteries was measured by B-mode ultrasonography, RI values were significantly correlated with both the femoral and carotid arterial IMT. These results demonstrate that intrarenal hemodynamic abnormalities are present in type II DM patients with nephropathy and that intrarenal hemodynamics are affected by decreased glomerular function and also probably by advanced arteriosclerosis.

Ohta et.al (2005) stated that the renal resistive index (RI) and pulsatility index (PI), measured using Doppler ultrasonography, reflect intrarenal vascular resistance. We evaluated the relationship between these indices and pulse wave velocity (PWV), a measure of arterial stiffness, which reflects atherosclerosis, and determined whether renal RI and PI differ depending on the underlying renal disease. A total of 245 inpatients with or without renal impairment who underwent ultrasonographic assessment of the renal artery were enrolled in the study. Patients with renal artery stenosis or severe renal failure (serum creatinine ≥ 6 mg/dl) were excluded from the study. In univariate analysis, the RI and PI of the main renal arteries and the interlobar arteries were significantly correlated with PWV. Multivariate analyses showed that PWV was independently associated with the RI of the main renal arteries ($P < 0.01$, $R^2 = 0.256$). Patients with a creatinine level less than 3 mg/dl were divided into a control group without renal diseases and three groups with different underlying renal diseases: diabetic nephropathy, chronic glomerulonephritis, and nephrosclerosis. The RI and PI of the main renal arteries and the interlobar arteries were significantly higher in patients

with diabetic nephropathy than in the other three groups, even after adjusting for multiple variables, including creatinine clearance. These results suggest that the increased RI of the renal arteries is associated with the severity of systemic atherosclerosis. Furthermore, the intrarenal vascular resistance differs depending on the underlying renal disease, and appears to increase to a greater extent in diabetic nephropathy.

Keller et al. (2004) he aims to find out the renal findings in short time diabetic mellitus type 2 under semi-ambulatory conditions, 85 consecutive patients with short duration (excluding patients with islet cell antibodies or maturity onset diabetes of the young) were admitted to a self-control training program and were examined in this study. A comprehensive renal assessment was performed, including evaluation of albumin excretion rate (AER), renal hemodynamics, blood pressure (BP) profile, and indicators of genetic risk. AER > or = 30 mg/24 h was found in 13 (15%) of patients; in two of these patients, AER was > or = 300 mg/24 h. By logistic regression, high HbA1, current smoking, and BP parameters were significantly correlated with an increased risk of micro-albuminuria (MA). In a multiple linear regression model, accounting for 57% of total variance, HbA1, ERPF, and current smoking were significantly correlated with AER. Median GFR (Cin(inulin clearance) 136 mL/min per 1.73m2; range, 94 to 194) and ERPF (Cpah(para-aminohippuric acid clearance) 733; range, 451 to 1328) were significantly higher in patients than in control subjects (upper 95th percentile, 131 and 706 mL/min per 1.73m2, respectively). In a multiple linear regression model, explaining 27% of total variance, age, AER, gender, and fasting blood glucose were significantly correlated to GFR. According to the criteria of average daytime BP > or = 135/85 mm Hg or 24-h BP > or = 130/80 mm Hg, 60% of patients were hypertensive (HT). Sixty-one percent of all patients (including 50% of the untreated nor motensive patients) were "nondippers", i.e., < 15% nighttime decrease of mean arterial pressure. Either HT or nondipping was found in 79% of all patients, so that only 21% had a

completely normal blood pressure profile. Ninety-four percent of untreated hypertensive patients had no MA. First-degree relatives of patients with MA compared with patients without MA had more frequent cardiovascular events (69% versus 31%). The risk of MA in diabetic patients with positive family history was amplified by poor glycemic control. MA, but not hypertension, was marginally related to K(m) of Na+/Li+ counter transport. It was concluded that micro albuminuria is found in 15% of patients newly presenting with Type 2 diabetes; a high proportion of patient's exhibit hyperfiltration , according to ambulatory BP only, 21% of patients have a completely normal circadian BP profile and a family history of cardiovascular events interacts with glycemic control to increase the risk of MA.

Cotoi et.al, (1999) who aim to demonstrate the importance of renal U/S in evaluation of DN and specify the most important U/s parameter that can characterize DN in different stag of evaluation comparing with hypertensive kidney without diabetes and with control group. The result showed the kidney volume is a indicator of diabetic nephropathy in early stages in larger and later in decreasing volume with not important for diabetic mellitus group but was relevant hypertensive group.

Omer et.al (2008) describes the Ultrasonographic Characteristics of Diabetes Impacts in Kidneys' Morphology. A total sample size consisting of 150 Diabetic male patients to assess the impact of diabetes in kidney morphology. The result showed that the diabetes has been as endemic disease in central Sudan (Khartoum & Jazeera) representing 55% and in the west of Sudan representing 38%. The BMI of diabetic patients has been significantly ($R^2 = 0.6$) decreasing following aging. The impact of duration was a reduction in size significantly .in late case of Diabetes, the kidney is more echogenic, atrophied size with loss of corticomedullary differentiation.

Kim et.al (1995) stated that the Diabetic nephropathy effect on duplex ultrasound findings and this study done to evaluate the correlations among Doppler sonographic findings, morphologic sonographic findings, and laboratory findings representing renal functional status, duplex Doppler sonography of the kidney was performed in 32 patients with diabetes mellitus. Resistive indices obtained in the region of the arcuate or the interlobar arteries in patients with elevated serum creatinine levels were significantly higher than those in patients with normal serum creatinine levels ($P < 0.05$). Also, there was a significant correlation between the resistive indices and creatinine clearance levels (correlation coefficient, −0.828). There was a significant difference between the serum creatinine levels of patients with normal renal cortical echogenicity and those with increased cortical echogenicity ($P < 0.05$). Analysis of the Doppler spectrum of the intrarenal arteries in conjunction with careful evaluation of the renal cortical echogenicity may be helpful in sonographic prediction of the renal functional status in patients with diabetes mellitus.

Harish, B S et.al (2006) describe the role Of Ultrasound And Doppler In Diabetic Renal Disease-Correlative Study With Biochemical Parameters her abstract he was aimed to evaluation of renal sonomorphological characteristics using gray scale ultrasound and renal vascular resistance by Doppler in patients with diabetic renal disease, Determining biochemical parameters like urine protein and serum creatinine and Correlation among ultrasound, Doppler and biochemical parameters. Methods: Conventional gray scale ultrasound and Doppler evaluation of both kidneys was performed in 54 known type II diabetic patients. Renal parameters like renal length, renal parenchymal thickness, renal cortical echogenicity, intra-renal resistive index and biochemical parameters like blood sugar, lipid profile and urine protein were recorded in all the diabetic patients .Results: Renal length and parenchymal thickness showed a progressive decrease with progression of diabetic renal

disease. All patients in the preclinical and incipient nephropathy subgroups showed normal echogenicity. 40 % and 47.37 % of the patients in overt nephropathy. Renal length and parenchymal thickness showed no correlation with serum creatinine and urine protein. A progressive increase in resistive index values was noted with progression of diabetic nephropathy. Resistive index values showed a positive correlation with blood urea nitrogen and serum creatinine, but this correlation was not found to be statistically significant. Conclusion: In conclusion, renal length, parenchymal thickness and echogenicity are reliable indicators of the disease severity in diabetic renal disease. The positive correlation of intra-renal resistive index with most of the biochemical parameters.

Chapter Three

The methodology

(Material and method)

3-1 Material:

3-1-1-Ultrasound Machine:

Ultrasound machine which used in this study were Esaote MyLab7™40 and General electric logic7 contain phased, convex, linear, Doppler pencil and endocavitary probes. Multi-frequency broadband transducers (up to 15 MHz).color flow map, power, continues and pulsed wave Doppler technique.

3-2 Method:

The subjects had to be aware of the nature of the study and had to willingly, provide informed consent before entering the study. U/S examination of the kidney will be performed using (GE logic 7 & Esaote MyLab™40 with 3.5MHz TA convex probe). Subject ages, duration of diabetes, and gender of subjects will be recorded in clinical data sheet the examination begins with the patient in the supine position. Scans are performed in the sagittal and transverse planes from the anterior approach using the liver and spleen as acoustic windows. and evaluated kidney volume, C/M ratio and Echogensity.

3-2 -1 Method of evaluation the volume:

By using as traditional, measured three dimension length ,width and antroposterior diameter in long and short axes then calculated by formula is :V = 0.49 x L x W x AP (L = maximum long axis length ,W = average of three width measurements taken at the hilum and one centimeter above and below the hilum AP = antroposterior measurement measured through the hilum.

3-2-2 Method of evaluation the C/M ratio

By make ratio between the cortex and medulla measurement

3-2-3 Method of evaluation the Echogensity:

Evaluated the echogenicity of right kidney compared with the liver echogenicity, while the echogenicity of the left kidney was compared with spleen all measurement wear done by one sonographer.

3-2-4The population:

The study sample was consisted of (50 patients) underwent ultrasound examination of the abdomen at Khartoum state.

Inclusion criteria:

Patients who were diagnosed as diabetes mellitus, males & females at age between '45-55'.

Exclusion criteria:

diabetic patient with urinary system congenital anomaly or urinary tract obstruction due to calculi or mass ,which can effect in the volume of kidney and the other study variables **.**

3-2-5 Study design:

Experimental study

3-2-6 study area:

The study was conducted in Khartoum state at ALSHAFA medical center and Elfasial specialized hospital.

3-2-7 Duration of study:

Was conducted in period from January 2014 to September 2014.

3-2-8 Variables of the study:

3.2.8.1. Data collection variables:

Kidney volume, C/M ratio, Echogensity of kidney and Diabetic duration.

3-2-8-2 Patient data variable:

Age, gender and medication status.

Method of data collection:

The data were collected using master data sheet used in collection of the variable that used to achieve the result of this study.

Example of master data sheet:-

Age	Gender	Medication status	Duration of diabetes	Echogenicity	CMT	Length of the kidney	Width of the kidney

Method of data analysis:

This data were analysis using an excel Microsoft office program and SPSS 16.0 and storage in personal computer with password.

Ethical issues:

- There was official permission to hospitals to take the data.
- No patient data were published.

Chapter Four

Results :

Table 4-1: the mean and the standard deviation of the study variable

Variables	Mean ± SD
Age	50.2±3.1
Duration of diabetes	3.4±2.9
Length of Rt Kidney	9.9±0.8
Width of Rt kidney	4.0±0.6
Thickness of Rt kidney	4.5±0.6
Length of Lt kidney	10.2±0.8
Width of Lt kidney	4.3±0.6
Thickness of Lt kidney	4.7±0.6
CMT of Lt kidney	0.6±0.2
CMT of Rt kidney	0.6±0.2

table 4-2: the Echogensity group and their frequency

Echogenicity	Frequency	Percent
Hypoechoic	7	14.0
Normal	43	86.0
Total	50	100.0

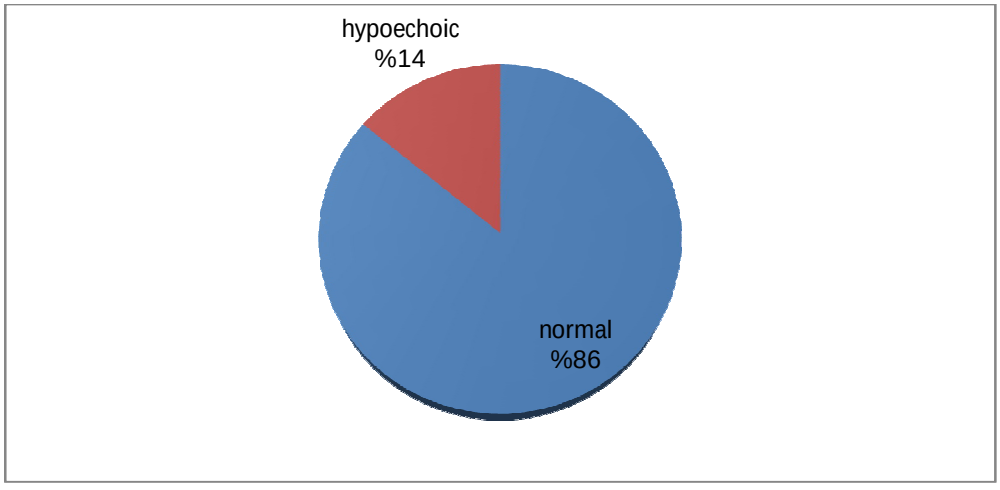

Figure 4-1: Echogensity pie chart

Table 4-3: cortico-medullary differentiation group and their frequency

CMD ratio	Frequency	Percent
Good	28	56.0
Poor	22	44.0
Total	50	100.0

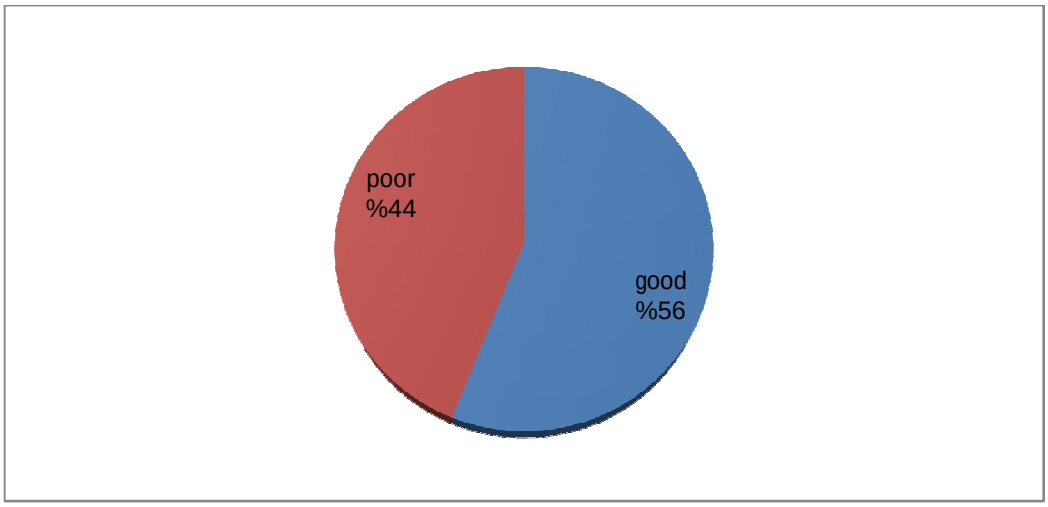

Figure4-2： CMD ratio bar chart

table 4-4: gender group and their frequency

Gender	Frequency	Percent
Male	30	60.0
Female	20	40.0
Total	50	100.0

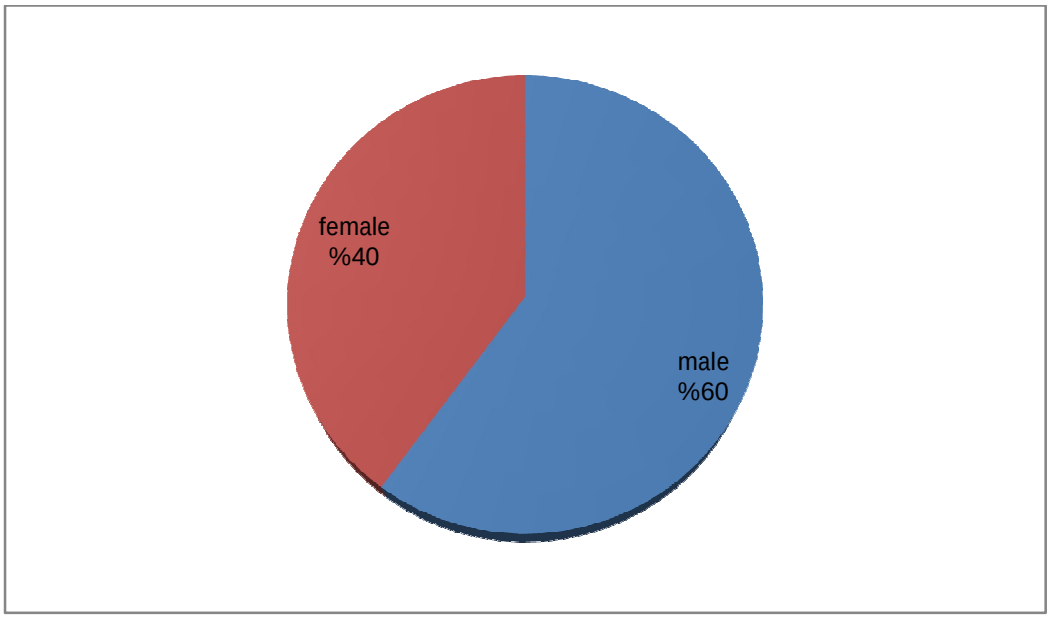

Figure4-3: gender distribution bar chart

Table 4-5: medication status and their frequency

Medication status	Frequency	Percent
Insulin dependant	3	6.0
NON Insulin dependant	47	94.0
Total	50	100.0

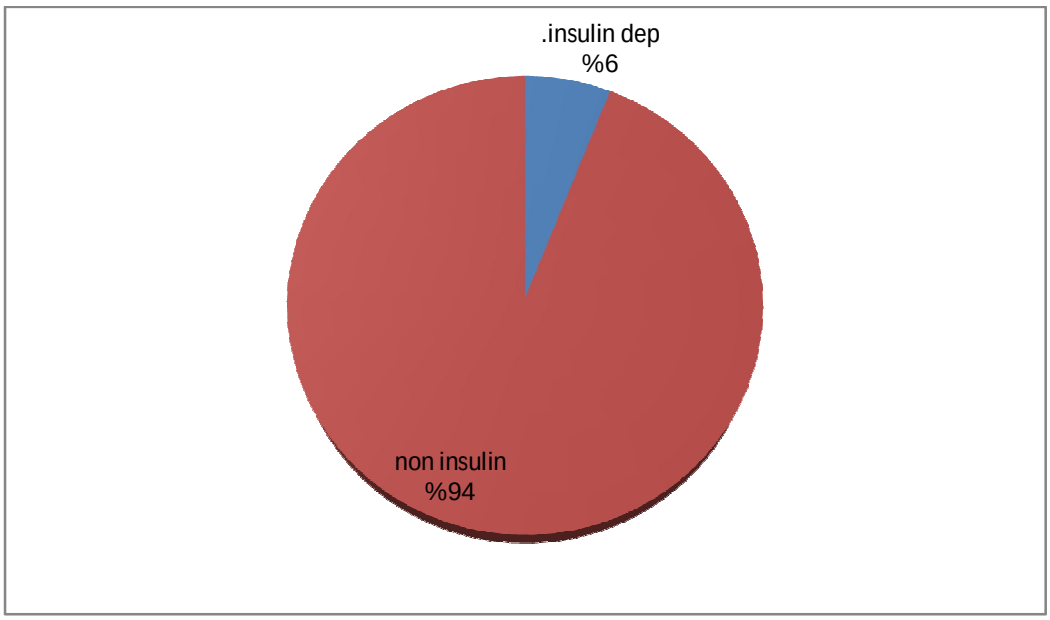

Figure4-4: medication status bar chart

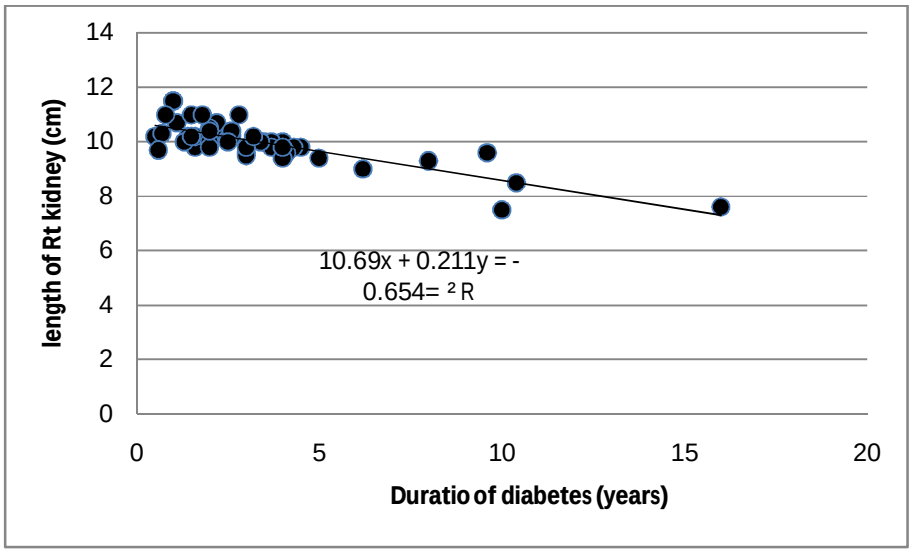

Figure4-5 : scatter plot show correlation between the duration of diabetes and the length of the right kidney with an inverse linear regression as depicted trend line.

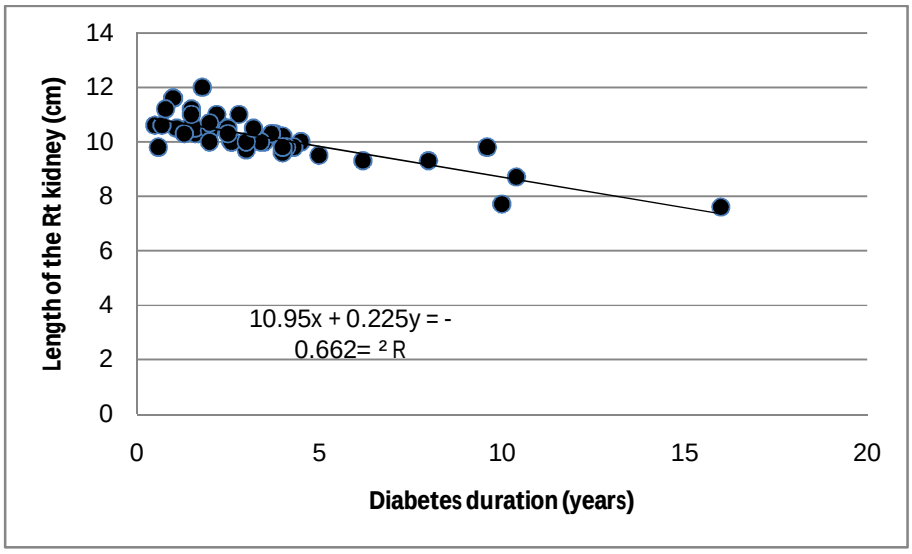

Figure 4-6: scatter plot show the correlation between the duration of diabetes and length of left kidney with an inverse linear regression as depicted by trend

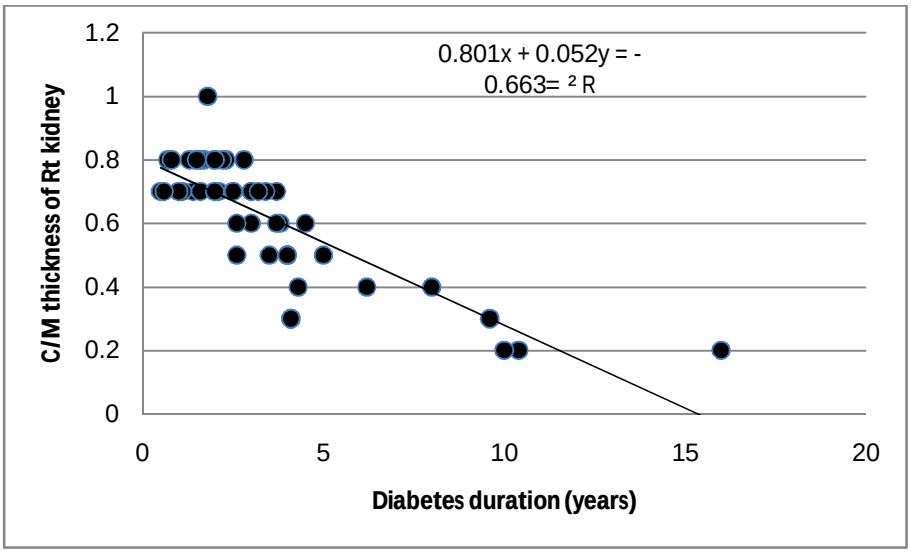

Figure 4-7: scatter plot show the correlation of diabetes duration and cortico-medullary thickness of the right kidney with an inverse linear regression as depicted by the trend line .

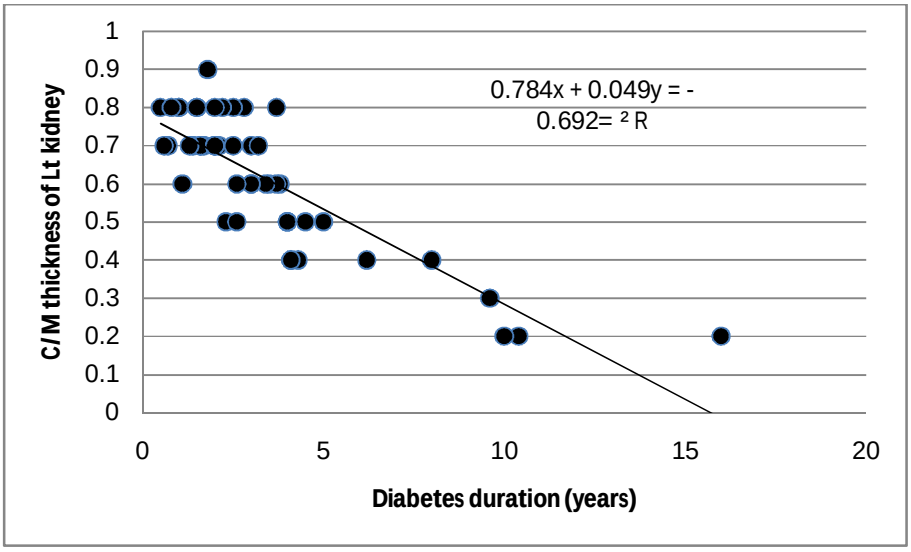

Figure 4-8: scatter plot show the correlation of diabetes duration and cortico-medullary thickness of the left kidney with an inverse linear regression as depicted by the trend line.

Table 4-6: paired T-test result between the length , width and thickness of RT&LT kidneys

	t	Sig. (2-tailed)
Length_Rt - Length_Lt	6.414	.000
Width_Rt - Width_Lt	5.276	.000
Thickness_Rt - Thickness_Lt	5.808	.000
CMT_Lt - CMT_Rt	.962	.341

Using paired *t*-test there is a significant difference between the Rt and Lt Kidneys concerning the length width and thickness at $p = 0.05$ with $p < 0.001$, in respect to CMT it shows inconclusive result at $p = 0.05$ with $p = 0.34$.

Table 4-7: independent sample test result of medication status effect on length, width and thickness of RT&LT kidneys.

Independent Samples Test		
	t-test for Equality of Means	
	t	Sig. (2-tailed)
Length Rt	2.583	.013
Width Rt	2.579	.013
Thickness Rt	2.764	.008
Length Lt	2.622	.012
Width Lt	3.097	.003
Thickness Lt	3.171	.003
CMT Lt	3.109	.003
CMT Rt	3.874	.000

The table above shows the significant differences between the kidneys dimensions incase of medication type, the result is significant at $p = 0.05$ with $p < 0.02$ for all variables

Chapter Five

This study has been done in U/S department of ELSHAFA medical center and Elfasial specialized hospital which aims to evaluate the effect of diabetic change in kidney using ultrasound examination and its was done for 50 diabetic patients 60% male (30 of 50), female 40% (20 of 50) in age between 45-55 years old.

5-1 Discussion:

Diabetes is the leading cause of Chronic Kidney Disease (CKD) in developed countries (Zimmet et al, 2001). The AusDiab study found 27.6% of people with diabetes had CKD and the prevalence of CKD was three times higher in those with diabetes compared to those without (AIHW 2005; Chadban et al, 2003). Chronic kidney disease has been defined by the Kidney Disease Outcomes Quality Initiative (KDOQI 2002) as: Glomerular filtration rate (GFR) <60ml/min/1.73 m2 that is present for 3 months or more; or evidence of kidney damage for 3 months or more with or without decreased GFR as evidenced by any of the following: microalbuminuria; macroalbuminuria/proteinuria; glomerular haematuria; pathological abnormalities; anatomical abnormalities.

Chronic kidney disease is a long term condition caused by changes in function and used medication in both kidneys. It is only relatively recently that the epidemiology of CKD has been studied in detail with the finding that it is more common than previously thought. The average prevalence has been reported at 11% in USA and Europe (excluding those on dialysis or with a functioning transplant). Diabetes mellitus has become a worldwide epidemic, especially type 2 diabetes, which is expected to stand for decades to come. In 2000, worldwide prevalence of diabetes was about 2.8%. Between 2000 and 2030, the number of diabetic adults is expected to increase by 50% - 70% in developing countries and by 20% in developed countries. In 2030, the prevalence of diabetes is expected to be 4.4% of the world population mostly related to the aging of people in the developed countries. The most important change in this prevalence appears to be an increase in the proportion of patients older than 65 years which was noticed in our study where 48% of patients were over 60 years (Couchoud and E. Villar (2013)).

Diabetes can affect both male and female in near percentage according to this study as 30 (60%) and 20(40%) frequency distribution for male and female respectively (table 4.4) this was explained by (National Health and Nutrition Examination Survey (NHANES) in 2004

study estimated that 26 million people in the United States have CKD (64.4 % male and 35.6 female).

This study showed that there are many changes in kidneys parameters, the age, duration of diabetes, length, width and thickness of both kidney was measured during renal ultrasound scan in addition to CMT of both kidney which having mean±SD of 50.2±3.1), 3.4±2.9), 9.9±0.8), 4.0±0.6), 4.5±0.6), 10.2±0.8), 4.3±0.6), 4.7±0.6), 0.6±0.2) and 0.6±0.2) for left and right kidney respectively table (4.1). Also the appearance of the kidney during the renal ultrasonic examination was investigated and the result was 14%(7 case) had a hypo-echogenic appearance, while 86% from these cases was normal in shape and echogenicity(table4.2), and this explained by (Jastaniah et al. 2013) he aims to study the role of US in the assessment and differentiation of kidney diseases in patients with type 2 DM., study included 400 type 2 diabetic patients ranging in age from 13 - 93 years (having mean± SD 58.86 ± 12.98). Regarding the study of renal parenchymal echogenicity, they found that most cases showed normal echogenicity (87.6% on the right side and 88.1% on the left side), moreover; the CMD ratio investigated and categorized into good and poor one with frequency of 28 (56%) and 22 (44%) respectively(table this changes was explained by Omer et.al (2008) he stated the Ultrasonographic Characteristics of Diabetes Impacts in Kidneys' Morphology, he stated a total sample size consisting of 150 Diabetic male patients to assess the impact of diabetes in kidney morphology.

And found that in late case of Diabetes, the kidney is more echogenic, atrophied size with loss of corticomedullary differentiation.

The medication used in treatment of diabetes patient was also investigated for those who using medication and non-medication users as 6.0% and 94.0% respectively (table 4.5) Because of patients refused taken medication and used diets, other traditional intakes, instead of drugs.

A correlation was made to study the relation between these study variables using linear regression correlation which showed that the length of right kidney in cm have a strong correlation in inverse relation with duration of diabetes which decrease by0.211 cm for every one year increment of this duration $y=-0.211x+10.69$ ($R^2=0.654$). And decreased by 0.225 for left kidney where the $R^2=0.662$, y=-0.225x+10.95 and this may explained by Chong YB ET AL, 2012 studied the difference in the renal findings detected by US in type 2 diabetic patients with diabetic nephropathy . They found that most of type 2 diabetic patients with Chong YB ET AL, (2012) studied the difference in the renal findings detected by US in type

2 diabetic patients with diabetic nephropathy. They found that most of type 2 diabetic patients had small kidneys (<9 cm length).

Also the relation between CM thickness of kidney and duration of diabetes and the result showed that there was inverse relationship between RT kidney and diabetic duration which decrease by 0.052 for every one year increase in this duration R2=0.663 y=-0.052x+0.801 and y=-0.049x+0.784 R2= 0.692 for left kidney. And this may explained by Harish, B S et.al (2006) he stated that renal length and parenchymal thickness showed a progressive decrease with progression of diabetic renal disease.

Emamian et al. (1996) demonstrated that most population both kidney had the same length (11 cm), thickness (2.5cm) width (5 cm) and weight between 155 -170 grams, using 665 volunteers, however, this study showed there was significant difference between right and left kidney concerning the length, width and thickness depend on Paired t-test showed that at p= 0.05 with <0.001, in respect to CMT it shows in conclusive result at p= 0.05 with p=0.34 using independent sample test there is a significant difference between the kidneys dimensions in case of medication status the result is significant at p=0.05 with p< 0.02 for all variables

5-2 Conclusion:

Diabetes and chronic kidney disease (CKD) are two clinical entities with important medical and socio-economical implications. Diabetic prevalence is growing and considering that 40% of type II diabetics are at risk for developing diabetic nephropathy in western countries, over 45% of all patients in renal replacement therapy are diabetics. Therefore, continuous researches are made in order to diagnose early kidney damage in diabetes. Microalbuminuria is diabetic as the „gold standard" for the diagnostic of DN, according with the K-DOQI criteria for DN, published in diabetic 2007 in American Journal of Kidney Diseases. In this important paper it is mentioned that imagistic examinations are important for evaluation of early diabetic kidney disease. Diabetic nephropathy is the most frequent cause of terminal renal failure. So, once type 2DM is diagnosed, patients should be screened for diabetic kidney disease on regular basis, Ultrasound is one of the most used imagistic examinations in nephrology. In order to establish a precise diagnosis in acute or chronic kidney disease, Renal ultrasound has become the standard imaging modality in the investigation of kidneys because it offers excellent anatomic detail, requires no special preparation of patients .it is readily available and does not expose the patient to radiation or contrast agent ,from this point of view the main goal of this study is to evaluate the kidney in patient with diabetes mellitus using ultrasound finding regarding to kidney size, echogenicity and C/M ratio. Which had been done in U/S department of ELSHAFA medical center and Elfasial specialized hospital for 50 diabetic patients there age between 45-55 years (30male, 20 female) by GE logic 7 & Esaote MyLab™40 with 3.5MHz TA convex probe. The results showed that is decrease in kidney size comparing with normal range and decrease in C/M ratio also, but there is no different in echogenicity noted, also there is difference in size between right & left kidney and there is significance difference in kidney dimension in case of medication used.

U/S scanning is very important to detect any diabetic changes to avoid the complications, in practice DM affect the kidney size in respect to the duration and this effect will lead to loss of kidney function, so early renal U/S examination could be helpful.

5-2 Recommendations:

After the enumeration of the results that related to the following thesis, there are some ideas which could help further in the field of research and better to be recommended as follow:

- U/S could be used as routine checkup, follow up to help treatment and control of the diabetic disorder.
- U/S is very important to diabetic patient to detect the complications as renal failure and could be avoided.
- more renal U/S studies could be done to evaluate the correlations among Doppler sonographic findings in diabetic patient and patient weight, laboratory investigations and ethnic group should be considered with application of Doppler to study nephropathy change in small blood vessels,

5-4 References:

1. Bruce M. Carlson (2004). Human Embryology and Developmental Biology (3rd edition ed.). Saint Louis: Mosby. ISBN 0-323-03649-X.

1. Berkman, James; Rifkin, Harold (1973). "Unilateral nodular diabetic glomerulosclerosis (Kimmelstiel-Wilson): Report of a case". *Metabolism* (Elsevier Inc.) 22 (5): 715–722. Doi:10.1016/0026-0495(73)90243-6. PMID 4704716.
2. Kimmelstiel P, Wilson C. *Benign and malignant hypertension and nephrosclerosis. A clinical and pathological study.* Am J Pathol 1936;12:45-48.
3. Diabetes Mellitus and Angiotensin Converting Enzyme Inhibitors
4. The ONTARGET Investigators; Yusuf, S; Teo, KK; Pogue, J; Dyal, L; Copland, I; Schumacher, H; Dagenais, G et al. (2008). "Telmisartan, Ramipril, or Both in Patients at High Risk for Vascular Events". *New England Journal of Medicine* 358 (15): 1547–59. doi:10.1056/NEJMoa0801317. PMID 18378520.
5. Wahren J, Ekberg K, Jörnvall H (2007). "C-peptide is a bioactive peptide". *Diabetologia* 50 (3): 503–9. doi:10.1007/s00125-006-0559-y. PMID 17235526.
6. http://www.diabetesbluecircle.org/ view article /74317
7. http://www. Kidney .net.nz/view article /64297
8. http://www.medscape.com/viewarticle/590644
9. http://www.medicalnewstoday.com/articles/139028.php
10. .Radermacher J (2003) Ultrasonography of the kidney and the renal vessels Part I Normal findings, inherited and renoparenchymatous diseases
11. http// www. Kidney .niddk..nih .gov /kudiseas/pubs/index.asp

12. page from National Kidney and Urologic Diseases Information Clearinghouse, NIH Publication No. 08-3925 September 2008.
13. Balens ytanatomy (Superficial anatomy of the trunk). Anca Dragomir, Mats Hjortberg and Godfried M. Romans. Section for human anatomy at the Department of medical biology, Uppsala university, Sweden.
14. Walter F., PhD. Boron (2004). *Medical Physiology: A Cellular And Molecular Approach*. Elsevier/Saunders. ISBN 1-4160-2328-3.
15. Http; //en. Wikipedia-org/wiki/kidney,(2012).
16. World Health Organization. Diabetes Mellitus: Report of a WHO Study Group. Geneva: WHO, 1985. Technical Report Series 727.
17. Cotran, RS S.; Kumar, Vinay; Fausto, Nelson; Robbins, Stanley L.; Abbas, Abul K. (2005). *Robbins and Cotran pathologic basis of disease*. St. Louis, MO: Elsevier Saunders. ISBN 0-7216-0187-1.
18. ^ "Kidneys Location Stock Illustration". http://www.indexedvisuals.com/scripts/ivstock/pic.asp?id=118-100

2. Glodny B, Unterholzner V, Taferner B, *et al.* (2009). "Normal kidney size and its influencing factors - a 64-slice MDCT study of 1.040 asymptomatic patients". *BMC Urology* 9: 19. doi:10.1186/1471-2490-9-19. PMC 2813848. PMID 20030823. http://www.biomedcentral.com/1471-2490/9/19
3. Gilani S.A (2003). Abdominal Ultrasound. Guidelines and protocol for medical diagnostic US, Burrwin institute of US, module two.
4. -"Diabetes Blue Circle Symbol". International Diabetes Federation. 17 March 2006. http://www.diabetesbluecircle.org/