1. Introduction and literature review

1.1 Introduction
Chronic renal failure (CRF) is a clinical syndrome that occurs when there is gradual decline of renal function over time. With renal failure there are many physiology derangement of homeostasis of water and minerals (sodium, potassium, chloride, calcium phosphate, magnesium, and sulphate) (Bishop et al., 2010).
Chronic kidney disease is a world wide epidemic and escalating problem. Approximately 20 millions adults in the United States are in various stages of chronic kidney disease. (Coresh, 2003).
The gradual failure of kidney function is accompanied by metabolic abnormalities including disordered phosphorus and calcium metabolism (Blocket et al., 2004).
Dialysis is used in cases of acute renal failure to improve the renal function, it may also used to prepare patient with chronic renal failure for transplantation. Dialysis to remove urea and other toxic substances from the plasma and correct electrolyte balance by dialyzing patient blood against fluid containing no urea and appropriate concentration of electrolytes, free ionized calcium and other plasma constituents (Mayneet et al., 2000).

1.2 Literature review
1.2.1 Urinary system
The paired kidneys lie on either side of the vertebral column below the diaphragm and liver, each adult kidney weighs about 160 g and about 11 cm long and 5 to 7 cm wide. About the size of first, urine produced in the kidneys is drained into a cavity known as renal pelvis and then it is channeled from kidney via long ducts the ureters to the urinary bladder (Ridge, 2006).
1.2.1.1 Kidneys
The right kidney is at a lower level compared to the left, the is kidney covered by the renal fascia and per renal fat, these coverings long with the renal vessels, the heli um of the kidney is in the Tran pyloric plane about 5 cm from the midline, it is upper pole lies 2.5 cm and the lower pole 7.5 cm away from midline, posterior the kidneys lie on the diaphragm the poses major the
quadrates labarum and the transverses abdominals, the cost diaphragm is an important posterior relation of the kidney (Jacob, 2002).

1.2.1.2 The ureters

The ureter lies on the psoas major muscle behind the parietal peritoneum to which it is adherent on both sides. The ureters cross the genitofemoral nerves and are crossed by the gonadal vessels. The right ureter lies behind the third part of the duodenum and as it descends is crossed by the ileocolic vessels and the root of the mesentery (Bishop et al., 1985).

1.2.1.3 Urinary bladder

The empty bladder has a superior surface; two infer lateral surfaces and abase the base faces posterior the lower part of the bladder which is continuous with the urethra is known as the bladder neck only the superior is covered by peritoneum (Bishop et al., 1985).

1.2.1.4 Urethra

Female urethra which is about 4 cm long lies on the anterior wall of the vagina and opens in the vestibule between the anterior ends of the labia minor and the clitoris, male urethra is about 20 cm long having three parts, it passes through the prostate deep perineal push and then through the corpus spongiosum of the penis (Bishop et al., 1985).
Figure (1.1): structure of Urinary System
(medical art library. Com)
1.2.2 Renal physiology

There are three basic renal processes:

- Glomerular filtration
- Tubular reabsorption
- Tubular secretion.

### 1.2.2.1 The Glomerular filtration:

The glomerulus is the first part of the nephron and functions to filter incoming blood. Several factors facilitate filtration; one factor is the unusually high pressure in the glomerular capillaries which is a result of their position between two arterioles. This sets up a steep pressure difference across the walls. Another factor is the semi-permeable glomerular basement membrane, which has a molecular size cut-off value of approximately 66,000 Daltons about the molecular size of albumin. This means that water, electrolytes, and small dissolved solutes, such as glucose, amino acid, low molecular weight proteins, urea, and creatinine pass freely through the basement membrane and enter the proximal convoluted tubule. Other blood constituents such as albumin, many plasma proteins, cellular elements, and protein-bound substances such as lipids and bilirubin are too large to be filtered. In addition, because the basement membrane is negatively charged, molecules such as proteins are repelled. Of the 1200-1500 ml of blood that kidneys receive each minute (approximately one-quarter of the total cardiac output), the glomerulus filters out 125-130 ml of an essentially protein-free, cell-free fluid per minute, which is the glomerular filtration rate (GFR) and its determination is essential in evaluating renal function (Bishop et al., 1985).
Figure (1.2) Structure of Kidney:
1.2.2.2 Tubular Functions:

1.2.2.2.1 Proximal convoluted tubule:

The proximal tubule is the next part of the nephron to receive the now cell-free and essentially protein-free food. This filtrate contains waste products which are toxic to the body above a certain concentration and substances that are valuable to the body. One function of the proximal tubule is to return the bulk of each valuable substance back to the blood circulation. Thus, 75% of the water, sodium, and chloride, 100% of glucose up to the renal threshold, almost all of the amino acids, vitamins, and ions such as magnesium, calcium, potassium, and bicarbonate are reabsorbed. Almost all (98% - 100%) of uric acid, a waste product, is actively reabsorbed only to be secreted at the distal end of the proximal tubule, when the substances move from the tubular lumen to the peritubular capillary plasma. The process is called tubular reabsorption. With the exception of water and chloride ions, the process is active, that is, the tubular epithelial cells use energy to bind and transport process that are involved normally have sufficient reserve for efficient reabsorption but they are saturable. When the concentration of filtered substance exceeds the capacity of the transport system, the substance is then excreted in the urine. The plasma concentration above which the substance appears in urine is known as the renal threshold and it is determination is useful in assessing both tubular function and non-renal disease states (Bishop et al., 1985).

A renal threshold does not exist for water because it is always transported passively through diffusion down diffuse in the wake of sodium.

A second function of the proximal tubule to secrete products of kidney tubular cell metabolism such as penicillin, the term tubular secretion, is used in two ways:

1. Tubular secretion describes the movement of substances from peritubular capillary plasma to the tubular lumen.

2. Tubular secretion describes when tubule cells secrete products of their own cellular metabolism into the filtrate in the tubular lumen. Transport across the membrane of the cells in again either active or passive (Bishop et al., 1985).

1.2.2.2.2 Loop of Henle:

Counter current multiplier system:

The osmolality in the medulla in the portion of the nephron increases steadily from the corticomedullary junction inward and facilitates the reabsorption of water, sodium, and chloride.
the hyperosmolality that develops in the medulla is continuously maintained by the loop of Henle, a
hairpin-like loop between the proximal tubule and the distal convoluted tubule. The opposing flows in the loop, the down ward flow in the descending limb, and the up ward flow in the ascending limb is termed a countercurrent flow. To understand how the hyperosmolality is maintained in the medulla it is best to look first at what happens in the ascending limb, sodium and chloride are actively and passively reabsorbed into the medulla interstitial fluid along the entire length of the ascending limb.

Because the ascending limb is relatively impermeable to water, little water follows and medulla interstitial fluid become hyper osmotic compared with the fluid in the ascending Limb (Bishop et al., 1985).

1.2.2.3 Distal convoluted tubule:
The distal convoluted tubule is much shorter than the proximal tubule, with two or three coils that connect to a collecting duct the filtrate entering this section of the nephron is close to its final composition. About 95% of the sodium and chloride ions and 90% of water have already been reabsorbed from the original glomerular filtrate. The function of the distal tubule is to effect small adjustments to achieve electrolyte and acid-base homestasis, these adjustments occur under the hormonal control of both anti diuretic hormone (ADH) and aldosterone (Bishop et al., 1985).

1.2.2.4 Collecting Duct:
The collecting ducts are the final site for either concentrating or diluting urine, the hormones ADH and aldosterone act on this segment of the nephron to control reabsorption of water and sodium. Chloride and urea are also reabsorbed here. Urea plays an important role in maintaining the hyperosmolality of the renal medulla. Because the collecting ducts in the medulla are highly permeable to urea, urea diffuse down its concentration gradient out of the tubule and into the medulla interstitium, increasing its osmolality (Bishop et al., 1985).
Figure (1.3): Structure of Nephron

(Rueeellkightly. Com)
1.2.3 Functions of the urinary system

Urine formation, fluid and electrolyte balance, regulation of acid-base balance, excretion of the waste products of protein metabolism, excretion of drugs and toxins, secretion of hormones (Bishop et al., 1985).

Normal Functions of the Kidneys depend on the integrity of the glomeruli and the tubular cells. Abnormal blood supply under normal circumstances about 20 percent of the cardiac output flows through the kidney, Normal secretion and feed back control of hormones acting on kidney (Mayn, 1994).

1.2.4 Renal Failure

1.2.4.1 Acute renal failure

Is a sudden sharp decline in renal function as a result of an acute toxic or hypoxic insult to the kidneys defined as occurring when the GFR is reduced to less than 10 ml/min this syndrome is subdivided into three types depending on the location of the precipitating defect (Bishop et al., 1985).

1.2.4.1.1 Pre renal failure

The defect lies in the blood supply before it reaches the kidney causes can include cardiovascular system failure and consequent hypovolemia (Bishop et al., 1985).

1.2.4.1.2 Primary renal failure

The defect involves the kidney the most common cause is acute tubular necrosis other causes include vascular obstruction, inflammation and glomerulonephritis (Bishop et al., 1985).

1.2.4.1.3 Post renal failure

The defect lies in the urinary tract after it exist the kidney, generally acute renal failure occurs as consequence of lower urinary tract obstruction or rupture of the urinary bladder.

Toxic insults to the kidney that are sever enough to initiate acute renal failure include hemolytic transfusion reactions, myeloniuria due to rhabdomyosis, heavy metal solvent poisonings, antifreeze ingestion and analgesic and amino glycoside toxicities, these conditions directly damage the renal tubules. Hypoxic insults include conditions that severely compromise renal blood flow such as septic hemorrhagic shock, burns and cardiac failure, the most commonly observed symptoms of acute renal failure are oliguria and anuria (<400 mg/dl) the diminished ability to excrete electrolytes and water results in significant increase in extra cellular fluid.
volume, leading to peripheral edema, hypertension and congestive heart failure; most prominent however is the onset of the uremic syndrome or ESRD in which increased BUN and serum creatinine values are observed along with the preceding symptoms. The outcome of this disease is either recovery or in the case of irreversible renal damage, progression to chronic renal failure (Bishop et al., 1985).

### 1.2.4.2 Chronic Renal Failure

Chronic kidney disease (CKD) is a clinical syndrome that occurs when there is gradual decline in renal function over time, according to the 2007 US Renal Data System (USRDS) Annual Data report one in nine US adults has CKD and 20 million more are at risk, early detection and treatment are needed to prevent progression to ESRD and complications such as coronary vascular disease. The national kidney foundation has formulated guidelines for earlier diagnosis, treatment and prevention of further disease progression. GFR and evidence of kidney damage based on measurement of proteinuria or other markers form the basis of the classification. The conditions that can precipitate acute renal failure also may lead to chronic renal failure (Bishop et al., 1985).

### 1.2.4.3 Increasing Incidence of chronic kidney disease

There is an increasing incidence of CKD in the US due to the increase in diabetes. Diabetes mellitus can have profound effects on the renal system. Patients with type 1 diabetes have an insulin deficit approximately 45% of patients with type 1 diabetes will develop progressive deterioration of kidney function (Diabetic nephropathy) within 15–20 years after diagnosis, a smaller percentage of persons with type 2 diabetes will also develop this condition. The effects are primarily glomerular but they may affect all kidney structures as well and are theorized to be caused by the abnormally hyperglycemic environment that constantly bathes the vascular system (Bishop et al., 1985).

### 1.2.4.4 Therapy of acute renal failure

#### 1.2.4.4.1 Dialysis

In patients with acute renal failure, uremic symptoms uncontrolled hyperkalemia and acidosis have traditionally been indications that the kidneys are unable to excrete the body’s waste products and substitute method in the form dialysis was necessary. Dialysis is often institute
before this stage however several forms of dialysis are available however they all use a semi permeable membrane surrounded by adialysate bath (Bishop et al., 1985).

In traditional hemodialysis (remove the waste from blood) the membrane is synthetic and outside the body, arterial blood and dialyzed are pumped at high rates (150_250ml \text{ min}) and 500 ml/min respectively in opposite directions. The blood is returned to the venous circulation and the dialysate discarded the diffusion of low molecular weight solutes (<500Da) into the dialysate is favored by the process but mid –molecular weight solutes (500_2000Da) are in adequately cleared creatinine clearance is about 150_160ml/min(Bishop et al., 1985).

1.2.4.4.2 Therapy of the End _stage renal disease

For patients with irreversible renal failure, dialysis and transplantation are the only two therapeutic options, initiation of either treatment occurs when the GFR falls to 5ml/min (10_15ml/min) in patients with diabetic nephropathy (Bishop et al., 1985).

1.2.4.4.2.1 Dialysis

traditional hem dialysis or it its more recent high efficiency form as well as peritoneal dialysis are the available methods the clinical laboratory used in conjunction with ahemodialysis facility must be able to adequately monitor procedural efficiency a wide variety of areas, renal dialysis has basic goals and specific laboratory tests should be performed to evaluate the achievement of each goal (Bishop et al., 1985).

1.2.4.4.2.2 Transplantation

The most efficient hemodialysis techniques provide only 10%_12% of the small solute removal of two normal kidneys and considerably less removal of larger solutes even patients who are well dialyzed have physical disabilities and decreased quality of life

Kidney transplantation offers the greatest chance for full return to healthy productive life however this option is limited by the significant shortage of donor organs for ESRD patients waiting for an organ donation can vary from several months to several years(Bishop et al., 1985).

1.2.4.5 Lipids

Constitute a group of naturally occurring molecules that include fats, waxes, sterols, fat-solublevitamins(such as vitamins A, D, E, and K), monoglycerides, diglycerides, triglycerides, phospholipids,and others. The
main biological functions of lipids include energy storage, signaling, and acting as structural components of cell membranes (Mashaghi et al, 2013).

Lipids have found applications in cosmetic and food industries as well as in nanotechnology (Stryer et al, 1998).

Lipids may be broadly defined as hydrophobic or amphiphilic small molecules; the amphiphilic nature of some lipids allows them to form structures such as vesicles, liposome’s, or membranes in an aqueous environment. Biological lipids originate entirely or in part from two distinct types of biochemical subunits or "building-blocks" ketoacyl and isoprene group Using this approach, lipids may be divided into eight categories fatty acids, glycerolipids, glycerophospholipids, sphingolipids, saccharolipids, and polyketides (derived from condensation of ketoacyl subunits); and sterol lipids and prenol lipid (derived from condensation of isoprene subunits).

Although the term lipid is sometimes used as a synonym for fats, fats are a subgroup of lipids called triglycerides. Lipids also encompass molecules such as fatty acids and their derivatives (including tri-, di-, monoglycerides, and phospholipids), as well as other sterol containing metabolites such as cholesterol (Stryer et al, 1998).

Although humans and other mammals use various biosynthetic pathways to both break down and synthesize lipids, some essential lipids cannot be made this way and must be obtained from the diet.

1.2.4.5.1 Categories of lipids

1.2.4.5.1.1 Fatty acids

Fatty acids, or fatty acid residues when they form part of a lipid, are a diverse group of molecules synthesized by chain-elongation of an acetyl-CoA primer with
malonyl-CoA or methylmalonyl-CoA groups in a process called fatty acid synthesis (Subramaniam et al, 2011).

They are made of a hydrocarbon chain that terminates with a carboxylic acid group; this arrangement confers the molecule with a polar, hydrophilic end, and a nonpolar, hydrophobic end that is insoluble in water. The fatty acid structure is one of the most fundamental categories of biological lipids, and is commonly used as a building-block of more structurally complex lipids. The carbon chain, typically between four and 24 carbons long (Mashaghi et al, 2013), may be saturated or unsaturated, and may be attached to functional groups containing oxygen, halogens, nitrogen, and sulfur. Where a double bond exists, there is the possibility of either a cis or trans geometric isomerism, which significantly affects the molecule’s configuration. Cis-double bonds cause the fatty acid chain to bend, an effect that is compounded with more double bonds in the chain. This in turn plays an important role in the structure and function of cell membranes. Most naturally occurring fatty acids are of the cis configuration, although the transform does exist in some natural and partially hydrogenated fats and oils (Michelle et al, 1993).

Examples of biologically important fatty acids are the eicosanoids, derived primarily from arachidonic acid and eicosapentaenoic acid, that include prostaglandins, leukotrienes, and thromboxanes. Docosahexaenoic acid is also important in biological systems, particularly with respect to sight. (Vance JE, et al, 2002).

Other major lipid classes in the fatty acid category are the fatty esters and fatty amides. Fatty esters include important biochemical intermediates such as wax esters, fatty acid thioestercoenzyme A derivatives, fatty acid thioesterACP derivatives and fatty acid carnitines. The fatty amides include N-acyl
ethanolamines, such as the cannabinoid neurotransmitter anandamide (Huntet al, 1995).

1.2.4.5.1.2 Glycerolipids
Glycerolipids are composed mainly of mono-, di-, and tri-substituted glycerol’s, the most well-known being the fatty acid triesters of glycerol, called triglycerides. The word "triacylglycerol" is sometimes used synonymously with "triglyceride", though the latter lipid contains no hydroxyl group. In these compounds, the three hydroxyl groups of glycerol are each esterified, typically by different fatty acids. Because they function as an energy store, these lipids comprise the bulk of storage fat in animal tissues. The hydrolysis of the ester bonds of triglycerides and the release of glycerol and fatty acids from adipose tissue are the initial steps in metabolizing fat (Fezzaet al, 2008).

Additional subclasses of glycerolipids are represented by glycosylglycerols, which are characterized by the presence of one or more sugar residues attached to glycerol via a glycosidic linkage. Examples of structures in this category are the digalactosyldiacylglycerols found in plant membranes and seminolipid from mammalian sperm cells (Hölzlet al, 2007).

1.2.4.5.1.3 Glycerophospholipids
Glycerophospholipids, usually referred to as phospholipids, are ubiquitous in nature and are key components of the lipid bilayer of cells, as well as being involved in metabolism and cell signaling. Neural tissue (including the brain) contains relatively high amounts of glycerophospholipids, and an alteration in their composition has been implicated in various neurological disorders. Glycerophospholipids may be subdivided into distinct classes, based on the nature of the polar headgroup at the sn-3 position of the glycerol backbone in eukaryotes and eubacteria, or the sn-1 position in the case of archaebacteria (Hölzlet al, 2004).
Examples of glycerophospholipids found in biological membranes are phosphatidylcholine (also known as PC, GPCho or lecithin), phosphatidylethanolamine (PE or GPEtn) and phosphatidylserine (PS or GPSer). In addition to serving as a primary component of cellular membranes and binding sites for intra- and intercellular proteins, some glycerophospholipids in eukaryotic cells, such as phosphatidylinositol and phosphatidic acids are either precursors of or, themselves, membrane-derived second messengers. Typically, one or both of these hydroxyl groups are acylated with long-chain fatty acids, but there are also alkyl-linked and 1Z-alkenyl-linked (plasmalogen) glycerophospholipids, as well as dialkylether variants in archaeabacteria (Berridge et al, 1998).

1.2.4.5.1.4 Sphingolipids

Sphingolipids are a complicated family of compounds that share a common structural feature, a sphingoid base backbone that is synthesized de novo from the amino acid serine and a long-chain fatty acyl CoA, then converted into ceramides, phosphosphingolipids, glycosphingolipids and other compounds. The major sphingoid base of mammals is commonly referred to as sphingosine. Ceramides (N-acyl-sphingoid bases) are a major subclass of sphingoid base derivatives with an amide-linked fatty acid. The fatty acids are typically saturated or mono-unsaturated with chain lengths from 16 to 26 carbon atoms (Farooqui et al, 2000). The major phosphosphingolipids of mammals are sphingomyelins (ceramidephosphocholines), whereas insects contain mainly ceramidephosphoethanolamines and fungi have phytoceramidephosphoinositols and mannose-containing headgroups. The glycosphingolipids are a diverse family of molecules composed of one or more sugar residues linked via a glycosidic bond to the sphingoid base. Examples of these are the simple and complex glycosphingolipids such as cerebrosides and gangliosides.

1.2.4.5.1.5 Sterol lipids
Sterol lipids, such as cholesterol and its derivatives, are an important component of membrane lipids (Merrill et al., 2002). along with the glycerophospholipids and sphingomyelins. The steroids, all derived from the same fused four-ring core structure, have different biological roles as hormones and signaling molecules. The eighteen-carbon (C18) steroids include the estrogen family whereas the C19 steroids comprise the androgens such as testosterone and androsterone. The C21 subclass includes the progestogens as well as the glucocorticoids and mineralocorticoids. The secosteroids, comprising various forms of vitamin D, are characterized by cleavage of the B ring of the core structure. Other examples of sterols are the bile acids and their conjugates, which in mammals are oxidized derivatives of cholesterol and are synthesized in the liver. The plant equivalents are the phytosterols, such as β-sitosterol, stigmasterol, and brassicasterol; the latter compound is also used as a biomarker for algal growth. The predominant sterol in fungal cell membranes is ergosterol (Guan et al., 2008)

1.2.4.5.1.6 Prenol lipids

Prenol lipids are synthesized from the five-carbon-unit precursors isopentenyl diphosphate and dimethylallyl diphosphate that are produced mainly via the mevalonic acid (MVA) pathway. The simple isoprenoids (linear alcohols, diphosphates, etc.) are formed by the successive addition of C5 units, and are classified according to number of these terpene units. Structures containing greater than 40 carbons are known as polyterpenes. Carotenoids are important simple isoprenoids that function as antioxidants and as precursors of vitamin A. Another biologically important class of molecules is exemplified by the quinones and hydroquinones, which contain an isoprenoid tail attached to a quinonoid core of non-isoprenoid origin. Vitamin E and vitamin K, as well as the ubiquinones, are examples of this class. Prokaryotes synthesize polyprenols (called bactoprenols) in which the terminal isoprenoid unit attached to oxygen remains unsaturated,
whereas in animal polyrenols (dolichols) the terminal isoprenoid is reduced (Russell, 2003).

### 1.2.4.5.1.7 Saccharolipids

Structure of the saccharolipid Kdo$_2$-Lipid A. Glucosamine residues in blue, Kdo residues in red, acyl chains in black and phosphate groups in green.

Saccharolipids describe compounds in which fatty acids are linked directly to a sugar backbone, forming structures that are compatible with membrane bilayers. In the saccharolipids, a monosaccharide substitutes for the glycerol backbone present in glycerolipids and glycerophospholipids. The most familiar saccharolipids are the acylated-glucosamine precursors of the Lipid A component of the lipopolysaccharides in Gram-negative bacteria. Typical lipid A molecules are disaccharides of glucosamine, which are derivatized with as many as seven fatty-acyl chains. The minimal lipopolysaccharide required for growth in E. coli is Kdo$_2$-Lipid A, a hexa-acylated disaccharide of glucosamine that is glycosylated with two 3-deoxy-D-manno-octulosonic acid (Kdo) residues (Kuzuyama 

### 1.2.4.5.1.8 Polyketides

Polyketides are synthesized by polymerization of acetyl and propionyl subunits by classic enzymes as well as iterative and multimodular enzymes that share mechanistic features with the fatty acid synthases. They comprise a large number of secondary metabolites and natural products from animal, plant, bacterial, fungal and marine sources, and have great structural diversity. Many polyketides are cyclic molecules whose backbones are often further modified by glycosylation, methylation, hydroxylation, oxidation, and/or other processes. Many commonly used anti-microbial, anti-parasitic, and anti-cancer agents are polyketides or polyketide derivatives, such as erythromycins, tetracyclines, avermectins, and antitumor epothilones (Brunmark, 1989)

### 1.2.4.5.2 Biological functions
1.2.4.5.2.1 Membranes

Eukaryotic cells are compartmentalized into membrane-bound organelles that carry out different biological functions. The glycerophospholipids are the main structural component of biological membranes, such as the cellular plasma membrane and the intracellular membranes of organelles; in animal cells the plasma membrane physically separates the intracellular components from the extracellular environment. The glycerophospholipids are amphipathic molecules (containing both hydrophobic and hydrophilic regions) that contain a glycerol core linked to two fatty acid-derived "tails" by ester linkages and to one "head" group by a phosphate ester linkage. While glycerophospholipids are the major component of biological membranes, other non-glyceride lipid components such as sphingomyelin and sterols (mainly cholesterol in animal cell membranes) are also found in biological membranes (Swiezewska et al, 2005).

In plants and algae, the galactosyldiacylglycerols, and sulfoquinovosyldiacylglycerol, which lack a phosphate group, are important components of membranes of chloroplasts and related organelles and are the most abundant lipids in photosynthetic tissues, including those of higher plants, algae and certain bacteria.

Bilayers have been found to exhibit high levels of birefringence, which can be used to probe the degree of order (or disruption) within the bilayer using techniques such as dual polarization interferometry and Circular dichroism.

A biological membrane is a form of lipid bilayer. The formation of lipid bilayers is an energetically preferred process when the glycerophospholipids described above are in an aqueous environment. This is known as the hydrophobic effect. In an aqueous system, the polar heads of lipids align towards the polar, aqueous environment, while the hydrophobic tails minimize their contact with water and tend to cluster together, forming a vesicle; depending on the concentration of the
lipid, this biophysical interaction may result in the formation of micelles, liposomes, or lipid bilayers. Other aggregations are also observed and form part of the polymorphism of amphiphile (lipid) behavior. Phase behavior is an area of study within biophysics and is the subject of current academic research. Micelles and bilayers form in the polar medium by a process known as the hydrophobic effect. When dissolving a lipophilic or amphiphilic substance in a polar environment, the polar molecules (i.e., water in an aqueous solution) become more ordered around the dissolved lipophilic substance, since the polar molecules cannot form hydrogen bonds to the lipophilic areas of the amphiphile. So in an aqueous environment, the water molecules form an ordered "clathrate" cage around the dissolved lipophilic molecule (Stryer et al, 1998).

1.2.4.5.2.2Energy storage
Triglycerides, stored in adipose tissue, are a major form of energy storage both in animals and plants. The adipocyte, or fat cell, is designed for continuous synthesis and breakdown of triglycerides in animals, with breakdown controlled mainly by the activation of hormone-sensitive enzyme lipase. The complete oxidation of fatty acids provides high caloric content, about 9 kcal/g, compared with 4 kcal/g for the breakdown of carbohydrates and proteins. Migratory birds that must fly long distances without eating use stored energy of triglycerides to fuel their flights (van Meer et al, 2008).

1.2.4.5.2.3Signaling
In recent years, evidence has emerged showing that lipid signaling is a vital part of the cell signaling. Lipid signaling may occur via activation of G protein-coupled or nuclear receptors, and members of several different lipid categories have been identified as signaling molecules and cellular messengers. These include sphingosine-1-phosphate, a sphingolipid derived from ceramide that is a potent messenger molecule involved in regulating calcium mobilization, cell growth, and
apoptosis; diacylglycerol (DAG) and the phosphatidylinositol phosphates (PIPs), involved in calcium-mediated activation of protein kinase C; the prostaglandins, which are one type of fatty-acid derived eicosanoid involved in inflammation and immunity; the steroid hormones such as estrogen, testosterone and cortisol, which modulate a host of functions such as reproduction, metabolism and blood pressure; and the oxysterols such as 25-hydroxy-cholesterol that are liver X receptor agonists. Phosphatidylserine lipids are known to be involved in signaling for the phagocytosis of apoptotic cells and/or pieces of cells. They accomplish this by being exposed to the extracellular face of the cell membrane after the inactivation of flippases which place them exclusively on the cytosolic side and the activation of scramblases, which scramble the orientation of the phospholipids. After this occurs, other cells recognize the phosphatidylserines and phagocytosize the cells or cell fragments exposing them (Dinasarapu et al, 2011).

1.2.4.5.2.4 Other functions

The "fat-soluble" vitamins (A, D, E and K) – which are isoprene-based lipids – are essential nutrients stored in the liver and fatty tissues, with a diverse range of functions. Acyl-carnitines are involved in the transport and metabolism of fatty acids in and out of mitochondria, where they undergo beta oxidation. Polyprenols and their phosphorylated derivatives also play important transport roles, in this case the transport of oligosaccharides across membranes. Polyprenol phosphate sugars and polyprenoldiphosphate sugars function in extra-cytoplasmic glycosylation reactions, in extracellular polysaccharide biosynthesis (for instance, peptidoglycan polymerization in bacteria), and in eukaryotic protein N-glycosylation. Cardiolipins are a subclass of glycerophospholipids containing four acyl chains and three glycerol groups that are particularly abundant in the inner mitochondrial membrane. They are believed to activate enzymes involved with
oxidative phosphorylation. Lipids also form the basis of steroid hormones (Nowicki et al, 2005).

1.2.4.5.3 Metabolism

The major dietary lipids for humans and other animals are animal and plant triglycerides, sterols, and membrane phospholipids. The process of lipid metabolism synthesizes and degrades the lipid stores and produces the structural and functional lipids characteristic of individual tissues.

1.2.4.5.3.1 Biosynthesis

In animals, when there is an oversupply of dietary carbohydrate, the excess carbohydrate is converted to triglycerides. This involves the synthesis of fatty acids from acetyl-CoA and the esterification of fatty acids in the production of triglycerides, a process called lipogenesis. Fatty acids are made by fatty acid synthases that polymerize and then reduce acetyl-CoA units. The acyl chains in the fatty acids are extended by a cycle of reactions that add the acetyl group, reduce it to an alcohol, dehydrate it to an alkene group and then reduce it again to an alkane group. The enzymes of fatty acid biosynthesis are divided into two groups, in animals and fungi all these fatty acid synthase reactions are carried out by a single multifunctional protein, (Hoch FL, et al, 1992). while in plant plastids and bacteria separate enzymes perform each step in the pathway (Billimoria et al, 1975), (Muscatet al, 1991).

The fatty acids may be subsequently converted to triglycerides that are packaged in lipoproteins and secreted from the liver.

The synthesis of unsaturated fatty acids involves a desaturation reaction, whereby a double bond is introduced into the fatty acyl chain. For example, in humans, the desaturation of stearic acid by stearoyl-CoA desaturase-1 produces oleic acid. The doubly unsaturated fatty acid linoleic acid as well as the triply unsaturated α-
linolenic acid cannot be synthesized in mammalian tissues, and are therefore essential fatty acids and must be obtained from the diet (Criqui, et al, 1980).

Triglyceride synthesis takes place in the endoplasmic reticulum by metabolic pathways in which acyl groups in fatty acyl-CoAs are transferred to the hydroxyl groups of glycerol-3-phosphate and diacylglycerol.

Terpenes and isoprenoids, including the carotenoids, are made by the assembly and modification of isoprene units donated from the reactive precursors isopentenyl pyrophosphate and dimethylallyl pyrophosphate. These precursors can be made in different ways. In animals and archaea, the mevalonate pathway produces these compounds from acetyl-CoA, while in plants and bacteria the non-mevalonate pathway uses pyruvate and glyceraldehyde 3-phosphate as substrates. One important reaction that uses these activated isoprene donors is steroid biosynthesis. Here, the isoprene units are joined together to make squalene and then folded up and formed into a set of rings to make lanosterol. Lanosterol can then be converted into other steroids such as cholesterol and ergosterol (Goldbourt et al, 1985).

1.2.4.5.3.2 Degradation

Beta oxidation is the metabolic process by which fatty acids are broken down in the mitochondria and/or in peroxisomes to generate acetyl-CoA. For the most part, fatty acids are oxidized by a mechanism that is similar to, but not identical with, a reversal of the process of fatty acid synthesis. That is, two-carbon fragments are removed sequentially from the carboxyl end of the acid after steps of dehydrogenation, hydration, and oxidation to form a beta-keto acid, which is split by thiolysis. The acetyl-CoA is then ultimately converted into ATP, CO₂, and H₂O using the citric acid cycle and the electron transport chain.

Hence the Krebs Cycle can start at acetyl-CoA when fat is being broken down for energy if there is little or no glucose available.
The energy yield of the complete oxidation of the fatty acid palmitate is 106 ATP. Unsaturated and odd-chain fatty acids require additional enzymatic steps for degradation (Goldbournet al., 1985).

1.2.4.5.4 Hemodialysis (artificial kidney)

Is the replacement of certain elements from the blood by use of the difference in the rates of either diffusion through a semipermeable membrane. It is used to remove toxic substance from the blood when the kidney are not able to remove them satisfactorily from the circulation (Norbert, 2001).

Severe loss of kidney function either acutely or chronically, is a threat to life, requires removal of toxic waste products and restoration of body fluid volume and composition toward normal. This can be accomplished by dialysis with an artificial kidney. In certain types of acute renal failure an artificial kidneys may be used to tide the patient over until the kidneys resume their function if the loss of function irreversible, it is necessary to perform dialysis chronically to maintain life (Norbert, 2001).

Thousands of people with irreversible renal failure or even total kidney removed are being maintained for 15 to 20 years by dialysis with artificial kidneys because dialysis with artificial kidney can not maintain completely normal body fluid composition and can not replace all multiple functions performed by the kidney, the health of patients maintained on artificial kidneys usually remains significantly impaired. A better treatment for permanent loss of kidney function is to restore functional kidney tissue by means of kidney transplant (Norbert, 2001).

1.2.4.5.4.1 Basic principle of dialysis

The basic principle of the artificial kidney is to pass blood through minute blood channels bounded by a thin membrane. On other side of the membrane is a
dialyzing fluid into which unwanted substances in the blood pass by diffusion (Arthur, 2000).

Figure (1.4) shows the components of one type of artificial kidney in which blood flows continually between two thin membrane of cellophane, outside the membrane is dialyzing fluid, the cellophane is porous enough to allow the constituents of the plasma, except the plasma proteins to diffuse in both directions from plasma into the dialyzing fluid or from the dialyzing fluid back into the plasma if the concentration of a substance is greater in the plasma than in the dialyzing fluid there will be net transfer of the substance from the plasma into dialyzing fluid (Arthur, 2000).

The rate of movement of solute across the dialyzing membrane depends on:

(a) Concentration gradient of the solute between the two solutions.

(b) The permeability of the membrane to the solute.

(c) The surface area of the membrane.

(d) The length of time that the blood and fluid remain in contact with the membrane.

Thus the maximum rate of the solute transfer occurs initially when the concentration gradient is greatest (when dialysis is begun) and slows down as the concentration gradient is dissipated. In a flowing system as is the case with hemodialysis.

In which blood and dialysate fluid flow through the artificial kidney the dissipation of the concentration gradient can be reduced and diffusion of solute across the membrane can be optimized by increasing the flow rate of either or both the blood and the dialyzing fluid (Arthur, 2000).
In normal operation of the artificial kidney, blood flows continually or intermittently back into the vein. The total amount of blood in artificial kidney at many one time is usually less than 500 milliliters; the rate of flow may be several hundred milliliters per minute and the total diffusion surface area between 0.6-2.5 square meters. To prevent coagulation of the blood in fused into the blood as it enters the artificial kidney (Arthur, 2000).

In addition to diffusion of solutes mass transfer of solutes and water can be produced by applying hydrostatic pressure to force the fluid and solutes by the process of filtration across the membranes of the dialyzer, such filtration is called bulk flow (Arthur, 2000).

1.2.4.5.4.2 Dialyzing Fluid

Note that the concentrations of ions and other substances in normal plasma or uremic plasma. Instead, they are adjusted to levels that are needed to cause appropriate movement of water and solutes through the membrane during the dialysis.

Note that there is no phosphate, urea, urate, sulfate or creatinine in the dialyzing fluid, however these are present in high concentration in the uremic blood.

Therefore when the uremic patient is dialyzed, these substances are lost in large quantities into the dialyzing fluid (Arthur, 2000).

1.2.4.5.4.3 Types of hemodialysis

There are three types of hemodialysis: conventional hemodialysis, daily hemodialysis, and nocturnal hemodialysis. Below is the adaption and summary from a brochure of The Ottawa Hospital (Arthur, 2000).
a. Conventional hemodialysis

Chronic hemodialysis is usually done three times per week, for about 3–4 hours for each treatment, during which the patient's blood is drawn out through a tube at a rate of 200-400 mL/min. The tube is connected to a 15, 16, or 17 gauge needle inserted in the dialysis fistula or graft, or connected to one port of a dialysis catheter. The blood is then pumped through the dialyzer, and then the processed blood is pumped back into the patient's bloodstream through another tube (connected to a second needle or port). During the procedure, the patient's blood pressure is closely monitored, and if it becomes low, or the patient develops any other signs of low blood volume such as nausea, the dialysis attendant can administer extra fluid through the machine. During the treatment, the patient's entire blood volume (about 5000 cc) circulates through the machine every 15 minutes. During this process, the dialysis patient is exposed to a week's worth of water for the average person (Arthur, 2000).

B. Daily hemodialysis:

Daily hemodialysis is typically used by those patients who do their own dialysis at home. It is less stressful (more gentle) but does require more frequent access. This is simple with catheters, but more problematic with fistulas or grafts. The "buttonhole technique" can be used for fistulas requiring frequent access. Daily hemodialysis is usually done for 2 hours six days a week (Arthur, 2000).
C. Nocturnal hemodialysis:

The procedure of nocturnal hemodialysis is similar to conventional hemodialysis except it is performed three to six nights a week and between six and ten hours per session while the patient sleeps (Arthur, 2000).
Figure (1.5): Show components of one type of artificial kidney

(psu. Edu.com)
The hemodialysis machine pumps the patient's blood and the dialysate through the dialyzer. The newest dialysis machines on the market are highly computerized and continuously monitor an array of safety-critical parameters, including blood and dialysate flow rates; dialysis solution conductivity, temperature, and pH; and analysis of the dialysate for evidence of blood leakage or presence of air. Any reading that is out of normal range triggers an audible alarm to alert the patient-care technician who is monitoring the patient. Manufacturers of dialysis machines include companies such as Nipro, Fresenius, Gambro, Baxter, B. Braun, NxStage and Bellco (Arthur, 2000).

**Dialyzer**

The dialyzer is the piece of equipment that actually filters the blood. Almost all dialyzers in use today are of the hollow-fiber variety. A cylindrical bundle of hollow fibers, whose walls are composed of semi-permeable membrane, is anchored at each end into potting compound (a sort of glue). This assembly is then put into a clear plastic cylindrical shell with four openings. One opening or blood port at each end of the cylinder communicates with each end of the bundle of hollow fibers. This forms the "blood compartment" of the dialyzer. Two other ports are cut into the side of the cylinder. These communicate with the space around the hollow fibers, the "dialysate compartment." Blood is pumped via the blood ports through this bundle of very thin capillary-like tubes, and the dialysate is pumped through the space surrounding the fibers. Pressure gradients are applied when necessary to move fluid from the blood to the dialysate compartment (Arthur, 2000).
Lipid and lipoprotein in chronic renal failure

Dyslipidemia, is often observed in patients with CRF, resulting in abnormal concentrations and composition of plasma lipoproteins. Plasma triglyceride concentration is frequently elevated in patients with CRF. However, plasma cholesterol concentration is usually normal, even reduced, and only occasionally elevated in patients with end stage renal disease (ESRD). Elevation of Plasma triglyceride in ESRD patients is accompanied by increased plasma concentration and impaired clearance of VLDL. This associated with the accumulation of atherogenic VLDL remnants, commonly known as IDL. Similarly, clearance of chylomicrons is impaired and plasma concentration of chylomicrons remnants is elevated in CRF patients. In contrast, plasma concentration of LDL is usually normal and only occasionally elevated in patients with end stage renal disease (ESRD). Plasma HDL concentration is consistently reduced, and maturation of cholesterol ester poor HDL-3 to cholesterol ester rich cardio protective HDL-2 is impaired in CRF. In addition to these quantitative abnormalities, the composition of plasma lipoproteins is altered in CRF e.g. the cholesterol content of VLDL is relatively increased and its triglyceride content is relatively reduced in CRF. In contrast CRF result in a relative reduction in cholesterol and relative increase in the triglyceride content of LDL. Similarly, cholesterol ester and free cholesterol of HDL are consistently reduced, where its triglyceride cotent is elevated in CRF. The above composition of abnormalities are present in nearly all patients with mild to sever renal insufficiency (even those with normal plasma total cholesterol and triglyceride level) and point to redistribution of cholesterol from HDL to IDL and defective removal of triglycerides from LDL and HDL particle (fytili and chanet al, 1981).
1.4 Rationale

Renal failure in sudan is a common disease, the incidence for new cases is increasing. The majority are young adult patients (below 50 year old) and most die before reaching medical attention. The incidence of cardiovascular complication is also abnormally elevated in patients with chronic renal failure.

There is limited local data about the effect of chronic renal failure on serum levels of total cholesterol, triglyceride and high density lipoprotein cholesterol in Sudanese patients.

This study will help health authorities to evaluate the problem more objectively and to implement appropriate measures for early prediction of cardiovascular and atherosclerosis in chronic renal failure.
1.5 Objectives:

1.5.1 General objectives:
To study the effect of hemodialysis on total cholesterol, triglyceride and high density lipoprotein cholesterol level in serum of renal failure patients.

1.5.2 Specific Objectives:
- To correlate between duration of disease and level of serum total cholesterol, triglyceride and high density lipoprotein cholesterol before dialysis.
- To compare between serum cholesterol, triglyceride and HDL- levels before and after hemodialysis.
2. Materials and methods

2.1 Study design
It is a Descriptive cross-sectional hospital base study.

2.2 Study area
The study was done in IBN SINA Hospital, Khartoum state, Sudan.

2.3 Study period
The study was carried during the period from March and June 2014.

2.4 Target population
Sudanese patients with chronic renal failure (males and females) under hemodialysis.

2.5 Inclusion criteria and exclusion
Inclusion criteria people whom have chronic renal failure under went regular hemodialysis.
Exclusion criteria people who have gout, hypertension and DM and bone diseases.

2.6 Sample size
50 patients with chronic renal failure and 30 healthy people as control.

2.7 Ethical consideration
Permission of this study was obtained from the college of medical laboratory science sudan university of science and technology.
The objectives of the study were explained to all individuals participating in the study.
An informed consent was obtained from each participant in the study.

2.8 Sampling
Venous blood collected (2.5ml) in plain container, then immediately centrifuged at 3000 rpm for 5 minutes, serum obtained and stored at -21°C until used.

2.9 Method
Serum total cholesterol, high density lipoprotein and triglyceride were measured using Mindary BS 200 analyzer, This analyzer is fully automated computerized and include: photometric measuring system analytical processing unit, screen and printer.

Analytical unit operating principle
The general sequences of events are:
- The sample disk rotates the appropriate sample to the sample probe.
- The sample probe aspirates sample for testing.
- The sample is delivered into the reaction cell, the reagent probe adds up the reagents in separate dispense cycle.
- Incubation occurs as the reaction cell is measured in the incubation bath below thereaction disk, reaction cell rotate through the photometer light path and measurement is taken.

2.9.1 Determination of total cholesterol
Biosystem cholesterol reagent was used
Cholesterol oxidase – peroxidase enzymatic (CHOD-POD) method

3.2.1.1 Principle
The cholesterol present in the sample originates a colored complex according to the following reaction:
Cholesterol ester + H2O -----(CHE)---- cholesterol + fatty acid
Cholesterol + O2 ------- (cholesterol oxidase) cholest-4-en-3-one+H2O
H2O is then measured in a peroxidase catalyzed reaction that forms a colored dye.
H2O2 + phenol+ 4 – aminoantipyrine ---- peroxidase ------ quinoneimine dye + 2H2O.
(tietz, 2005), (friedman and young, 2001).

2.9.1.8 Quality control
Control sera normal and pathological were used for monitoring the validity of the reaction. These controls should be run at least with every working shift in which total cholesterol determinations are performed.

2.9. 2 Determination of high density lipoprotein cholesterol
Biosystem cholesterol HDL precipitating reagent was used

2.9. 2.1 Principle
The very low density VLDL and low density LDL in the sample precipitate with phosphotungstate and magnesium iron. The supernatant contains high density lipoprotein HDL.

The HDL cholesterol is colorimetrically by means of coupled reaction
Cholesterol ester + H2O ------- CHE---------- cholesterol + fatty acid
Cholesterol + ½ O2 + H2O ---------cholesterol oxidase------- cholestronone+ H2O2
2H2O2 + 4-amioantipyrine+ phenol-----peroxidase------ quinoneimine + 4H2O

2.9. 2.2 Procedure
Precipitation:
Post testpipette into label centrifuge tube, from sample 0.1ml added to it 0.5ml of reagent (A) (cholesterol HDL), mixed thoroughly and let stand for 10 minute at room temperature, centrifuged and minimum of 4000rpm for 10 minute, carefully collect the supernatant.
200µL from Reagent and 4µL from sample to the reaction disk automatically by the analyzer.
(Grove et al, 1979), (NCEP, 2001), (friedman et al, 2001), (tietz, 2005).

2.9.3 Estimation of Triglyceride

2.9.3.1 Principle
Triglyceride in the sample originates, by means of coupled reactions described below, a coloured complex that can be measured by spectrophotometer.

\[
\begin{align*}
\text{Triglyceride} + \text{H}_2\text{O} & \rightarrow \text{Glycerol} + \text{fatty acids} \\
\text{Glycerol} + \text{ATP} & \rightarrow \text{Glycerol-3-P} + \text{ADP} \\
\text{Glycerol-3-P} + \text{O}_2 & \rightarrow \text{Dihydroxyacetone-P} + \text{H}_2\text{O}_2
\end{align*}
\]

\[2\text{H}_2\text{O}_2 + 4\text{- Aminoantipyrine} + 4\text{- chlorophenol} \rightarrow \text{Quinoneimine} + 4\text{H}_2\text{O}\]


2.9.3.2 Quality control
It is recommended that each run contain a normal control with assayed values, the use of this material checks both instrument and reagent functions together.

2.10 Statistical method
- SPSS package was used for the analysis of the result. Paired sample T test was used.
3. Results

Fifty patients with chronic renal failure (29 males and 21 females) minimum age 24 years maximum age 79 years and mean of age 50 years from IBN SINA Hospital were enrolled in the study as a test group and 30 healthy people as control.

1- Table (3.1): Show Sex frequency for patients with chronic renal failure.

2- Table (3.2): Show mean of Age, minimum and maximum.

3- Table (3.3): Show Age group.

4- Table (3.4): Show mean of total cholesterol (mg/dl) in patients with chronic renal failure before dialysis with after dialysis.

5- Table (3.5): Show mean of total cholesterol (mg/dl) in patients with chronic renal failure before dialysis compare with control.

6- Table (3.5): Show mean of triglyceride (mg/dl) in patients with chronic renal failure before dialysis with after dialysis.

7- Table (3.7): Show mean of triglyceride (mg/dl) in patients with chronic renal failure before dialysis compare with control

8- Table (3.6): Show mean of HDL (mg/dl) in patients with chronic renal failure before dialysis with after dialysis.
9- Table (3.9): Show mean of HDL cholesterol (mg/dl) in patients with chronic renal failure before dialysis compare with control

10- Figure (3.1): scatter plot correlation between duration of disease and Serum total cholesterol insignificant no correlation (P.value =0.33 r = -0.13).

11- Figure (3.2): scatter plot correlation between duration of disease and Serum HDL insignificant no correlation (P.value =0.8 r = 0.03).

12- Figure (3.3): scatter plot correlation between duration of disease and Serum HDL insignificant no correlation (P.value =0.33 r = -0.13)
Table (3.1): Show Sex frequency for patients with chronic renal failure.

<table>
<thead>
<tr>
<th>Sex</th>
<th>No</th>
<th>Percent%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>29</td>
<td>58%</td>
</tr>
<tr>
<td>Female</td>
<td>21</td>
<td>42%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table (3.2): Show mean of Age, minimum and maximum.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>50</td>
<td>24</td>
<td>79</td>
</tr>
</tbody>
</table>

Table (3.3): Show Age group.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Frequency</th>
<th>Percent%</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-40</td>
<td>14</td>
<td>28%</td>
</tr>
<tr>
<td>40-60</td>
<td>22</td>
<td>44%</td>
</tr>
<tr>
<td>60-80</td>
<td>14</td>
<td>28%</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table (3.4): Show mean of total cholesterol (mg/dl) in patients with chronic renal failure before dialysis with after dialysis:

<table>
<thead>
<tr>
<th>Total cholesterol (mg/dl)</th>
<th>Mean ± SD mg ( \text{dl} )</th>
<th>P.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predialysis</td>
<td>137± 38</td>
<td>0.03</td>
</tr>
<tr>
<td>Post dialysis</td>
<td>155± 45</td>
<td></td>
</tr>
</tbody>
</table>
- P value considered significant level ≤ 0.05

Table (3.5): Show mean of total cholesterol (mg/dl) in patients with chronic renal failure before dialysis compare with control:

<table>
<thead>
<tr>
<th>Total cholesterol (mg/dl)</th>
<th>Mean ± SD</th>
<th>P.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Pre dialysis</td>
<td>.022</td>
</tr>
<tr>
<td>121± 22</td>
<td>137± 38</td>
<td></td>
</tr>
</tbody>
</table>

- P value considered significant level ≤ 0.05

Table (3.6): Show mean of triglyceride (mg/dl) in patients with chronic renal failure before dialysis with after dialysis:

<table>
<thead>
<tr>
<th>Triglyceride (mg/dl)</th>
<th>Mean ± SD mg \ dl</th>
<th>P.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predialysis</td>
<td>129±50</td>
<td>0.00</td>
</tr>
<tr>
<td>Post dialysis</td>
<td>165±60</td>
<td></td>
</tr>
</tbody>
</table>

- Paired sample T test was used.
- P value considered significant level ≤ 0.05

Table (3.7): Show mean of triglyceride (mg/dl) in patients with chronic renal failure before dialysis compare with control:

<table>
<thead>
<tr>
<th>Triglyceride (mg/dl)</th>
<th>Mean ± SD</th>
<th>P.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Pre dialysis</td>
<td>0.002</td>
</tr>
<tr>
<td>121± 25</td>
<td>129± 50</td>
<td></td>
</tr>
</tbody>
</table>

- Paired sample T test was used.
- P value considered significant level ≤ 0.05
Table (3.8): Show mean of HDL (mg/dl) in patients with chronic renal failure before dialysis with after dialysis:

<table>
<thead>
<tr>
<th>HDL (mg/dl)</th>
<th>Mean ± SD mg/dl</th>
<th>P.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predialysis</td>
<td>25±8</td>
<td>0.00</td>
</tr>
<tr>
<td>Post dialysis</td>
<td>33±10</td>
<td></td>
</tr>
</tbody>
</table>

- Paired sample T test was used.
- P value considered significant level ≤ 0.05

Table (3.9): Show mean of HDL cholesterol (mg/dl) in patients with chronic renal failure before dialysis compare with control:

<table>
<thead>
<tr>
<th>HDL cholesterol (mg/dl)</th>
<th>Mean ± SD</th>
<th>P.value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Pre dialysis</td>
<td>0.00</td>
</tr>
<tr>
<td>64±10</td>
<td>25±8</td>
<td></td>
</tr>
</tbody>
</table>

- Paired sample T test was used.
- P value considered significant level ≤ 0.05
Figure (3.1): scatter plot between duration of disease and Serum total cholesterol no correlation (P.value =0.33   r = - 0.13)

*CHOLBEFO = cholesterol concentration before hemodialysis.
Figure (3.2): Scatter plot between duration of disease and Serum HDL no correlation (P.value = 0.8  $r = 0.03$)

*HDBEFORE = HDL concentration before hemodialysis.
Figure (3.3): Scatter plot between duration of disease and Serum HDL no correlation (P.value = 0.33 r = -0.13)

* TGBEF = triglyceride concentration before hemodialysis.
4. Discussion

4.1 Discussion:

This study was carried out in IBN SINA Hospital in Khartoum state (Sudan). The preliminary investigations obtained from this study revealed that the ESRD patents participates in this study were at advanced age and male are predominating in other words, men are more effected than women in regards with renal disease, the mean of sex showed in table (3:1). This remark are also reported by lowi et al 1989. Who postulated that women with renal disease progress to end stage renal disease (ESRD) more slowly than men (lewiet al, 1989).

Also this study indicate that significant increase in the mean of serum total cholesterol concentration, was found to be in ESRD patients after hemodialysis compare to level pre hemodialysis. Also, in this study the results indicate that significant increase in the mean of serum triglyceride level in post hemodialysis are paired with pre hemodialysis.

Although kaysen, claimed that serum triglyceride increase in majority of patients with advanced renal failure, triglyceride increase in all lipoproteins fraction and around one to third of hemodialysis patients have hypertriglyceridemia with values ranging from 200-300mg/dl and occasionally up to 600mg/dl.

ESRD was reported to be associated with lipid abnormalities including increased total serum cholesterol, LDL cholesterol and triglyceride concentration, along with decrease HDL cholesterol concentration. (Norberck, 1979, 2000), (Nestel, 1982). Heparin used in hemodialysis machine activates lipoprotein lipase and in this way can increase the triglyceride concentration, lowering level of HDL cholesterol. Both lipid abnormalities are important when using low molecular weight heparin. (Elisaf,1997).
4.2 Conclusion:

In this study:

- Serum total cholesterol and triglyceride levels were significantly increased in patients with chronic renal failure pre dialysis.
- Serum HDL cholesterol level was significantly decreased in patients with chronic renal failure pre and post dialysis.
- Serum levels of total cholesterol, triglyceride and HDL cholesterol showed no correlation with the duration of the disease.

4.3 Recommendations:

From the results obtained from this study, we may recommend the following:

- Serum total cholesterol and triglyceride in patients suffering from renal failure must be regularly monitored as part of management in patients undergoing renal hemodialysis.
- Such study must be continued large scale on ESRD patients ensure adequate findings with estimation of more parameters underline the mechanism of associate between lipid metabolism and hemodialysis in chronic renal failure patients.
- Diet containing cholesterol should be avoided by patients suffering renal failure disease.
References


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