Sudan University of Sciences and Technology

College of Graduate Studies

Characterization of Spleen in long standing Hemodialysis Patients Using Ultrasonography

توصيف الطحال لدي مرضي الاستصفاء الدموي طويل الأجل باستخدام التصوير بالموجات فوق الصوتية

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

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الآية

قال تعالى:

"الذين يذكرون الله قياما وقعودا وعلى جنوبهم ويتفكرون في خلق السموات والأرض ربنا ماخلقت هذا باطلاً سبحانك فقنا عذاب النار"

(سورة آل عمران: الآية 191)

Dedication

To my family the source of love, patient and care of my life. To my husband who has taught me what life is.

To those who have been the source of light and encouragement.

To all those who are fetching for more knowledge and really interested on this field I dedicate this simple work.

Acknowledgement

My sincere thanks to **Dr. Ahmed Mostafa Mohamed Abukonna** who helped me to arrange my thoughts, words and data together to production this thesis, as I believed that he tried honestly to transfer his experience to all his students. Other people who need special acknowledgement are my family who have always stood with me in difficult time and proved to be helpful and supportive in all types of creative work in my life. My thanks also to everyone who helped me in this work.

Abstract

This study was conducted in the renal dialysis center in Khartoum state at Sudanese kidney transplanted association (Association specialized hospital) and Bahry hemodialysis center in the period from July 2018 to October 2018. The aim of this is study was to evaluate the spleen of long standing hemodialysis. 120 Patients under regular hemodialysis for 2 years or more were enrolled in the study. All patients were scanned with ultrasound machine with 3.5 MHz probe; spleen measurements and texture were obtained.

The result of the study showed that the spleen volume was increased in the first years and then decreased to normal range. The volume of the spleen not related to duration of hemodialysis. Also it showed that there was reduction in echogenicity when duration increased, in addition the texture was not change from homogenecity to heterogeneity with the increased duration.

The study concluded that ultrasound is a very useful tool for studying short and long term of hemodialysis patients and their follow-up, and determined a suitable time for intervention and management.

الخلاصة

تم إجراء هذه الدرسة بمركز الكلى للاستصفاء الدموي في ولاية الخرطوم بالجمعية السودانية لزراعة الكلى ومركز بحري للاستصفاء الدموي في الفترة من يوليو 2018 وحتى اكتوبر 2018 .وكان الهدف الاساسي من هذه الدراسة هو تقييم مظهر الطحال عند المرضى المداومين على الاستصفاء الدموي باستخدام جهاز موجات صوتية به مسبار تردده الموجي 3.5 ميقا هيرتز.

تمت الدراسة على 120 حالة من المرضى المداومين على الاستشفاء الدموي لفترة سنتين او اكثر باستخدام استبيان يحتوي البيانات الشخصية بالاضافة الى نتائج فحص الموجات فوق الصوتية.

أظهرت نتائج الدراسة ان حجم الطوحال عند المرضى المداومين على الاستصفاء الدموي يزيد عن المعدل الطبيعي لحجم الطوحال وأن حجم الطوحال ليس له علاقة بزيادة عمر الغسيل .كما أظهرت ايضا أن صدى جميع قياسات الطوحال ينخفض عندما يزيد عمر الغسيل.كما بينت الدراسة ان مستوى الصدي لا يتغير من منتظم الى غير منتظم عند زيادة عمر الغسيل.

أظهرت الدراسة أن الموجات فوق الصوتية لها قدرة فائقة على دراسة هذه الحالات ولها القدرة على المساعدة في اتخاذ القرارت والتدابير المناسبة بشانها.

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Introduction

1.1 Introduction:

Chronic kidney disease is a progressive loss in renal function over aperiod of months or years.The symptoms of worsening kidney function are non-specific, and might include feeling generally unwelland experiencing a reduced appétit. Chronic kidney disease is identified by blood test for creatinine. Higher levels of creatinine indicate a lower glomerular filtration rate and as a result a decreased capability of the kidney to excrete waste products (Levey et al., 2003).

There is no specific treatment unequivocally shown to slow the worsening of chronic kidney disease. If there is an underlying cause to CKD, such as vasculities, this may be treated directly to slow the damage. In more advanced stages, treatments may be required for anemia and bone disease. Severe CKD requires renal replacement therapy, which may involve a form of dialysis, but ideally constitutes kidney. There are many complications of hemodialysis like anemia which affect the spleen, neuropathy, blood coagulopathy and amyloidosis. In stage 5 CKD, renal replacement therapy is usually required, in the form of either dialysis or transplant (Levin et al., 2008).

While renal replacement therapies can maintain patients indefinitely and prolong life, the quality of life is severely affected (de Francisco and Pinera, 2006). Medical Sonography (ultrasonography) is an ultrasound-based diagnostic medical imaging technique used to visualize muscles, tendons, and many internal organs, to capture their size, structure and any pathological lesions with real time tomographic images. Ultrasound has been used by radiologists and sonographers to image the human body for at least 50 years and has become a widely used diagnostic tool(Aldrich, 2007).

Massive splenomegaly may be associated with grave complications. Among these are anemia, leucopenia, and thrombocytopenia due to consumption of these blood elements by the enlarged spleen-hypersplenism. Similarly, such enlarged spleen may easily be subjected to trauma, resulting in splenic rupture, bleeding, and shock.Though splenic enlargement has been reported in patients with chronic kidney disease, its mechanism is poorly understood; however, the role of hemodialysis in red blood cell destruction and the influence of immunologic response to components of the hemodialysis such as ethylene oxide have been implicated (Beale etal., 1997).

The hemodialysis now a day is becoming light guide in the darkness of end stage renal disease (ESRD) to who cannot undergo renal transplantation. This study aimedatevaluation of the effect of long term hemodialysis especially in the spleen.

1.2 Problem of the study:

The hemodialysis now a day is becoming light guide in the darkness of end stage renal disease (ESRD) to who cannot undergo renal transplantation. Kidney disease deaths in Sudan reached 1.64% of total death.

1.3 Objectives of the study:

1.3.1 General objective

The general objective of this study was to evaluate the spleen in patients underlying hemodialysis.

1.3.2 Specific Objectives:

- To measure the size of spleen.
- To determine the echogenicity of the spleen.
- To assess the echotexure of the spleen.

1.4 Thesis overview:

Chapter one: introduction ,objective and problem.

Chapter two: literature review.

Chapter three: material and methods.

Chapter four: results.

Chapter five: discussion ,conclusion and recommendation.

Chapter two

Literature review and theoretical background

Chapter two
Literature review and theoretical background

2.1 Anatomy of the spleen:

2.1.1 Introduction:-

The spleen, the largest of the lymphoid organs lies under the diaphragm on the left side of the abdomen, and although not a part of the alimentary tract, it drains to the portal venous system. It lies between the ninth and eleventh ribs. The spleen developed in the dorsal mesogastrium and projects into the greater sac surrounded by the peritoneum of theorigenal left leaf of the dorsal mesogasterium. It lies at the left margin of the lesser sac below the diaphragm, and it is diaphragmatic surface is mounded in to reciprocal convexity (Chummy, 1999).

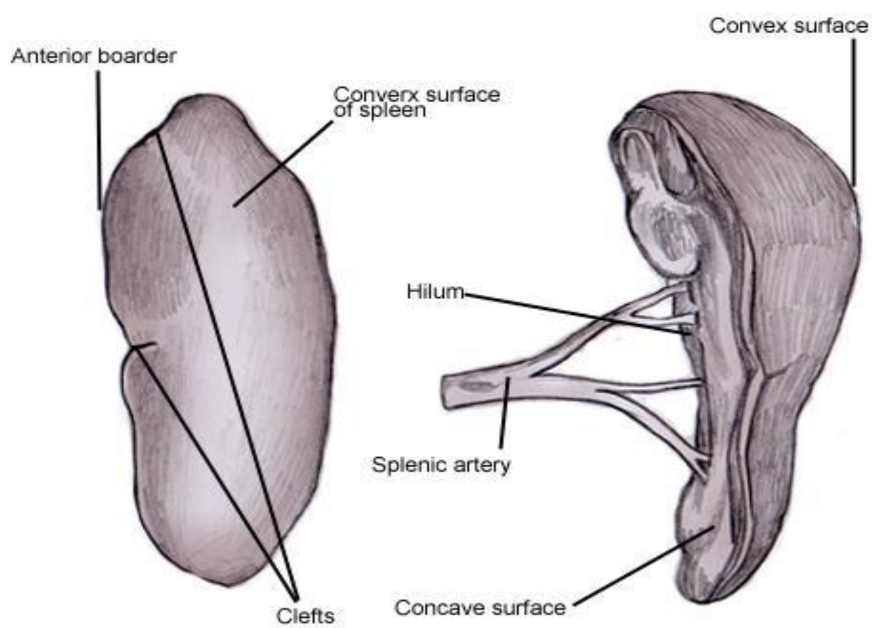

Figure 2-1Showing (A) lateral surface and (B) hilum of spleen

It is hilum lies in the angle between the stomach and the left kidney. It is long axis lies along the line of the tenth rib. A small colic area lies in contact with the splenic flexure and the phrenicocolic ligament. It is anterior border is notched, a relic of the fusion of the several ―slenulesfrom which the organ arises in the embryo (Chummy, 1999).

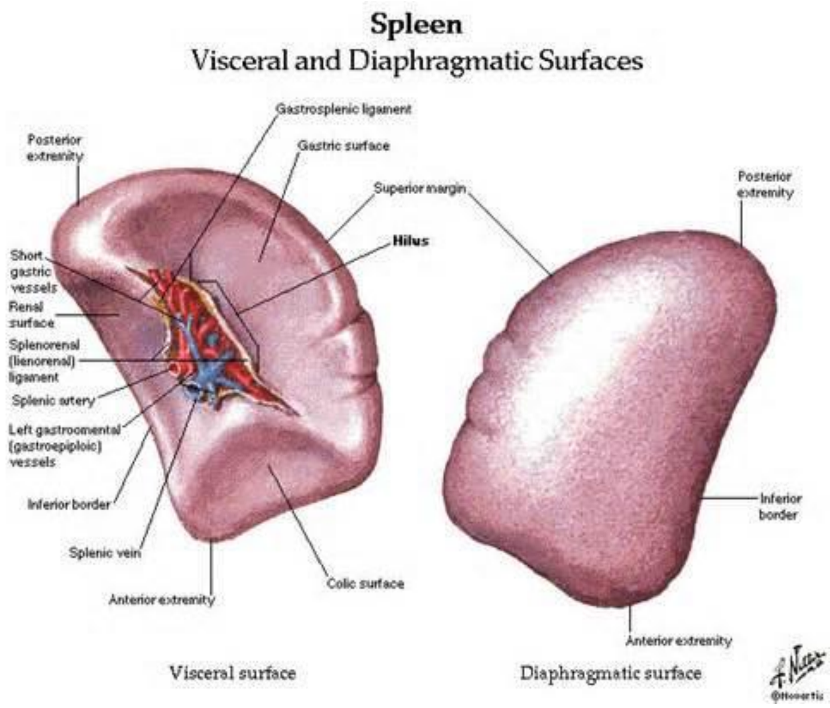

Figure (2-2): Showing Visceral surface (A) and Diaphragmatic surface (B)

It is visceral peritoneum or a serous coat ,invests all surface ― gastric, diaphragmatic , colic and renal. The leaves of the greater omentumpass from the hilum forwards to the greater curvature of the stomach ―gastrosplenicligament, and backwards to the front of the left kidney lienorenal ligament‖. The hilum of the spleen makes contact with the tail of the pancreas. In enlargement of the spleen, it is long axis extends down and forwards along the tenth rib in the direction of umbilicus, and it is anterior border approaches the costal margin to the left of the greater curvature of the stomach . A palpable spleen is identified by the notch in it is anterior border (Richard etal., 2005).

2.1.2 Spleen location:

The spleen lies against the diaphragm there for in the left upper quadrant, or left hypochondrium of the abdomen. Spleen surrounded by visceral peritoneum except in the area of the hilum on the medial surface of the spleen. The spleen contact with the adrenal gland , upper pole of the left kidney , the tail of the pancreas from anterior and Lower part of the left lung ,left pleura and nine,ten and eleven ribs of the left side from posterior (Snell, 2004) .

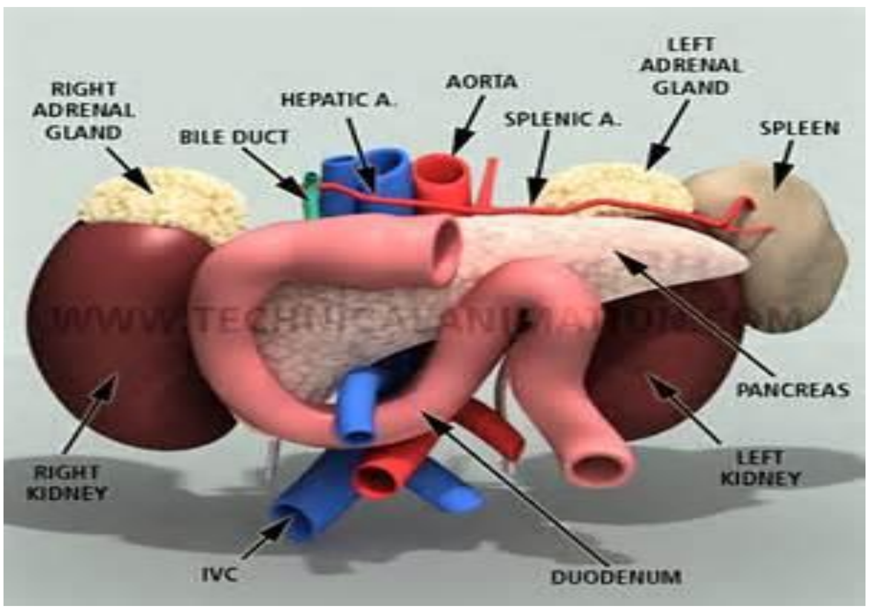

Figure (2-3): Shows location of Spleen

2.1.3 Spleen weight:

The normal size and weight of the spleen is varying at different period of life in different individual. In adult 8-13 cm in length, 7-8 cm in anteroposreiordiameter, and less than 6 cm in thickness also measures 1 x 3 x 5 inches. It is weight in adultis ranged between 80 to 300 gram averages of 150 gram. These are average measures and the size of the spleen varies considerably (Artheretal., 2001).

2.1.4 Spleen shape:-

The spleen is an organ shaped like a shoe that lies relative to the 9th and 11th ribs and is located in the left hypochondrium and partly in the epigastrium. Thus, the spleen is situated between the fundus of the stomach and the diaphragm. The spleen is very vascular and reddish purple in color; its size and weight vary. A healthy spleen is not palpable (Richard etal., 2005).

2.1.5 Blood Supply:

Splenic artery, the largest branch of the celiac trunk, passes between the layers of the lienorenal ligament and at the hilum divides into two or three main branches, from which five or more branches enter the spleen. Veins accompany the arteries and unite together to form the splenic vein (Chummy and Sinnatomby, 1999)

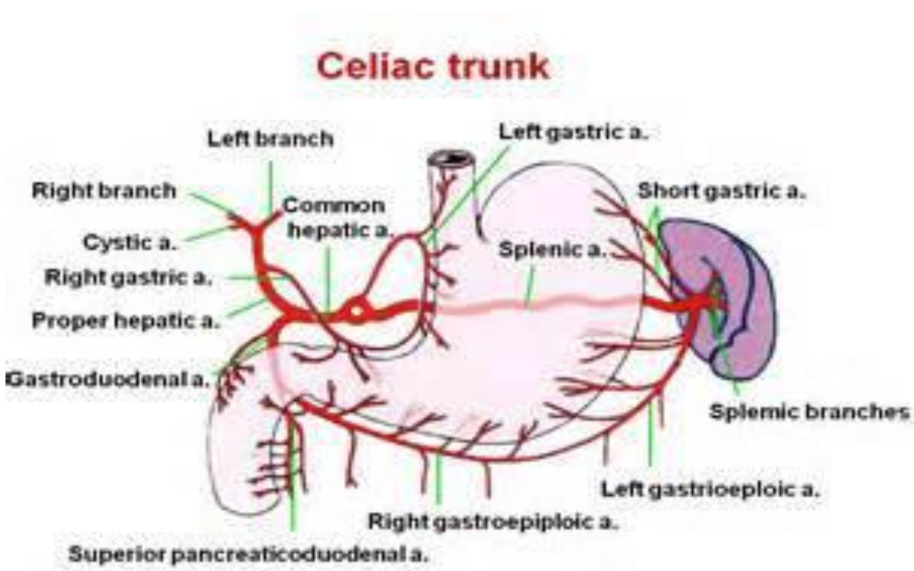

Figure (2-4): Shows celiac trunk and blood supply of spleen

2.1.6 Nerve Supply:

The spleen is supplied by the celiac plexus with sympathetic fibers only (Snell, 2004).

2.1.7 Lymph Drainage

Lymph drains into several nodes in the hilum, by way of the pancreaticosplenic nodes to the celiac nodes in upper abdomen (Snell, 2004).

2.1.8 Development;

Spleen begins to develop in sixth weeks as several condensations of mesodorsal cells in the dorsal mesogasterium. Then the spleen comes to lie at left margin of the lesser sac. Accessory spleens are the result of lack of fusion, occur about twenty percent of population and rarely bigger than 2 cm in diameter. The spleen develops in the cephalic part of dorsal mesogastrium (from its left layer; during the sixth week of intrauterine life) into a number of nodules that fuse and form a lobulated spleen. Notching of the superior border of the adult spleen is evidence of its multiple origins (Arthur etal., 2001).

2.2 Normal ultrasound appearance of the spleen:-

The spleen has uniform homogeneous echo pattern, its slightly less echogenic than the liver. There are no absolute criteria for the size of the spleen on ultrasound .When normal, is a little larger than or about the same size as the left kidney. The length should not exceed 14cm in the major axis. The volume and weight depend on the circulating blood volume. It calculated by the equation (volume = length x width x thickness x.523) and the normal volume is, (124.1 ± 51.8 cm3). And the weight is calculated by the equation (length x width x thickness x0.43gm) and the normal weight range between 80 and 300 gm. Splenic length was measured along the long axis, from the dome to the tip of the spleen, in the sagittal plane. The width was the longest (straight) organ diameter in the transverse plane. The thickness was the distance between the center (inner) and peripheral (outer) surface, measured at the level of the splenic hilum on the transverse plane (Aldrich, 2007).

Figure (2-5): Ultrasound image, transabdominal showing Long axis of normal ultrasound appearance of spleen with Lt Kidney

2.3 Physiology of the spleen:

The spleen is not essential for life and there is no obvious effect in the body if the spleen is removed. It is a large mass of lymphoid tissue that is a part of the reticulo-endothelial system. The spleen has many functions to do as follow; Responsible for antigenic challenge by production of cells making anti bodies, destruction of all the abnormal shaped or rigid red cells by culling and pitting. Normal red blood cells life span approximately 120 days, Phagocytosis of foreign substances by reticuloendothelial macrophages. Spleen do as platelets reservoir and normally sequester 30—40 % of blood platelets. Life span of platelets is about 10 days. Spleen do as erythrocytes production and normally spleen produced red blood cells in fetal life from the fourth month of development until birth.The spleen filters foreign materials from the blood and, from antibodies and also break down hemoglobin as blood reservoir and important for blood formation in the fetal life and when there is severe anemia (Artheretal., 2001).

After antigenic stimulation, increased formation of plasma cells for humoral responses and increased lymphopoiesis for cellular responses occurs. One of the spleen's most important functions is phagocytosis. The spleen is a component of the reticuloendothelial system. The splenic phagocytes include reticular cells, free macrophages of the red pulp, and modified reticular cells of the ellipsoids. Phagocytes in the spleen remove debris, old and effete red blood cells (RBCs), other blood cells, and microorganisms, thereby filtering the blood. Phagocytosis of circulating antigens initiates the humoral and cellular immune responses (Guyton etal., 2006).

The spleen is an important hematopoietic organ during fetal life; lymphopoiesis continues throughout life. The manufactured lymphocytes take part in immune responses of the body. In the adult spleen, hematopoiesis can restart in certain diseases such as chronic myeloid leukemia and myelosclerosis.The RBCs are stored in the spleen. Approximately 8% of the circulating RBCs are present within the spleen; however, this function is seen better in animals than humans (Andrew etal., 2001).

2.4 Pathology of Spleen:

The spleen is an organ located under the ribs on the left side of the body. It is part of the lymphatic system, which is composed of lymph nodes, lymph vessels, lymphatic fluid, the tonsils, thymus, spleen, and lymphoid tissue of the digestive tract. The spleen filters the blood and helps thebody fight infections (Cotran, 2004)

2.4.1 Congenital Anomalies:

Complete absence of spleen is rare, and is associated with other congenital anomalies. Accessory spleens are common and it could be single or multiple. They are usually small and are situated in the gastrosplenic ligament or the tail of the pancreas(Danish, 2009).

2.4.2 Splenic Infarcts:

Are common lesions caused by occlusion of the major splenic artery or any of its branches, due to emboli that arise in the heart. The infarct may be small or large, multiple or single and sometimes involve the entire organ (Danish, 2009).

2.4.3 Splenomegaly:

Splenic enlargement may be important diagnostic clue to existence of an underlying disorder, but the condition itself may cause problems. When sufficiently enlarged, the spleen may cause dragging sensation in the left upper quadrant and discomfort after eating. The storage function may lead to the sequestration of significant numbers of blood elements, leading to hypersplenism which characterized by splenomegaly, reduction of one or more of the cellular elements of the blood leading to anemia , leucopenia, thrombocytopenia in association with hyperplasia of the bone marrow (Cotran, 2004) .

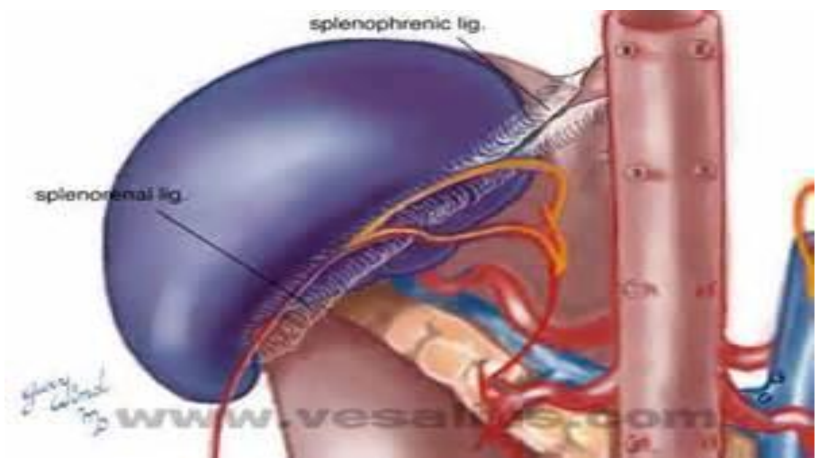

Figure (2-6): Shows splenomegaly

2.4.4 Rupture of Spleen:-

Usually caused by crushing injury or severe blow or may be spontaneous —non-traumatic. Spontaneous ruptures encountered most often in infectious mononucleosis, malaria, typhoid fever and leukemia. Rupture spleen is usually followed by extensive or massive intraperitoneal hemorrhage (Danish, 2009).

2.4.5 Amyloidosis of Spleen:

It is an immunological mechanism contributing to a large number of diseases. A myeloid is a pathologic proteinaceous substance deposited between cells in various tissues and organs. Amyloidosis of the spleen may cause moderate to marked splenomegaly ―800 gm. The deposit is largely limited to the splenic follicles producing tapioca like granules ―sago spleen‖ or involves the wall of the splenic tissue and connective tissue framework then red pulp. Fusion of deposits gives rise to lardaceous spleen (Cotran, 2004).

2.4.6 Sarcoidosis of Spleen:

Is a systemic disease of unknown cause characterized by non caseating granulomas in many tissues or organs. The spleen is affected microscopically in about 75% of cases, but enlarged in 18%. On occasion granulomas coalesce to form small nodules and the splenic capsule is not involved(Danish, 2009).

2.4.7 Neoplasm's of Spleen:

Neoplastic involvement of the spleen is rare except in tumors of the lymph hematopoietic system, then induce splenomegally . The benign tumors of spleen like fibromas,osteomas, chondromas, lymphangiomas and hemangiomas(Cotran, 2004).

2.4.8 Lymphoma and leukemia:

Most splenic cancers do not start in the spleen, and those do are almost always lymphomas. Lymphoma is a type of blood cancer that develops in the lymphatic system. It is more common for a lymphoma to start in another part of the lymphatic system and invade the spleen than it is for lymphoma to start in the spleen itself. Leukemia's, which start in the bone marrow, are another type of blood cancer that can invade the spleen. Uncommonly, some other types of cancers that are located elsewhere in the body can spread, or metastasize, to the spleen. These include lung cancers, stomach cancers, pancreatic cancers, liver cancers, and colon cancers (Danish, 2009).

Symptoms of spleen cancer can be vague and may resemble those of a cold. If the spleen enlarges, pain or fullness of the upper abdomen may be noticed. Treatment of spleen cancer depends on the cause of the cancer and the extent to which it has spread. Complications of spleen cancer requiring emergency care are rare, but may include severe infection or rupture of the spleen**.** Seek immediate medical care (call 911) for symptoms such as night sweats, difficulty breathing, pale or blue lips and fingernails, rapid heart rate (tachycardia), confusion or loss of consciousness, or fever and chills (Cotran, 2004).

2.5 Renal Failure:

2.5.1 Definition:

Kidney failure or renal insufficiency is a medical condition in which the kidneys fail to adequately filter waste products from the blood. The two main forms are acute kidney injury, which is often reversible with adequate treatment, and chronic kidney disease, which is often not reversible. In both cases, there is usually an underlying cause. Renal failure is mainly determined by a decrease in glomerular filtration rate, the rate at which blood is filtered in the glomeruli of the kidney. This is detected by a decrease in or absence of urine production or determination of waste products (creatinine or urea) in the blood. Depending on the cause, hematuria (blood loss in the urine) and proteinuria (protein loss in the urine) may be noted in renal failure, there may be problems with increased fluid in the body (leading to swelling), increased acid levels, raised levels of potassium, decreased levels of calcium, increased levels of phosphate, and in later stages anemia. Bone health may also be affected. Long-term kidney problems are associated with an increased risk of cardiovascular disease (Arthur, 2006).

2.5.2 Types of Renal Failure:-

Renal failure can be divided into two categories: acute kidney injury or chronic kidney disease. The type of renal failure is differentiated by the trend in the serum creatinine; other factors that may help differentiate acute kidney injury from chronic kidney disease include anemia and the kidney size on sonography as chronic kidney disease generally leads to anemia and small kidney size (Hada, 2009).

2.5.2.1 Acute Kidney Injury:

Acute kidney injury (AKI), previously called acute renal failure (ARF), is a rapidly progressive loss of renal function, generally characterized by oliguria (decreased urine production, quantified as less than 400 ml per day in adults, less than 0.5 ml/kg/h in children or less than 1 ml/kg/h in infants); and fluid and electrolyte imbalance. AKI can result from a variety of causes, generally classified as *prerenal*, *intrinsic*, and *post renal*. The underlying cause must be identified and treated to arrest the progress, and dialysis may be necessary to bridge the time gap required for treating these fundamental causes (Hada, 2009).

2.5.2.2 Chronic kidney disease:-

Chronic kidney disease (CKD) can also develop slowly and, initially, show few symptoms. CKD can be the long term consequence of irreversible acute disease or part of a disease progression (Hada, 2009).

2.5.2.3 Acute-on-chronic renal failure:-

Acute kidney injuries (AKI) can be present on top of chronic kidney disease, a condition called acute-on-chronic renal failure (AoCRF). The acute part of AoCRF may be reversible, and the goal of treatment, as with AKI, is to return the patient to baseline renal function, typically measured by serum creatinine. Like AKI, AoCRF can be difficult to distinguish from chronic kidney disease if the patient has not been monitored by a physician and no baseline (i.e., past) blood work is available for comparison (Hada, 2009).

2.5.3 Treatment of Chronic Renal Failure:-

Severe loss of kidney function, either acutely or chronically, is a threat to life or requires removal of toxic waste products and restoration of body fluid volume and composition towards normal. This can be accomplished by dialysis with an artificial kidney. In certain types of acute renal failure, an artificial kidney may be used to tide the patient over until the kidneys resume their function. If the loss of kidney function is irreversible, it is necessary to perform dialysis chronically to maintain life. Because dialysis cannot maintain completely normal body fluid composition and cannot replace all the multiple functions performed by the kidneys, 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 a kidney transplant (Arthur. C. Guyton, 2006).

2.5.3.1 Renal transplantation:-

A renal transplant is a surgical procedure to place a kidney from a live or deceased donor into a person whose kidneys no longer function properly (Arthur. C. Guyton, 2006).

2.5.3.2 Hemodialysis:

A medical procedure to remove fluid and waste products from the blood and to correct electrolyte imbalances. This is accomplished using a machine and a dialyzer, also referred to as an "artificial kidney." It is also used to treat both acute (temporary) and chronic (permanent) kidney failure. Is the most common method used to treat advanced and permanent kidney failure. Since the 1960s, when hemodialysis first became a practical treatment for kidneyfailure, hemodialysis treatment more effective and minimize side effects. In recent years, more compact and simpler dialysis machines have made home dialysis increasingly attractive. But even with better procedures and equipment, hemodialysis is still a complicated and inconvenient therapy that requires a coordinated effort from the patient and the whole health care team, including the nephrologists, dialysis nurse, dialysis technician, dietitian, and social worker.The most important members of the health care team is the patient and his family. By learning about the treatment, the patient can work with his health care team to give himself the best possible results, and he can lead a full, active life. Healthy kidneys clean the blood by removing excess fluid, minerals, and wastes. They also make hormones that keep the bones strong and the blood healthy. When the kidneys fail, harmful wastes build up in the body, the blood pressure may rise, and the body may retain excess fluid and not make enough red blood cells (Guyton, 2006).

In hemodialysis, the blood is allowed to flow, a few ounces at a time, through a special filter that removes wastes and extra fluids. The clean blood is then returned to the patient body. Removing the harmful wastes and extra salt and fluids helps control the blood pressure and keep the proper balance of chemicals like potassium and sodium in the body. One of the biggest adjustments the patient must make when he starts hemodialysis treatments is following a strict schedule. Most patients go to a clinic—a dialysis center—three times a week for 3 to 5 or more hours each visit. For example, it may be on a Monday-Wednesday-Friday schedule or a Tuesday-Thursday-Saturday schedule. The patient may be asked to choose a morning, afternoon, or evening shift, depending on availability and capacity at the dialysis unit. The dialysis center will explain to the patient the options for scheduling regular treatments. Researchers are exploring whether shorter daily sessions, or longer sessions performed overnight while the patient sleeps, are more effective in removing wastes (Guyton, 2006).

Newer dialysis machines make these alternatives more practical with home dialysis. But the Federal Government has not yet established a policy to pay for more than three hemodialysis sessions a week. Several centers around the country teach people how to perform their own hemodialysis treatments at home. A family member or friend who will be the patient helper must also take the training, which usually takes at least 4 to 6 weeks. Home dialysis gives the patient more flexibility in his dialysis schedule. With home hemodialysis, the time for each session and the number of sessions per week may vary, but the patient must maintain a regular schedule by giving himself dialysis treatments as often as he would receive them in a dialysis unit(Guyton, 2006).

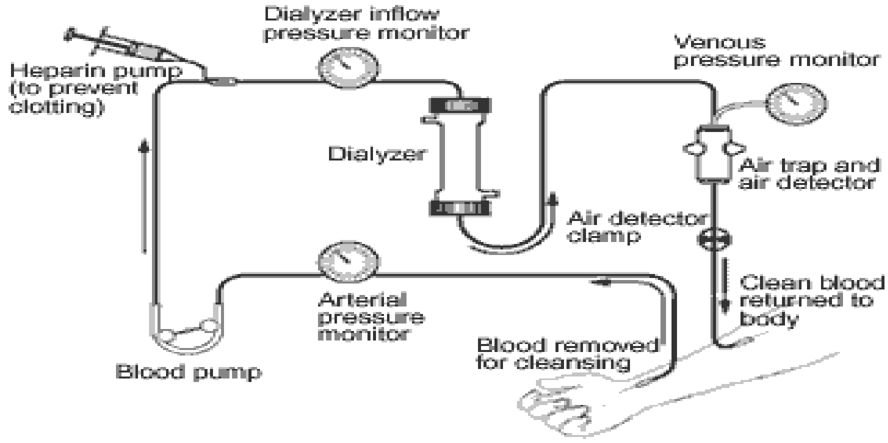

Figure (2-7): Schematic Diagram Showing Hemodialysis Circuits

2.6 Spleen measurement in long term hemodialysis:

The weight of normal adult human spleen post mortem varies considerably by average about 100g, spleen weight less in female and older people.The measurement for splenic volume is significantly greater in patients undergoing hemodialysis than in patients with renal failure treatment in other method. By comparing patient with uremia who had not receiveddialysis or those treated by continuous peritoneal dialysis and the patient in long term dialysis they found that splenomegaly is characteristic only of the patients undergoing hemodialysis and these due to the process of hemodialysis itself.

The spleen may enlarge as aresult of removal of erythrocytes damage mechanically in hemodialysis circuit or chemically by chloramines, bacterial toxins or other contaminants in the dialysis.

2.6.1 Previous Studies:-

In study done by (Platts etal), in patients receiving regular hemodialysis, splenic volume was assessed in 34 controls and 149 patients with chronic renal failure. Of the patients, 16 had never received dialysis, 10 were undergoing continuous peritoneal dialysis, 94 were undergoing regular hemodialysis, and 29 had undergone successful renal transplantation more than nine months previously. Mean splenic volume was increased only in the patients who were receiving hemodialysis. Splenic enlargement was probably not due to iron overload as it occurred in all patients who had received hemodialysis, 14 of whom had not received intravenous iron. No patient had hepatitis. Splenic enlargement was probably related to the process of hemodialysis itself and may have been due either tored cell damage produced by hemodialysis or to an immunological reaction induced by component of hemodialysis, possibly ethylene oxide.

In study done by Albadri, the study data is 50 cases under regular hemodialysis for 5 years or more, collected using data sheet collection include patientpersonal data plus ultrasound finding using computer program for analysis. The study showed that there was an increasing in spleen volume comparing with normal range , and also there was an increasing in length and thickness comparing with normal range but the width in not significantly change due to hemodialysis, because mostly due to the presence of the stomach and diaphragm from above and the left kidney from below . The measurement of the spleen (length, thickness and volume) all were increasing when age increasing. Also it showed that there was decreasing in echogenicity when there was increasing in all measurements' of spleen; also the texture change from homogenecity to heterogenecity when there was increasing in all measurements of spleen.

The study was done by Nuha on 100 cases under regular hemodialysis for 3 years or more. The study showed that there was an increasing in spleen volume comparing with normal range, and also there was an increasing in length, width and thickness comparing with normal range.

The measurement of the splenic parameters (length, thickness and volume) reported that they were increasing when age increased. Also it was showed that when the all measurement of spleen increased, its echogenecity decreasing and echotexture changing from homogenecity to heterogenecity.

Chapter three

Materials and Methods

Chapter three

Materials and Methods

3.1 Design of the study:

This was a descriptive cross sectional study where the data collected prospectively.

3.2 Study area:

The study was conducted in Khartoum state at Sudanese kidney transplanted association (Association specialized hospital) and Bahri heamodialysis centre.

3.3 Study duration:

The study will be conducted in the period from july 2018 to september 2018.

3.4 Populations:

Hundred patients on hemodialysis for more than 3 years came to hospital for hemodialysis and ultrasound examination for checkup were included in the study, their inclusion and exclusion criteria as follows:

3.4.1Inclusion criteria:

Patients will come to hospital for hemodialysis and ultrasound examination for checkup, with twenty years old or more and on hemodialysis for three years or more

3.4.2 Exclusion criteria;

Patient less than twenty years old and Patient on hemodialysis for less than three years will be excluded

3.5 Study variable:

Spleen: length; width; thickness; echogenicity; echotexure; volume and duration of dialysis

3.6 Sampling:

Patients were randomly selected.

3.6.2 Sample size:

The study was conducted on 120 patients on hemodialysis.

3.7 Technique used:

The patient should be supine initially and later on the right side. Apply coupling agent liberally over the left lower chest, the upper abdomen and left Flank. The patient should take a deep breath and hold it in when a specific area is being scanned. Start by placing the transducer centrally at the top of the abdomen (the xiphoid Angle), scan with the patient in supine and oblique position. Multiple scan may be necessary. Scan from below the costal margin, angling the beam toward the diaphragm. Then in The ninth intercostal space downward. Repeat through all lower intercostal spaces. First with the patient supine and then with the patient lying obliquely (30) on the Right side. Also perform longitudinal scan from anterior to posterior axillary line and transverse upper abdominal scan.

3.8 Ultrasound Machine:

A highly designated ultrasound machine was used (Mindary 3300 v 100-240) with a convex probe (3.5) MHz frequency.

3.9 Data analysis:

Descriptive statistics was used to describe the study variables, using the Statistical Package software for Social Science (SPSS) to analyze these variables.

3.10 Data management:

For data presentation table and figures has been used.

3.11 Ethical consideration:

Ethical clearance had obtained from the authorities; no individual patient details mentioned throughout this study.

Chapter Four

Results

Chapter Four

Results

4.1 Results:

Table 4.1 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	120	20	84	46.32	13.886
Length	120	6	15	10.71	1.697
Width	120	4	15	9.27	1.917
Thickness	120	3	7	5.13	1.037
Volume	120	93	746	285.69	129.080

Table 4.2 Gender distribution

	Frequency	Percent	Valid Percent	Cumulative Percent
Male	69	57.5	57.5	57.5
Female	51	42.5	42.5	100.0
Total	120	100.0	100.0	

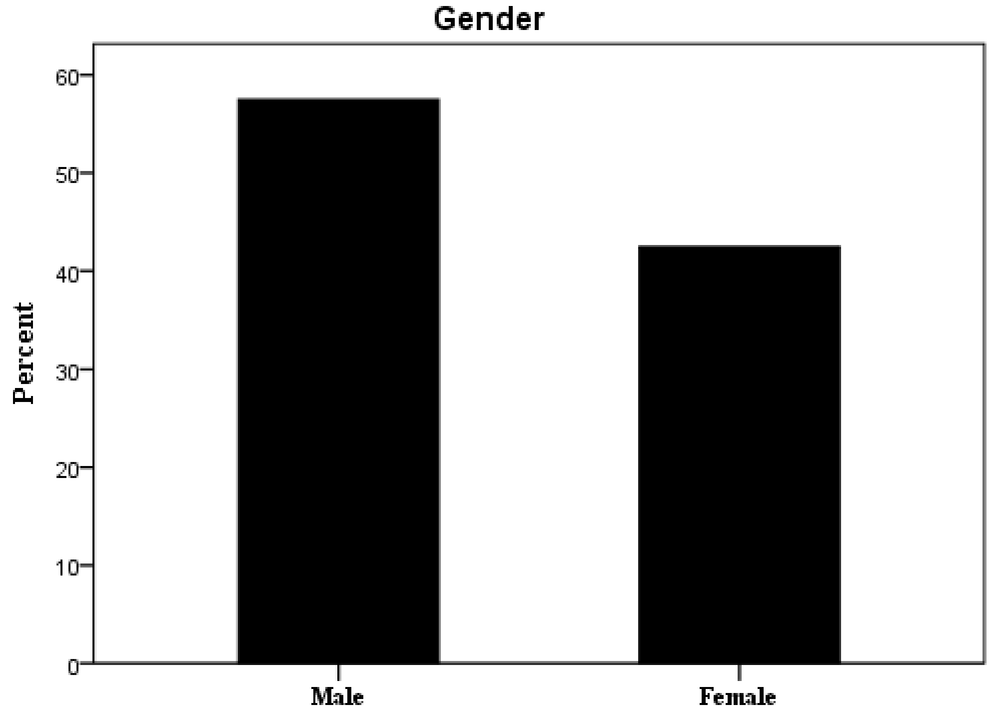

Figure 4.1 Gender distribution

Table 4.3 Echogenicity of the spleen

	Frequency	Percent	Valid Percent	Cumulative Percent
Increased	15	12.5	12.5	12.5
Normal	34	28.3	28.3	40.8
Decreased	71	59.2	59.2	100.0
Total	120	100.0	100.0	

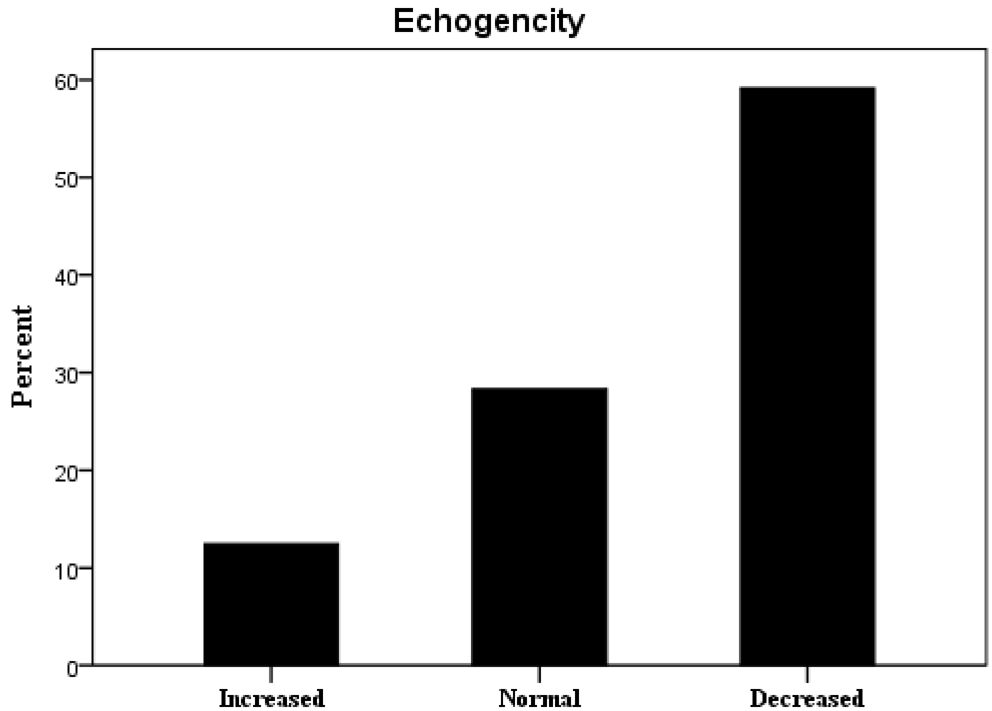

Figure 4.2 Echogenicity of the spleen

Table 4.4 Echotexture of the spleen

	Frequency	Percent	Valid Percent	Cumulative Percent
Homogenous	76	63.3	63.3	63.3
Hetrogenous	44	36.7	36.7	100.0
Total	120	100.0	100.0	

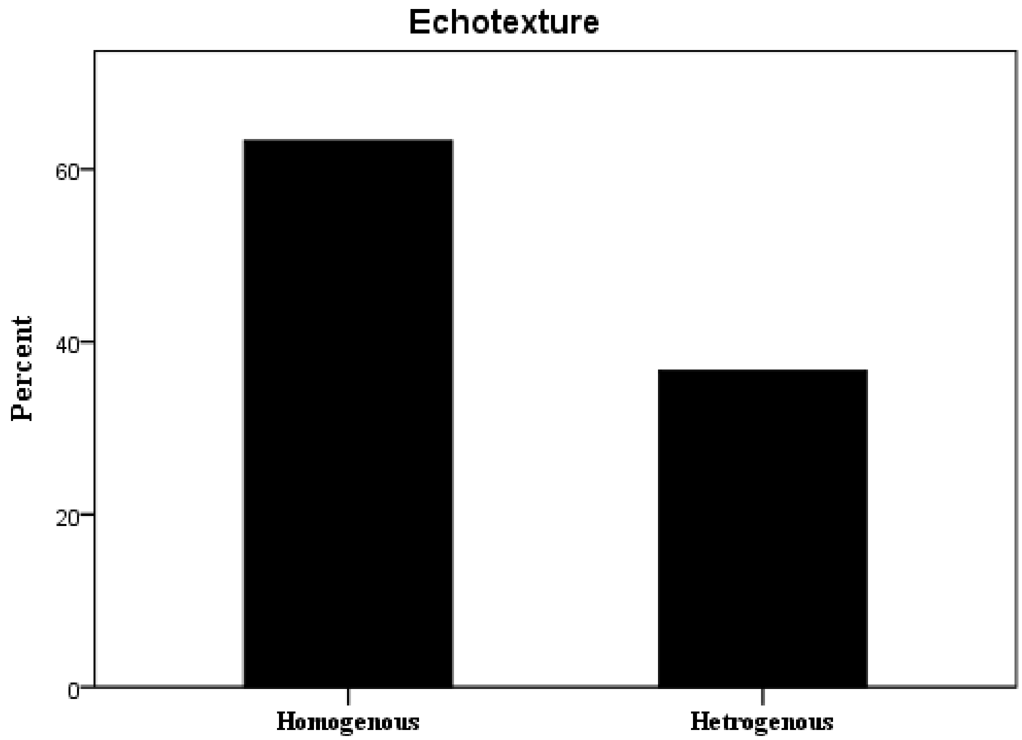

Figure 4.3 Echotexture of the spleen

Table 4.5 Duration of Hemodialysis group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 – 4	78	65.0	65.0	65.0
	4 – 7	24	20.0	20.0	85.0
	7 – 10	13	10.8	10.8	95.8
	10 – 13	5	4.2	4.2	100.0
	Total	120	100.0	100.0	

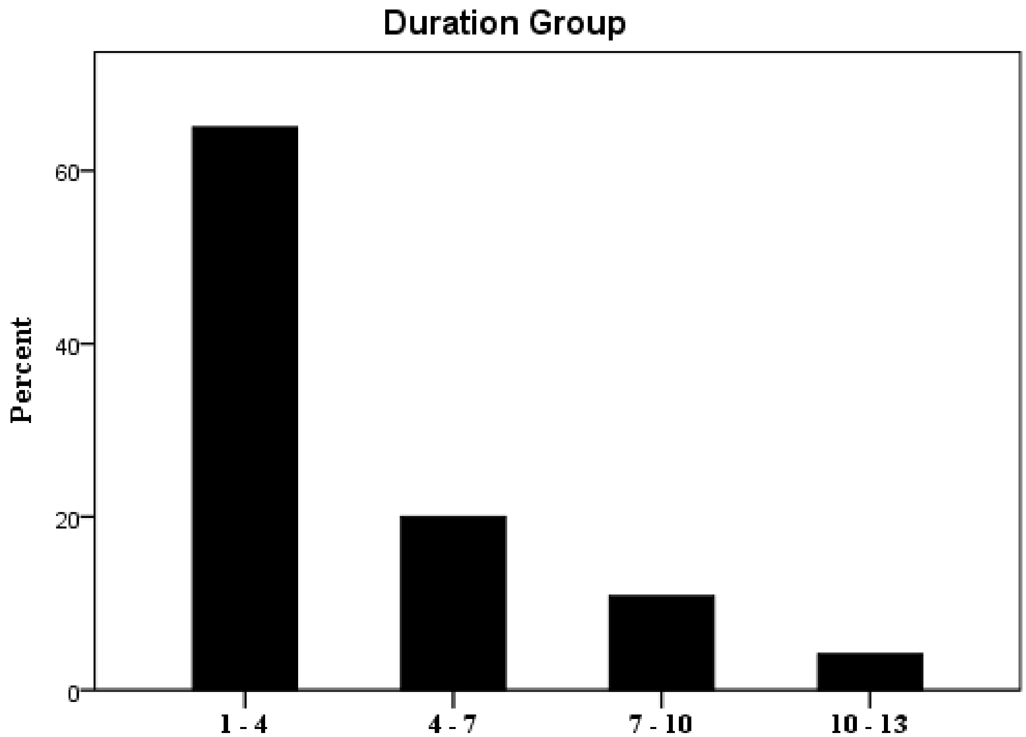

Figure 4.4 Duration of Hemodialysis group

Table 4.6 Descriptive statistic for spleenvolume in different group

Duration	N	Minimum	Maximum	Mean	Std. Deviation	Std. Error
1 – 4	78	127	746	282.49	134.612	15.242
4 – 7	24	135	705	291.54	136.066	27.774
7 – 10	13	93	467	285.92	105.604	29.289
10 – 13	5	186	393	307.00	77.327	34.582
Total	120	93	746	285.69	129.080	11.783

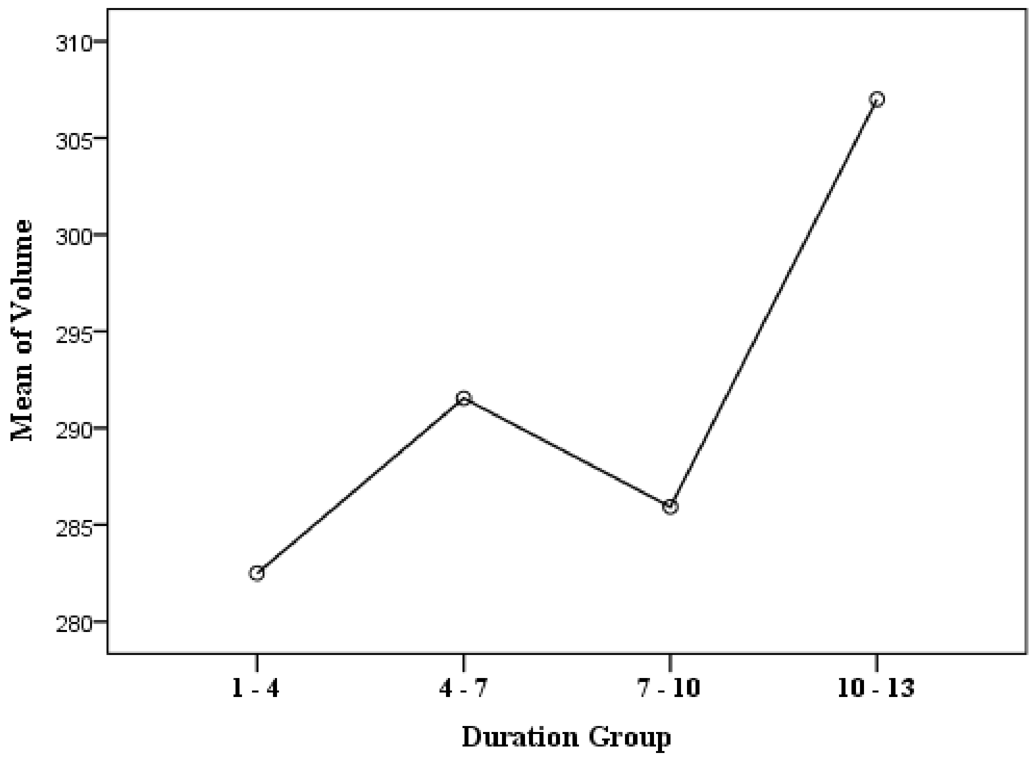

Figure 4.5 comparison of mean spleen volume

Table 4.7 spleen Length Group

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6 – 9	31	25.8	25.8	25.8
	9 -12	70	58.3	58.3	84.2
	12 -15	19	15.8	15.8	100.0
	Total	120	100.0	100.0	

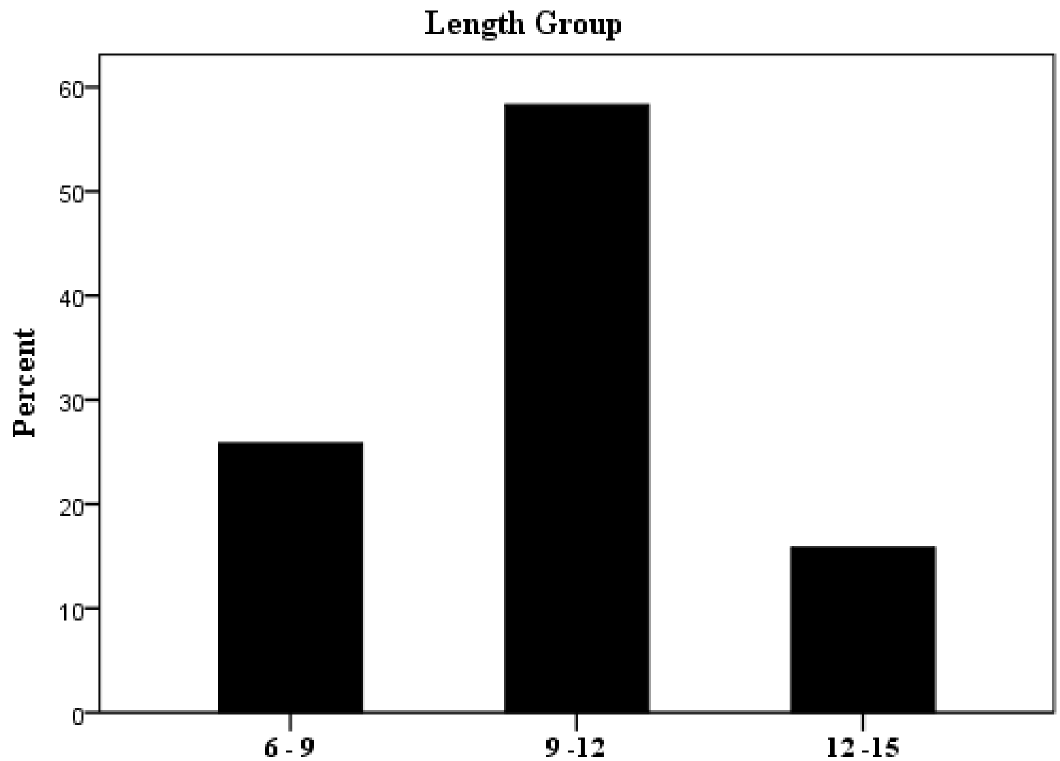

Figure 4.6 spleen Length distribution

Table 4.8 Hemodialysis Duration * Length Group Crosstabulation

			Length Group			Total
			6 – 9	9 -12	12 -15	
Duration Group	1 – 4	Count	23	43	12	78
		% within Duration Group	29.5%	55.1%	15.4%	100.0%
	4 – 7	Count	6	15	3	24
		% within Duration Group	25.0%	62.5%	12.5%	100.0%
	7 – 10	Count	2	7	4	13
		% within Duration Group	15.4%	53.8%	30.8%	100.0%
	10 – 13	Count	0	5	0	5
		% within Duration Group	0.0%	100.0%	0.0%	100.0%
Total		Count	31	70	19	120
		% within Duration Group	25.8%	58.3%	15.8%	100.0%

Table 4.8 Hemodialysis Duration * Echogenicity Crosstabulation

			Echogenicity			Total
			Increased	Normal	Decreased	
Duration Group	1 – 4	Count	9	28	41	78
		% within Duration Group	11.5%	35.9%	52.6%	100.0%
	4 – 7	Count	3	5	16	24
		% within Duration Group	12.5%	20.8%	66.7%	100.0%
	7 – 10	Count	3	0	10	13
		% within Duration Group	23.1%	0.0%	76.9%	100.0%
	10 – 13	Count	0	1	4	5
		% within Duration Group	0.0%	20.0%	80.0%	100.0%
Total		Count	15	34	71	120
		% within Duration Group	12.5%	28.3%	59.2%	100.0%

Table 4.8 Hemodialysis Duration * EchotextureCrosstabulation

			Echotexture		Total
			Homogenous	Heterogeneous	
Duration Group	1 – 4	Count	53	25	78
		% within Duration Group	67.9%	32.1%	100.0%
	4 – 7	Count	16	8	24
		% within Duration Group	66.7%	33.3%	100.0%
	7 – 10	Count	4	9	13
		% within Duration Group	30.8%	69.2%	100.0%
	10 – 13	Count	3	2	5
		% within Duration Group	60.0%	40.0%	100.0%
Total		Count	76	44	120
		% within Duration Group	63.3%	36.7%	100.0%

Chapter Five

Discussion, Conclusion and Recommendations

Chapter Five

Discussion, Conclusion and Recommendations

5.1Discussion

The study has been done in renal center in Khartoum state at Bahry Hemodialysis Centre in 120 patients for 2 years or more. 69 of them are male (57.5%)and 51 female (42.5%).

The study showed 71 patients have decreased echogenicity (59.2%) and 34 patients have normal echogenicity (28.3%) and 15 patients have increased echogenicity (12.5%).

Regarding echotexure, the study showed that 76 patients have homogenous echotexure(63.3%) and 44 patients have hetrogenousechotecxure(36.3%). From the table (4-5) the mean of the volume of the spleen on (1-4) years of hemodialysiswas 282.49, in (4-7)years of hemodialysiswas 291.54, in (7-10) years of hemodialysis 285.92 and in (10-13) years of hemodialysis 307. The study revealed that the volume of the spleen increased on the first years of hemodialysis from 1-7 years then decreased from 7-10 and thenincreased up to 10 years of heamodialysis,the results of this study concluded that there was an increase in spleen volume comparing with normal range. Splenic enlargement due to either to red cell damage produces by hemodialysis or to an immunological reaction induced by component of hemodialysispossibly.This finding was similar to that study done by (Plattsetal., 1984) mean splenic volume was increased in the patients who were receiving hemodialysis. Splenic enlargement was probably not due to iron overload as it occurred in all patients who had received haemodialysis.The study also showed that the homogeneity not changed when there is increasing in length, thickness, width and volume which was disagreed with previousstudy done by(Plattsetal., 1984)which stated that hemodialysis decrease the echogenecity of spleen depending on the duration of dialysis.

Regarding the correlation between duration and volume there was an increase in spleen volume during the first 4 years of hemodialysisafter that the volume fall down, the results of the study concluded that there was increase in spleen volume comparing with normal range, the spleen in hemodialysis seemed to be enlarged independently from the term or number of hemodialysis program.

5.2 Conclusion:

This study was done for 120 patients on hemodialysis for 2 years or more to evaluate the spleen volume, length, thickness and width, and even the echogenicity and heterogenicity. The resultsof the study concluded that there increased the volume in first years and then decreased to normal range that mean the volume not related with the age of duration; furthermore was decreasing in echogenicity when increasing age of duration, also the homogenicity not changed to hetergenicity when there was increasing age of duration.

5.3 Recommendations:

After the counting of the results that related to the following thesis, there are some ideas which could help in more proper management and follow up of patient in long term hemodialysis and better to recommend the followings:

- Ultrasound scanning could be used as routine investigation and follow up to help in treatment of chronic renal failure and hemodialysis patient. Ultrasound scanning is very important to end stage renal disease patients to detect any complications in renal system and other organs.
- Ultrasound department should be found in any renal center.
- Further studies must be done to detect the long hemodialysis effect on the blood supply using Doppler ultrasound as well as detection of any abnormalities that may occur in liver, parathyroid gland and heart related to hemodialysis.
- Study should be done on effect of hemodialysis on bones using x-ray, CT or MRI.

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Appendices

Data collection

Characterization of the Spleen

Index No ☐ Date ☐

Background Information

1. **Gender :**

Male: ☐ Female: ☐

2. Age (years):

20-30 ☐ 31-40 ☐ 41-50 ☐ 51-65 ☐

3. Duration of dialysis (years):

3 – 5 ☐ 6 – 8 ☐ 9 – 13 ☐ More then 13 ☐

Sonographic image of the Spleen:

1/ spleen length ☐ spleen width ☐ spleen thickness ☐

Spleen volume = spleen length × spleen width × spleen thickness ×0.523

2/ Echo texture : (A) Homogeneous ☐ (B) Heterogeneous ☐

3/ Echogenecity:

(A) Decrease ☐ (B) Normal ☐ (C)Increase ☐

Appendix:

Image (1)US image of spleen53years old male patient with dialysis for 2.3 years show heterogeneous and decreasd in echodenicity of spleen

Image (2) US image of spleen a patient with dialysis for 5 years show

Image (3) US image of spleen a patient with dialysis for 5 years show heterogeneous and increase in echodenicity

Image (4) US image of spleen 25years old femal a patient with dialysis for 11 years show hemogenous and decreasd in echodenicity.

Image (5) US image of spleen a patient with dialysis for 5 years show heterogeneous and normal in echodenicity

Image (6) US image of spleen 80years old male patient with dialysis for 5 years show heterogeneous and decreasd in echodenicity

mage (7) US image of spleen 45years old femal patient with dialysis for3.
5 years show heterogeneous and decreasd in echodenicity.

Image (8) US image of spleen a patient with dialysis for 5 years show hemogeneous and decreasd in echodenicity.

Image (9) US image of spleen 57 male a patient with dialysis for 2 years show homogeneous and increase in echodenicity.

Image (10) US image of spleen 38 years old patient with dialysis for 2 years show hemogeneous and decreasd in echodenicity.

Image (11) US image of spleen a patient with dialysis for 5 years show hemogeneous and decreasd in echodenicity

Image (12) US image of spleen 33years old a patient with dialysis for 4 years show heterogeneous and decreasd in echodenicity

Image (13) US image of spleen a patient with dialysis for 5 years show hemorogeneous and decreasd in echodenicity

Image (14) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicity

Image (15) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicity

Image (16) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicity

Image (17) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicity

Image (18) US image of a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicity

Image (19) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicity

Image (20) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicity

Image (21) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicit

Image (22) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicit

Image (23) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echodenicit

Image (24) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreased in echogencity.

Image (25) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echod

Image (26) US image of spleen a patient with dialysis for 5 years show heterogeneous and decreasd in echogencity.