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Characterization of Normal Caudate Lobe in Sudanese Population by Using Computed Tomography

توصيف الفص المذنب الطبيعي لدى السودانيين باستخدام الأشعة المقطعية

A thesis submitted For Partial Fulfillment for Requirement of M.Sc Degree in Diagnostic Radiologic Technology

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الآيــــــــة

قال تعالي:

(قل هل يستوي الذين يعلمون والذين لا يعلمون إنما يتذكّر أولو الألباب)

سورة الزمر (9)

Dedication

This work is dedicated to my parents.

Acknowledgement

The completion of this study would have been not possible if not dependent on the steadfast support and encouragement of my mother. She hence paid equal contribution to the study for which I always feel profound gratitude in my heart.

I would like to express here the very thanks to my supervisor, Prof. Dr. Hussien Ahmed Hassan, for his assistance, ideas, and feedbacks during the process in doing this work.

I also owe my special thanks to my collages in Karary University- College of medical radiologic sciences Ahmed Alsharef Farah and Murtada Mohammed Ibrahim.

Abstract

The caudate lobe is an independent anatomical region in the liver. It also shows different patterns of variability in different populations and Caudate lobe/Right lobe ratio is important for diagnosing. Knowledge and awareness of these variations are useful for Clinicians for the diagnosis and management of hepatic disorders.

The aim of this study was to characterize the normal caudate lobe shape, location, texture and size in Sudanese population by using computed tomography.

The study was carried out in three months during the period from December 2015 to February 2016 in Antalya Medical Center (Khartoum) And Military Hospital (Omdurman).

This study carried out in a sample of 50 patients (18males and 32 females) who underwent abdominal CT examination *for* other reason without liver diseases.

The main results of this study were that the caudate lobe measurements (right to left Diameter, antroposterior Diameter, caudate to right lobe ratio) and the right lobe diameter increased with age and this indicate that the size of liver and caudate lobe increased as the age increased. And the most common shape of the caudate lobe was rectangular 90 %.

Also the study showed that the texture of caudate lobe increased as age increased.

الملخص

الفص المذنب هو منطقة تشريحية مستقلة في الكبد . وهو أيضا يظهر أنماط مختلفة من التباين في مختلف قطاعات السكان و نسبة الفص المذنب للفص الأيمن مهمة للتشخيص . المعرفة والوعي بهذه الاختلافات هي مفيدة بالنسبة للأطباء لتشخيص وعلاج اضطرابات الكبد .

الهدف من هذه الدراسة توصيف شكل ومكان وطبيعة وحجم الفص المذنب الطبيعي لدى السودانيين باستخدام الأشعة المقطعية .

بمركز انطاليا الطبي أجريت هذه الدراسة لمدة ثلاثة أشهر في الفترة من ديسمبر 2015 حتى فبراير 2016 (الخرطوم) ومستشفى السلاح الطبي (أم درمان).

(18 ذكور و32 إناث) خضعوا لفحص أشعة مقطعية هذه الدراسة أجريت في عينة تتكون من 50 مريضا لأسباب أخرى غير أمراض الكبد للبطن .

(من اليمين للشمال ،الأمام للخلف ،الفص الأيمن ،نسبة الفص المذنب النتائج الرئيسية لهذه الدراسة قياسات للفص الأيمن للكبد) الفص المذنب تزيد بزيادة العمر مما يعنى زيادة حجم الفص المذنب مع العمر. والشكل 90% . أيضا أوضحت الدراسة طبيعة الفص المذنب تزيد بنسبة الأكثر شيوعا للفص المذنب هو المستطيل مع زيادة العمر .

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AP	Antroposterior
CAT	Computed Axial Tomography
CL	Caudate Lobe
CRL-R	Caudate To Right Lobe Ratio
CT	Computed Tomography
GE	General Electric
HU	Hounsfield Unit
IVC	Inferior Vena Cava
LPV	Left Portal Vein
LT	Left
MDCT	Multi Detectors Computed Tomography
NAFLD	Non Alcoholic Fatty Liver Disease
NPO	Non By Os
R^2	Liner Correlation Coefficient
RH	Right
RL	Right Lobe
RUQ	Right Upper Quadrate

Contents

Chapter One

Chapter One

1.1 Introduction:

The liver is the largest of the abdominal viscera, occupying a substantial portion of the upper abdominal cavity. It occupies most of the right hypochondrium and epigastrium, and frequently extends into the left hypochondrium as far as the left lateral line. As the body grows from infancy to adulthood the liver rapidly increases in size. This period of growth reaches a plateau around 18 years and is followed by a gradual decrease in the weight from middle age. The ratio of liver to body weight decreases with growth from infancy to adulthood. The liver weighs approximately 5% of the body weight in infancy and it decreases to approximately 2% in adulthood. (Standriing.S, 1999)

It performs a wide range of metabolic activities required for homeostasis, nutrition and immune defense. It is an important site of haemopoiesis in the fetus. Conventionally, the liver has been considered to be divided into right, left, caudate and quadrate lobes by the surface peritoneal and ligaments attachments. (Standriing.S, 1999)

The caudate lobe (Spigelian lobe or Couinaud's segment I) is visible as a prominence on the inferior and posterior surfaces to the right of the groove formed by the ligamentum venosum: it lies posterior to the porta hepatis. To its right is the groove for the inferior vena cava. Above, it continues into the superior surface on the right of the upper end of the fissure for the ligamentum venosum. Below and to the right, it is connected to the right lobe by a narrow caudate process, which is immediately behind the porta hepatis and above the epiploic foramen. Below and to the left, the caudate lobe has a small rounded papillary process. In gross anatomical descriptions this lobe is said to arisefrom the right lobe, but it is functionally separate. (Standriing.S, 1999)

Dodds et al., hypothesized that during second trimester the ductus venosus rotates rightward as the liver enlarges, so that a small portion of the liver become inserted behind the mesentery for the ductus venosus. This part of liver gives rise to caudate lobe of liver. (Dodds.W.J1990)

Caudate lobe of liver is an anatomically independent entity as is evident from ourfindings about its blood supply and biliary drainage. The Shapes of caudate lobe display differentn patterns of variability in different populations. In our set of population less of caudate lobe is exposed to the surface. (Dodds.W.J1990)

The caudate lobe indeed is an independent anatomical region in liver, making it relatively safe from many of the afflictions of the liver. It also has separate blood supply and biliary drainage. It has great clinical significance due to its paradoxical behavior with respect to rest of the liver in cirrhosis. (Dodds.W.J1990)

The normal anatomy of the caudate lobe can create several pitfalls that may lead mistakenly to a diagnosis of disease. First, the caudal margin of the caudate lobe often ends in a papillary process that attaches to the caudate lobe by a narrow connection. On axial CT scans the connection of the papillary process may be missed and the process thereby judged to be an enlarged lymph node (Kowalczyk.N, 2014)

The most common abnormality of the caudate lobe is enlargement. Methods of measuring caudate enlargement are discussed elsewhere. Caudate enlargement generally occurs in the setting of primary cirrhosis of any type or is caused by venous occlusion (Kowalczyk.N, 2014)

The aim of this study was to study morphology and variations of caudate lobe to aid radiologists and surgeons for better interpretation and intervention.

1.2 Problem of study:

The normal anatomy of the caudate lobe can create several pitfalls that may lead mistakenly to be diagnosed as a disease. First, the caudal margin of the caudate lobe often ends in papillary process that attaches to the caudate lobe by narrow connection. On axial CT scans the connection of the papillary process may be missed and the process thereby judged to be an enlarged lymph node.

Also the normal anatomy of the caudate lobe may be confused with tumor.

1.3 Objectives:

1.3.1 General objective:

- to characterize the Normal Caudate Lobe in Sudanese Population by using Computed Tomography.

*1.3.*2 Specific objectives:

- to evaluate the shapes and location of the normal caudate lobe of liver.
- to evaluate the texture of the normal caudate lobe of liver.
- to measure the right to left diameter and antroposterior diameter of Caudate lobe of liver.
- to measure the transverse length of right lobe of liver.
- to evaluate the caudate to right lobe ratio.
- to correlate between caudate lobe texture and size with age and gender.

1.4 The contents of the study:

Chapter one – introduction and objectives of the study.

Chapter two – literature review.

Chapter three-Materials and Methods.

Chapter four – the Results.

Chapter five – Discussion, Conclusion and Recommendation and Last Pages Contain References and Appendix.

Chapter Two

Literature Review

Chapter Two

Background

2.1 Anatomy:

The liver is formed by eight independent functional units, each with specific vascular and biliary connections. The identification of these units or segments first described in its current naming by the French surgeon and anatomist Claude Couinaud – in each individual organ is the key to a reproducible and clinically meaningful description of where liver lesions are localized, and to modern liver surgery. We present a simple way to identify liver segments in radiological examinations based on constant anatomical landmarks, and to memorize their numbering. The anatomy of the liver can be detailed based on the external appearance of the organ (external or descriptive anatomy) or based on its vascular and biliary architecture (vascular or functional anatomy). (Eills .H, 2006)

The descriptive anatomy was sufficient until abdominal surgeons had to perform liver resection, when it became important to respect the vascular integrity and the biliary drainage of the portion of the gland that would be spared. Two problems had to be addressed. The first was to simplify the intricacy of the vascular architecture of the liver to a relatively constant pattern to which even variations can be related (an ”ideal” functional anatomy). (Eills.H, 2006)

The second was tolerate this ideal pattern to the individual anatomy of each liver (the”real” functional anatomy) and to follow this real anatomy in describing the location of liver lesions and in planning and performing the operations. (Eills .H, 2006)

This is the largest organ in the body. It is related by its domed upper surface to the diaphragm, which separates it from pleura, lungs, pericardium and heart. Its postero-inferior (or visceral) surface abuts against the abdominal esophagus, the stomach, duodenum; hepatic flexure of colon and the right kidney and suprarenal, as well as carrying the gall-bladder. (Eills.H, 2006)

The liver is divided into a larger right and small left lobe, separated superiorly by the falciform ligament and postero-inferiorly by an H-shaped arrangement of fossae anteriorly and to the right is the fossa for the gall-bladder; posteriorly and to the right is the groove in which the inferior vena cava lies embedded anteriorly and to the left is the fissure containing the ligamentum teres posteriorly and to the left is the fissure for the ligamentum venosum The cross-bar of the H is the porta hepatis. (Eills .H, 2006)

Two subsidiary lobes are marked out on the visceral aspect of the liver between the limbs of this H—the quadrate lobe in front and the caudate lobe behind.The ligamentum teres is the obliterated remains of the left umbilical vein which, in utero, brings blood from the placenta back into the fetus. (Eills .H, 2006)

The ligamentus venosum is the fibrous remnant of the fetal ductus venosus which shunts oxygenated blood from this left umbilical vein to the inferior vena cava, short-circuiting the liver. It is easy enough to realize, then, that the grooves for the ligamentum teres, ligamentum venosum and inferior vena cava, representing as they do the pathway of a fetal venous trunk, are continuous in the adult. Laying in the porta hepatis (which is 2 in (5 cm) long) are the common hepatic duct anteriorly the hepatic artery in the middle the portal vein posteriorly. As well as these, autonomic nerve fibers (sympathetic from the celiac axis and parasympathetic from the vagus), lymphatic vessels and lymph nodes are found there. (Eills.H, 2006)

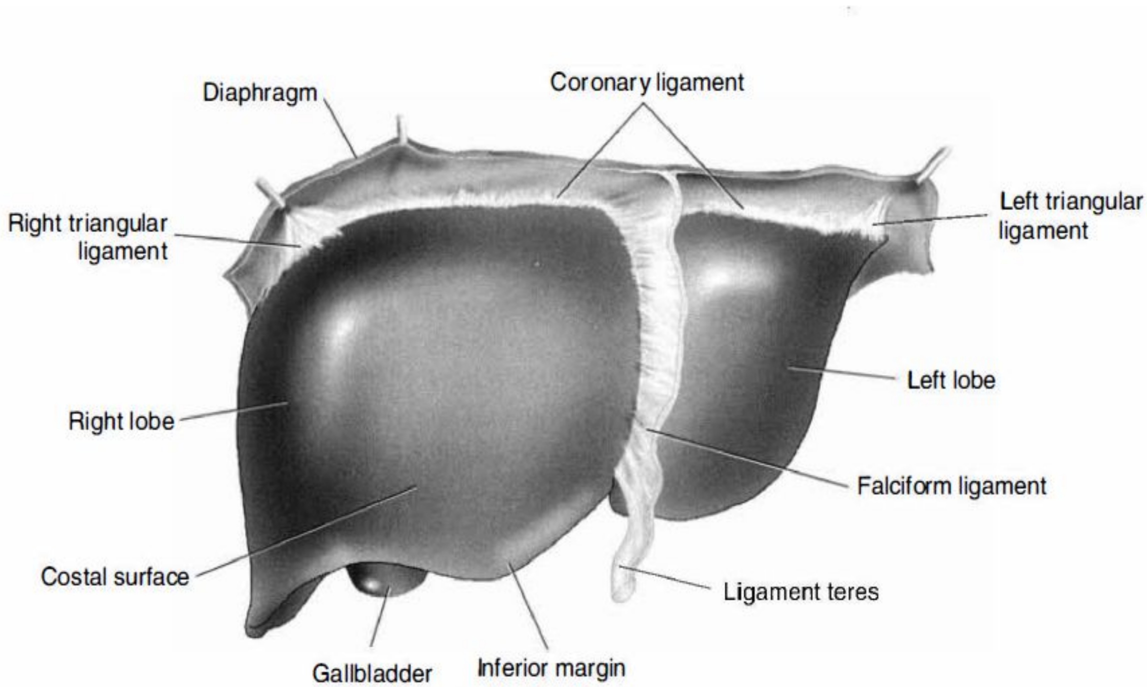


Figure 2.1: The Anterior view of the liver

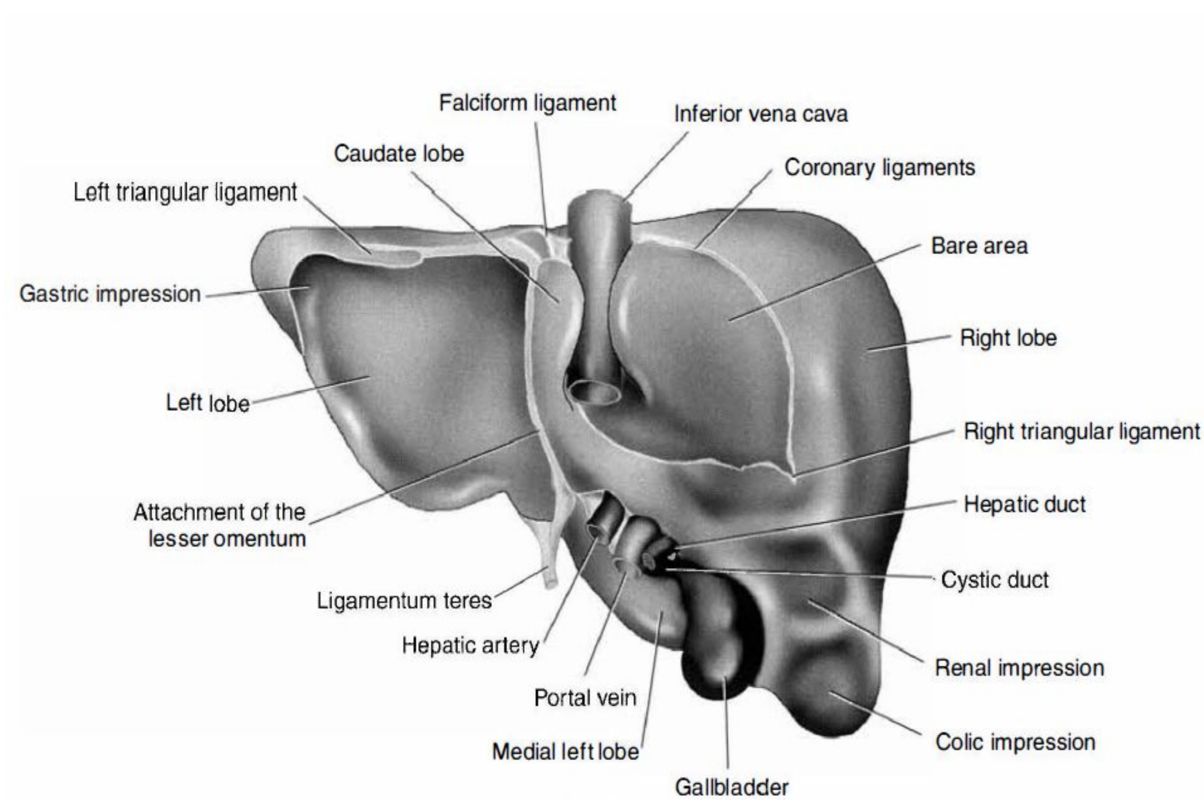


Figure 2.2: The posterior view of the liver

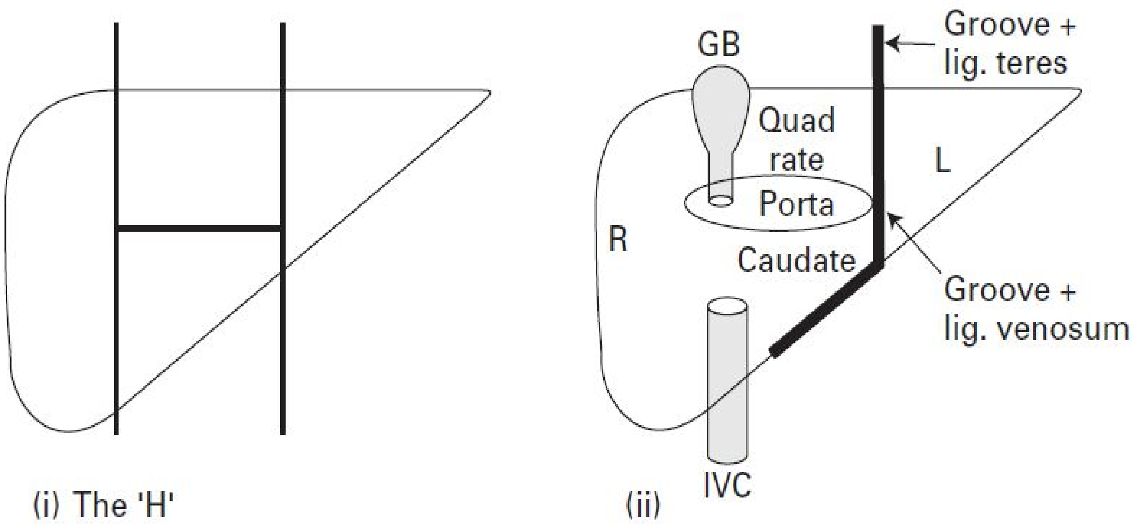


Figure2.3: The liver and its subdivisions. (i)"The H" . (ii) Inferior aspect.

The liver is enclosed in peritoneum except for a small posterior bare area, demarcated by the peritoneum from the diaphragm reflected on to it as the upper and lower layers of the coronary ligament. To the right, these fuse to form the right triangular ligament. (Eills .H, 2006)

The falciform ligament ascends to the liver from the umbilicus, somewhat to the right of the midline, and bears the ligamentum teres in its free border. The ligamentum teres passes into its fissure in the inferior surface of the liver while the falciform ligament passes over the dome of the liver and then divaricates. Its right limb joins the upper layer of the coronary ligament and its left limb stretches out as the long narrow left triangular ligament which, when traced posteriorly and to the right, joins the lesser omentum in the upper end of the fissure for the ligamentum venosum.The lesser omentum arises from the fissures of the porta hepatics and the ligamentum venosum and passes as a sheet to be attached along the lesser curvature of the stomach. (Eills.H, 2006)

2.1.1 Segmental anatomy:

Current practice favors dividing the liver into eight segments, according to its vascular supply, which can aid in surgical resection. According to the French anatomist Couinaud, the liver can be divided into segments based on the branching of the portal and hepatic veins. The three main hepatic veins divide the liver longitudinally into four sections (Lorrie.L.K, 2007).

The middle hepatic vein divides the liver into right and left lobes. The right lobe is divided into medial and lateral sectors by the right hepatic vein, and the left lobe is divided into medial and lateral sectors by the left hepatic vein. Each section is then subdivided transversely by the right and left portal veins, creating nine segments numbered counterclockwise from the IVC. Each segment can be considered functionally independent with its own hepatic artery, portal vein, and bile duct and drained by a branch of the hepatic vein (Lorrie.L.K, 2007).

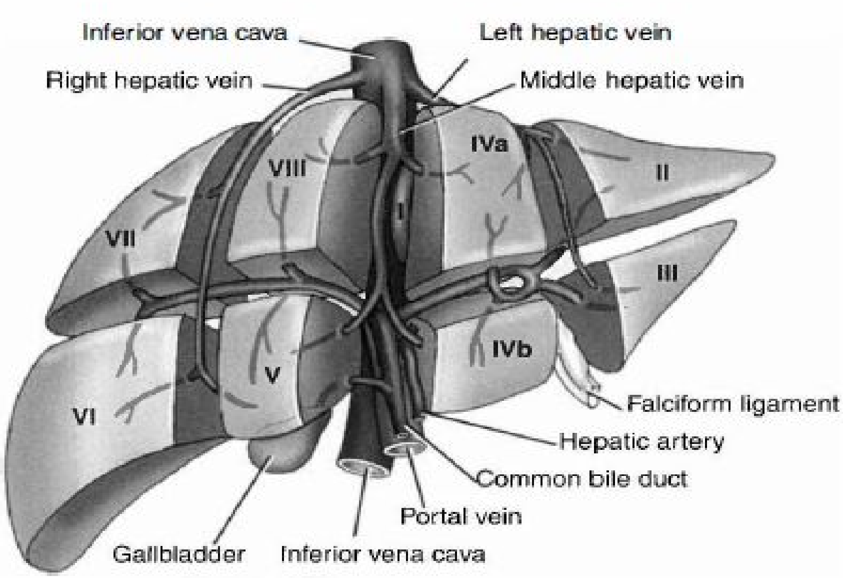


Figure 2.4: Anterior view of segmentation of liver.

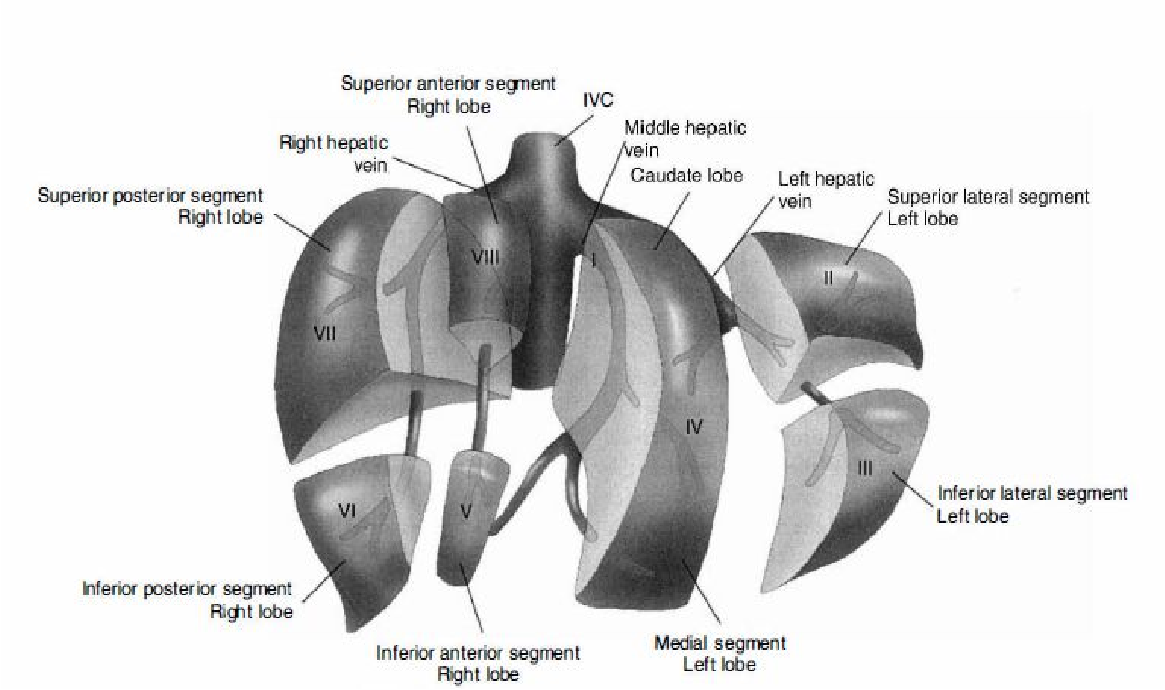


Figure 2.5: Couinaud's segmentation of the liver with hepatic veins.

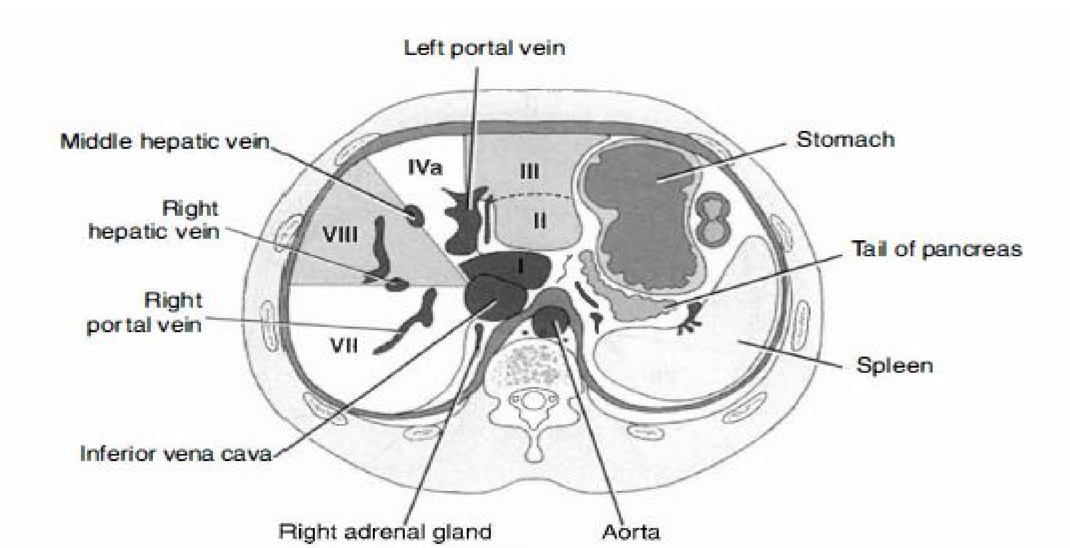


Figure 2.6: Axial view of liver segments.

There are three major hepatic veins, comprising a right, a central and a left. These pass upwards and backwards to drain into the inferior vena cava at the superior margin of the liver. Their terminations are somewhat variable but usually the central hepatic vein enters the left hepatic vein near its termination. In other specimens it may drain directly into the cava. In addition, small hepatic venous tributaries run directly backwards from the substance of the liver to enter the vena cava more distally to the main hepatic veins. Although these are not of great functional importance they obtrude upon the surgeon during the course of a right hepatic lobectomy. (Lorrie.L.K, 2007).

The three principal hepatic veins have three zones of drainage corresponding roughly to the right, the middle and left thirds of the liver. The plane defined by the falciform ligament corresponds to the boundary of the zones drained by the left and middle hepatic veins. Unfortunately for the surgeon, the middle hepatic vein lies just at the line of the principal plane of the liver between its right and left morphological lobes and it is this fact which complicates the operation of right hepatic resection (Lorrie.L.K, 2007).

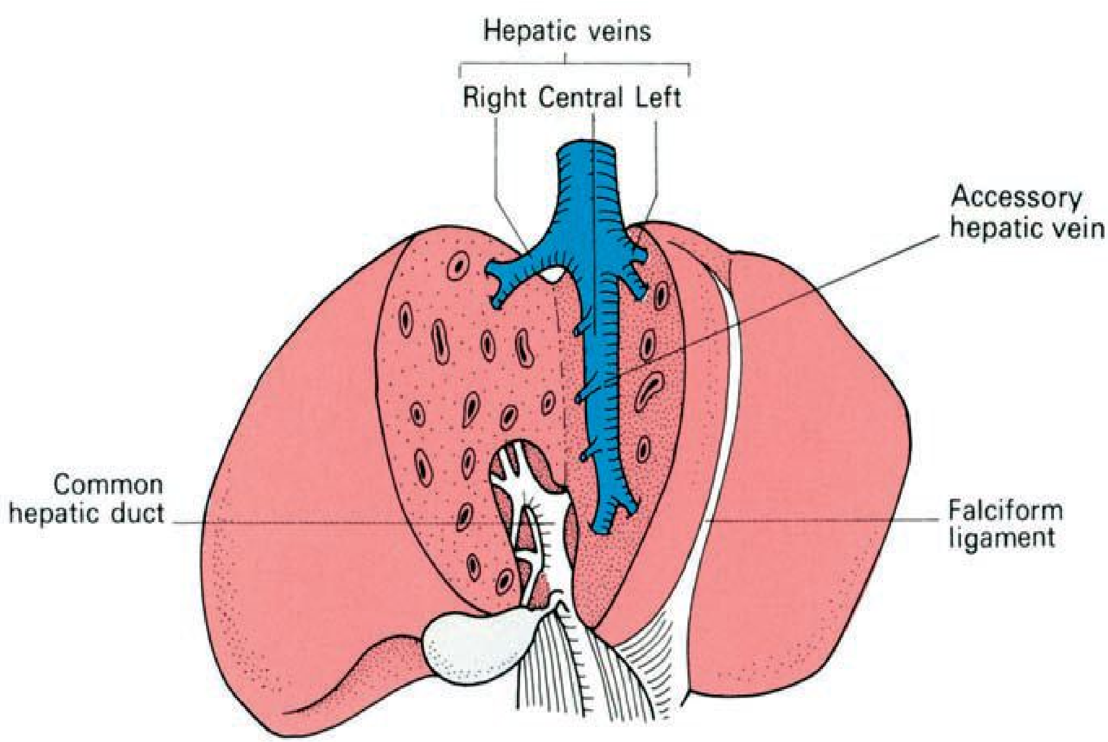


Fig.2.7: Liver split open to demonstrate the tributaries of the hepatic vein.

2.1.2 The Caudate Lobe of the Liver:

Caudate lobe is a central structure of the liver that generally is seen readily on abdominal imaging studies such as CT or sonography. Caudate anatomy, however, is complex and may cause difficulties in the interpretation of cross-sectional images. (Wylie .J, dodds 1990)

The hepatic segment of the left lobe of the liver describe the caudate lobe as a midline, vertically oriented hepatic lobe, seen on the posterior aspect of the liver separating a portion of the right and left hepatic lobes in an H configuration. (Wylie .J, dodds 1990)

The horizontal bar of the H configuration represents the portal hepatics, which includes the horizontal portion of both portal veins. Above the bar is the caudate lobe of the liver and below the bar is the medial segment, or quadrate lobe, of the left lobe of the liver. Although such descriptions delineate the topography of the liver, they do not adequately describe the relationship of the caudate lobe to the interior of the liver (Wylie .J, dodds 1990)

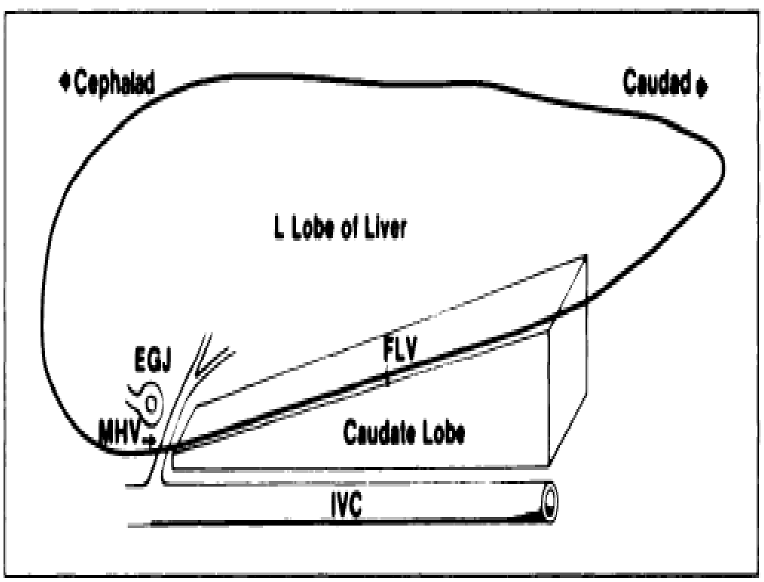


Fig. 2.8: Schematic representation of lateral view of caudate lobe.

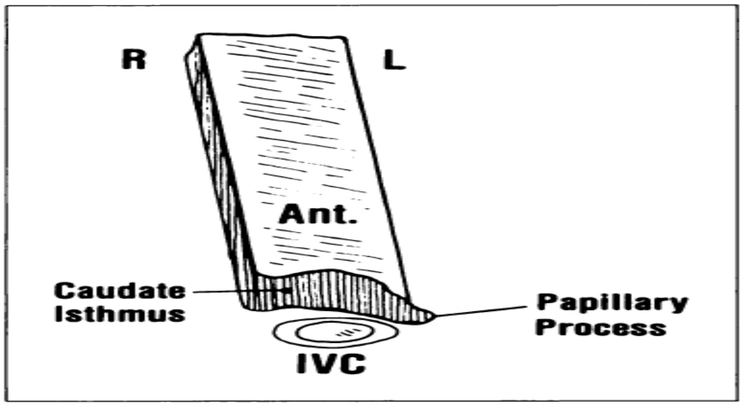


Fig. 2.9: Schematic representation of frontal view of caudate lobe. R = right L = left IVC = **inferior vena cava.**

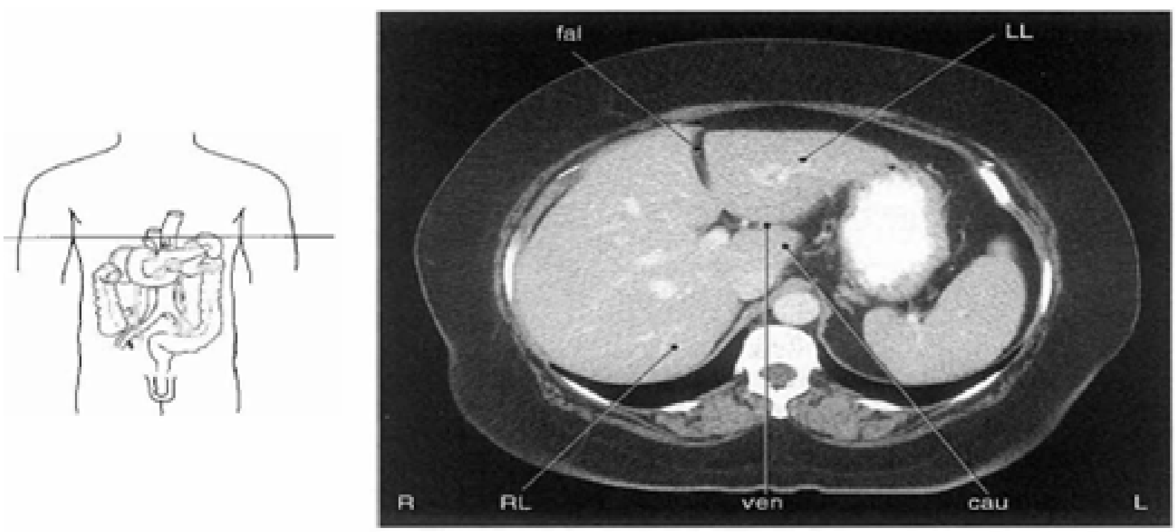


Fig. 2.10: CT scans through caudate lobe.

Development of the caudate lobe is shrouded in mystery; it has been said to develop from either the left or right hepatic lobe. The origin of the blood supply to the caudate lobe is uncertain. To address this problem, we propose a unifying hypothesis about developmental caudate embryology that we think clarifies existing anatomic findings in the adult. We propose that the key to understanding the development of the caudate lobe is the ducts venous, which in early embryonic life is suspended within the superior portion of the dorsal mesentery of the liver. In the early embryo, the primitive gastrointestinal tract, including the esophagus, is suspended along its length by both a dorsal and ventral mesentery. (Wylie .J, dodds 1990)

Most of the ventral mesentery disappears, but the liver develops in the ventral mesentery, resulting in a dorsal portion of lesser omentum with persistence of the gastro hepatic and hepatoduodenal ligaments. All vascular structures to the liver that connect to posterior structures, such as the aorta or the vena cava, must run through the dorsal mesentery of the liver and dorsal mesentery of the duodenum to reach the liver. For example, the gastro hepatic artery originates from the aorta, but through a series of mesenteric twists and folding, its original mesentery is no longer apparent in the adult. Yet the course of this artery and its major branches provides clear evidence of the original location of their mesentery .In similar fashion, we propose that the ductus venosus originally was suspended by a dorsal mesentery early in embryologic development, and part of this mesentery later disappeared. (Wylie .J, dodds 1990)

The history of this mesentery delineates the development of the caudate lobe. At present, there is little argument that a ligament (within the original mesentery) persists from the original ductus venosus in the adult liver In adults, the ligament of the ductus venosus passes through the liver from the base of the left portal vein to the vena cava to which it is attached. The ligament venosum passes between the leaves of the original dorsal mesentery of the liver (Wylie .J,dodds 1990)

The mesentery persists as the fissure for the ligamentum venosum. During the second trimester the right umbilical vein becomes atrophic and disappears. The persistent left umbilical vein runs in the free margin of the falciform ligament to attach at the base of the left portal vein. From this juncture, a large vessel, the uctus venosus, suspended within the cephalad portion of the dorsal mesentery of the liver, shunts placental blood through the liver to the heart by coursing directly to the vena cava or middle hepatic vein near their junction with the heart .During the second trimester the liver and mesentery of the ducts venosus rotate rightward as the liver enlarges, so that a small portion of the liver becomes inserted behind the mesentery for the ductus venosus, within the sagittally oriented angle formed by the ductus venosus and the inferior vena cava. Subsequently, the extra hepatic portion of the ductus mesentery shortens and folds over so that the vena cava lies against the spine and there is no longer an identifiable complete mesentery between the duct sand vena cava. (Wylie .J, dodds 1990)

The ductus venosus becomes obliterated shortly after birth, and the former ductus Venosus persists as the ligamentum venosum. Studies in cadavers have shown that this ligament runs through the liver from the base of the left portal vein to attach to the inferior vena cava or base of the middle hepatic vein. (Wylie .J, dodds 1990)

2.2 Physiology:

The bile produced in the liver is collected in bile canaliculi, which merge from bile ducts. These eventually drain into the right and left hepatic ducts, which in turn merge to form the common hepatic duct. The cystic duct (from the gallbladder) joins with the common hepatic duct to form the common bile duct. (http://en.wikibooks.org/wiki/Human_Physiology)

Bile can either drain directly into the duodenum via the common bile duct or be temporarily stored in the gallbladder via the cystic duct. The common bile duct and the pancreatic duct enter the duodenum together at the ampulla of Vater. The branching of the bile ducts resemble those of a tree, and indeed term "biliary tree" is commonly used in this setting. The liver is among the few internal human organs capable of natural regeneration of lost tissue: as little as 25% of remaining liver can regenerate into a whole liver again. This is predominantly due to hepatocytes acting as unipotential stem cells. There is also some evidence of bio potential stem cells, called oval cell, which can differentiate into either hepatocytes or cholangiocytes (cells that line bile ducts).

The various functions of the liver are carried out by the liver cells or hepatocytes. The liver produces and excretes bile requires for dissolving fats. Some of the bile drains directly into the duodenum, and some is stored in the gallbladder. (http://en.wikibooks.org/wiki/Human_Physiology)

The liver performs several roles in carbohydrate metabolism such as gluconeogenesis (the formation of glucose from certain amino acids, lactate or glycerol), Glycogenolysis (the formation of glucose from glycogen), Glycogenesis (the formation of glycogen from glucose) and the breakdown of insulin and other hormones. The liver is responsible for the mainstay of protein metabolism. The liver also performs several roles in lipid metabolism: cholesterol synthesis, the production of triglycerides (fats).

The liver produces coagulation factors I (fibrinogen), II (prothrombin), V, VII, IX, X and XI, as well as protein C, Protein S and antithrombin.The liver breaks down hemoglobin, creating metabolites that are added to bile as pigment and also breaks down toxic substances and most medicinal products in a process called drug metabolism. This sometimes results in toxication, when the metabolite is more toxic than its precursor. The liver converts ammonia to urea and stores a multitude of substances, including glucose in the form of glycogen, vitamin B12, iron, and copper. The liver is responsible for immunological affects the reticuloendothelial system if the liver contains many immunologically active cells, acting as a 'sieve' for antigens carried to it via the portal system. (http://en.wikibooks.org/wiki/Human_Physiology).

2.3 Pathology:

Alcohol is a known toxin, which, when metabolized by the liver, causes cellular damage; alcohol abuse has long been associated with liver disease. Alcohol cannot be stored in the human body, and therefore, the liver must convert it, through oxidation, to alcohol dehydrogenase, acetaldehyde, and acetate, all of which reduce cellular function. This leads to interference with carbohydrate and lipid metabolism. Oxidation also results in reduced gluconeogenesis and increased fatty acid synthesis associated with alcohol metabolism. Chronic alcohol abuse often leads to fatty liver followed by hepatitis, cirrhosis, hepatocellular carcinoma, or all of these diseases. (Kowalczyk.N, 2014)

Fatty liver is the most frequent early response to alcohol abuse. Changes in liver function result in a buildup of lipids such as triglycerides, which are deposited in the liver cells. This condition is usually asymptomatic; however, patients may have hepatomegaly. Fatty infiltration may be demonstrated by using CT or sonography, but CT is currently the examination of choice. CT demonstrates the fatty deposits as hypodense. (Kowalczyk.N, 2014)

Areas throughout the liver Inflammation often follows fatty changes within the liver, leading to alcoholic hepatitis. At this stage, many patients present with jaundice. This inflammation is diffuse throughout the liver cells and culminates in liver necrosis. This disease may be fatal, progressing quickly to liver failure; or if the individual survives the hepatitis, the condition progresses to alcoholic cirrhosis of the liver, which is an end-stage disease. (Kowalczyk.N, 2014)

Factors other than alcohol abuse may also lead to fatty infiltrates within the liver. Obese individuals with type 2 diabetes mellitus, metabolic syndrome, hyperlipidemia, or all of these diseases are at an increased risk of developing nonalcoholic fatty liver disease (NAFLD). This pathology develops as lipids accumulate within the hepatocytes forming free radicals. At some point, the liver cannot rid itself of the excessivetrigly cerides. This results in an excess of fatty acids within the liver, which leads to fatty infiltration of the liver, termed steatosis, and fatty liver disease. In the early stages, NAFLD is oftenasymptomatic, and diagnosis requires biopsy of liver tissue. Although the disease progresses slowly, it may advance to cirrhosis of the liver if left untreated. Management includes implementation of weight loss programs and exercise programs as treatment for insulin resistance and associated metabolic disturbances. (Kowalczyk.N, 2014)

Cirrhosis is a chronic liver condition in which the liver parenchyma and architecture are destroyed, fibrous tissue is laid down, and regenerative nodules are formed. In its early stages, it is usually asymptomatic, as it may take months or even years before damage becomes apparent. Cirrhosis affects the entire liver and is considered an end-stage condition resulting from liver damage caused by chronic alcohol abuse, drugs, autoimmune disorders, metabolic and genetic disease, chronic hepatitis, cardiac problems, and chronic biliary tract obstruction. (Kowalczyk.N, 2014)

CT is the primary modality for evaluating the complications arising from cirrhosis. Fatty infiltration of the liver is well visualized by CT. The most characteristic finding in cirrhosis is an increase in the ratio of the caudate lobe and the right lobe. This occurs with cirrhosis because of atrophy of the right lobe and medial segment of the left lobe and hypertrophy of the caudate lobe and the lateral segment of the left lobe. Because of its dual arterial blood supply, the caudate lobe of the liver is usually spared in cirrhosis. Studies show that individuals with cirrhosis have an increased risk of developing hepatic carcinoma, so CT is also of value in assessing the presence of complications of cirrhosis such as ascites and hepatocellular carcinoma. (Kowalczyk.N, 2014)

Ascites is the accumulation of fluid within the peritoneal cavity is also seen as a result of portal hypertension and the leakage of excessive fluids from the portal capillaries. Much of this excess fluid is composed of hepatic lymph weeping from the liver surface. It is associated with approximately 50% of deaths from cirrhosis. Ascites may also result from chronic hepatitis, congestive heart failure, renal failure, and certain cancers. (Kowalczyk.N, 2014)

Hepatocellular adenoma is a benign tumor of the liver. Most tumors are asymptomatic, but the incidence of this disease has increased over the past few years. Hepatocellular adenomas occur most often in women using oral contraceptives, which play a role in the development of these benign lesions. In terms of imaging, both CT and sonography are useful in demonstrating hepatic lesions. (Kowalczyk.N, 2014)

A hemangioma is the most common tumor of the liver. It is a benign neoplasm composed of newly formed blood vessels, and these neoplasms may form in other places within the body. For instance, a port-wine stain on the face (a superficial purplish red birthmark) is an example of a hemangioma elsewhere in the body. Hemangiomas are generally well-circumscribed, solitary tumors. They may range in size from microscopic to 20 cm. They are more common in women than in men, especially in postmenopausal women. (Kowalczyk.N, 2014)

Diagnosis may be complicated when it occurs with a known malignancy because its characteristics may be difficult to distinguish from metastasis.. A CT of the liver following an injection of IV contrast medium demonstrates the hemangioma with peripheral enhancement with fibrosis within the tumor. (Kowalczyk.N, 2014)

Hepatocellular carcinoma, a primary neoplasm of the liver. An association between cirrhosis and hepatocellular carcinoma exists, with chronic hepatitis B or C and alcoholism associated with each. Thus, the incidence of this neoplasm is on the rise because of an increase in chronic hepatitis B and C infections in the United States. Most primary hepatomas originate in the liver parenchyma, creating a large central mass with smaller satellite nodules. Although vascular invasion is common, death occurs from liver failure, often without extension of the (Kowalczyk.N, 2014)

Cancer outside the liver. Hepatocellular carcinoma is suspected in patients with cirrhosis who experience an unexpected deterioration and in patients with increased jaundice, abdominal pain, weight loss, an RUQ mass, ascites, or a rapid increase in liver size. Plain abdominal radiographs may demonstrate hepatomegaly. Sonography and CT are often used to reveal the extent of the tumor (Kowalczyk.N, 2014)

Metastatic liver lesions are much more common than primary carcinoma because of the liver's role in filtering blood. The liver is a common site for metastasis from other primary sites such as the colon, pancreas, stomach, lung, and breast Primary cancers located in the abdomen, especially those drained by the portal venous system, often metastasize to the liver (Kowalczyk.N, 2014)

Alcoholic cirrhosis. Caudate lobe is enlarged and left hepaticlobels atrophic. Ascitesis present Portal vein is replaced by multiple small veins and varices are located in gastrohepatic ligament B, Cirrhosis from occlusion of hepatic vein (Budd-Chiarl syndrome). Caudate lobe is markedly enlarged and compresses intrahepatic portion of inferior vena cava. Liver exhibits scattered areas of Increased and decreased enhancement. Hepatic veins are not seen. (Kowalczyk.N, 2014)

With right lobar atrophy, the fissure for the ligamentum venosum may rotate counterclockwise. In some instances, the gallbladder relocates posterior to the liver and bowel interposes in front of the liver. Orientation of the fissure for the ligamentum venosum also may be useful for recognition not only of right lobar atrophy but also of volume loss from a partial right hepatic lobar resection. Enlargement of the caudate lobe commonly accompanies occlusion of the hepatic veins, along with patchy areas of low and high attenuation on CT. (Kowalczyk .N, 2014)

The explanation given is that the venous drainage of the caudate lobe is maintained by emissary veins that pass directly from the caudate lobe to the vena cava. Thus, obstruction of the hepatic veins causes greater blood flow through the caudate lobe and, thereby, hypertrophy of the caudate lobe. Although the patchy hepatic changes that occur with hepatic vein occlusion may occur with chronic right heart failure, right heart failure seldom causes enlargement of the caudate lobe. Enlargement of the caudate lobe may narrow the intrahepatic portion of the vena cava (Kowalczyk .N, 2014)

Focal lesions similar to lesions elsewhere in the liver may involve the caudate lobe. For example, the caudate lobe may harbor a simple cyst, primary tumor, metastatic lesion, or abscess. Fatty infiltration confined to the caudate lobe may simulate a tumor. Traumatic fracture of the caudate, although rare, may occur (Kowalczyk .N, 2014).

2.5 CT machine:

CT scanners are complex, with many different components involved in the process of creating an image. Adding to the complexity, different CT manufacturers often modify the design of various components. From a broad perspective, all makes and models of CT scanners are similar in that they consist of a scanning gantry, x-ray generator, computer system, operator's console, and physician's viewing console. Although hard-copy filming has largely been replaced by workstation viewing and electronic archiving, most CT systems still include a laser printer for transferring CT images to film. (Lois E. Romans, 2011)

The three major components of a CT imaging system are the operating console, the computer, and the gantry. Each of these major components has several subsystems.

Computed tomography imaging systems can be equipped with two or three consoles. One console is used by the CT radiologic technologist to operate the imaging system. Another console may be available for a technologist to post process images to annotate patient data on the image (e.g., hospital identification, name, patient number, age, gender) and to provide identification for each image (e.g., number, technique, couch position). This second monitor also allows the operator to view the resulting image before transferring it to the physician's viewing console.

A third console may be available for the physician to view the images and manipulate image contrast, size, and general visual appearance. This is in addition to several remote imaging stations. (Stewart Carlyle Bushong, 2013)

The computer is a unique subsystem of the CT imaging system. Depending on the image format, as many as 250,000 equations must be solved simultaneously; thus, a large computing capacity is required. Many CT imaging systems use an array processor instead of a microprocessor for image reconstruction. The array processor does many calculations simultaneously and hence is significantly faster than the microprocessor. (Stewart Carlyle Bushong, 2013)

The gantry includes the x-ray tube, the detector array, the high-voltage generator, the patient support couch, and the mechanical support for each. These subsystems receive electronic commands from the operating console and transmit data to the computer for image production and post processing tasks. (Stewart Carlyle Bushong, 2013)

X-ray tubes produce the x-ray photons that create the CT image. Their design is a modification of a standard rotating anode tube, such as the type used in angiography. Tungsten, with an atomic number of 74, is often used for the anode target material because it produces a higher-intensity x-ray beam. CT tubes often contain more than one size of focal spot; 0.5 and 1.0 mm are common sizes. Early CT scanners used recoiling system cables to rotate the gantry frame. Current systems use electromechanical devices called slip rings. Slip rings use a brush like.

apparatus to provide continuous electrical power and electronic communication across a rotating surface. They permit the gantry frame to rotate continuously, eliminating the need to straighten twisted system cables. (Lois E. Romans, 2011)

As the x-ray beam passes through the patient it is attenuated to some degree. To create an x-ray image we must collect information regarding the degree to which each anatomic structure attenuated the beam. In CT, detectors used to collect the information. The detector array comprises detector elements situated in an arc or a ring, each of which measures the intensity of transmitted x-ray radiation along a beam projected from the x-ray source to that particular detector element. Detectors can be made from different substances, each with their own advantages and disadvantages. All new scanners possess detectors of the solid-state crystal variety. Detectors made from xenon gas have been manufactured but have largely become obsolete as their design prevents them from use in MDCT systems. (Lois E. Romans, 2011)

High-frequency generators are currently used in CT. They are small enough so that they can be located within the gantry. Generators produce high voltage and transmit it to the x-ray tube. CT generators produce high kV (generally 120–140 kV) to increase the intensity of the beam, which will increase the penetrating ability of the x-ray beam and thereby reduce patient dose. In addition, a higher kV setting will help to reduce the heat load on the x-ray tube by allowing a lower MA setting. Reducing the heat load on the x-ray tube will extend the life of the tube. (Lois E. Romans, 2011)

The patient lies on the table (or couch, as it is referred to by some manufacturers) and is moved within the gantry for scanning. The process of moving the table by a specified measure is most commonly called incrementation, but is also referred to as feed, step, or index. Helical CT table incrementation is quantified in millimeters per second because the table continues to move throughout the scan. The degree to which a table can move horizontally is called the scannable range, and will determine the extent a patient can be scanned without repositioning. The specifications of tables vary, but all have certain weight restrictions. On most scanners, it is possible to place the patient either head first or feet first, supine or prone. Patient position within the gantry depends on the examination being performed. (Lois E. Romans, 2011)

2.6 Previous studies:

The study was done by (kamal.N etal) Morphometric Study of Caudate Lobe of Liver to study the morphology of the caudate lobe of liver. The caudate lobe is visible on the posterior surface, bounded on the left by the fissure for the ligamentum venosum, below by the porta hepatis and on the right by the groove for the inferior vena cava. Above, it continues into the superior surface on the right of the upper end of the fissure for the ligamentum venosum. Below and to the right, it is connected to the right lobe by a narrow caudate process, which is immediately behind the porta hepatis and above the epiploic foramen. Below and to the left, the

Caudate lobe has a small rounded papillary process. Taking into consideration clinical importance of this lobe in metastasis, cirrhosis and hepatic resections a morphological study was carried out on caudate lobe. The Results of this study is various shapes of the caudate lobe were observed, rectangular being the commonest.

Another study done by **Sarala H**s and others showed that various shapes of the caudate lobe were noticed. Vertical fissure extending upwards from lower border was seen in 30%. Prominent papillary process was seen in 21%. Prominent caudate process was seen in 9%.Various shapes of the caudate lobe were encountered in the present study. **Sahni et aland Joshi S,Det al** also reported a variety of shapes of the caudate lobe. Vertical fissure extending upwards from the inferior border was seen in 30% of the livers. **Kogure et al** noticed the notch in approximately half of the patients undergoing hepatoectomy. **Kogure et al** also noted that the external notch may be a vestige of the portalsegmentation of the et al has also found prominent papillary process in 33% of the livers in their study. **Auh et al** observed that on CT (Computed Tomography), a normal or small papillary process may be mistaken for enlarged porta hepatis lymph nodes. When enlarged papillary process extends on to left side it can mimic pancreatic body mass.

Chapter Three

Materials and Methods

Chapter Three
Materials and Methods

3.1 Materials:

3.1.1 Study sample:

This is practical study carried out in a sample of 50 patients in different genders and age whom will be referred to the radiology department in modern medical center, undergoing abdomen CT examination, to evaluate caudate lobe of liver, the data collected and interpreted by radiologist.

3.1.2 Study area and Duration:

Antalya Medical Center and Military Hospital**.** Duration from 1/12/2015 to 1/3/2016.

3.1.3 Equipments:

Figure 3.1: Toshiba sensation 64 slices in military hospital.

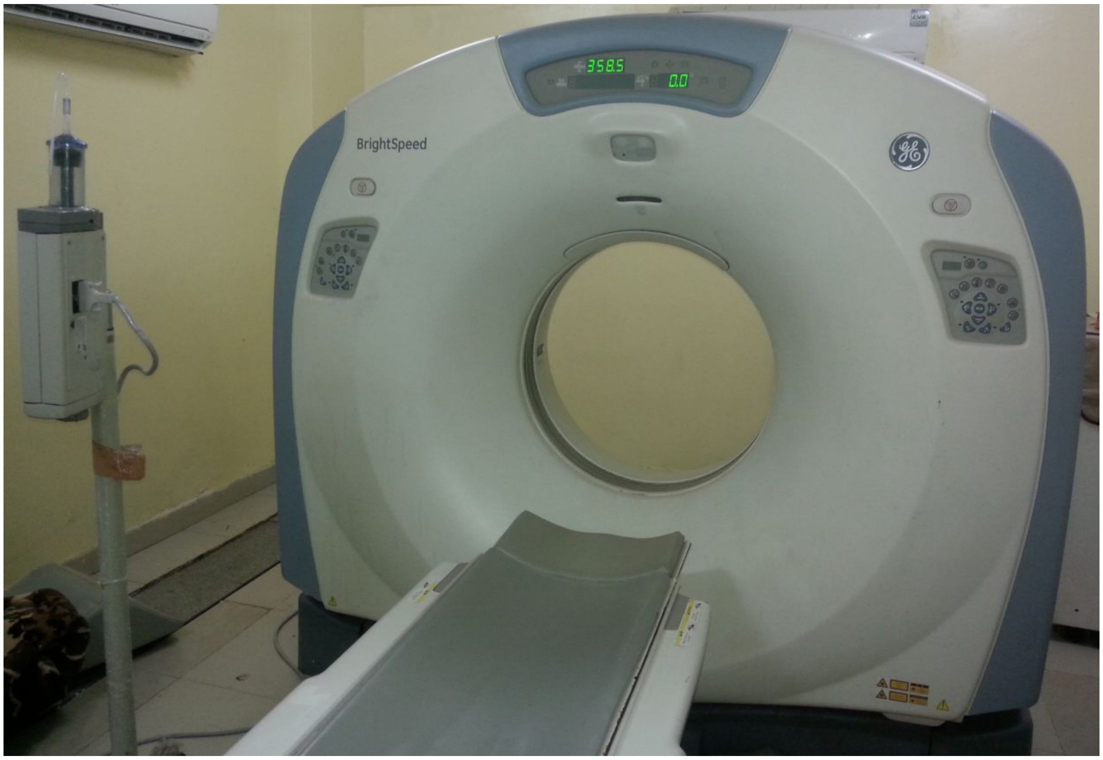


Figure 3.2: G.E speed dual sensation in Antalya medical center**.**

3.2 Methods:

3.2.1 Technique used

The patient should be NPO from midnight until the time of the examination. Food and fluids should be withheld for at least 8 hours prior to the exam.

The protocol used dynamic liver triphase: hepatic arterial phase, portal phase and Venus phase.

The patient position is in supine (feet first).

The slice thickness .is used 10 mm pre- contrast but after contrast use as slice thickness.

No breasting technique use.

3.2.2 Image interpretation:

All CT image were studied for different ages and weight, to evaluate caudate lobe from right to left and from anterior to posterior and caudate lobe right lob ratio.

The data analysis statistically using SPSS.

3.2.3 Measurements of the caudate lobe:

Transverse length of Right lobe: A midpoint was fixed on falciform ligament between superior & inferior borders of liver. From this point three readings were taken up to the lateral border of right lobe

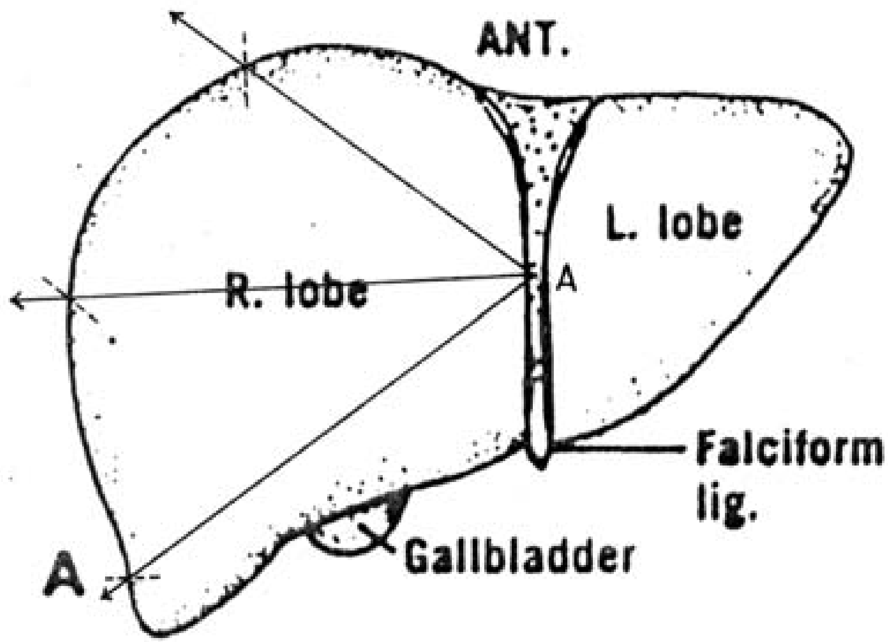


Figure 3.3: Show Transverse length of Right lobe

Antro-posterior measurement of caudate lobe: Three measurements were taken. First at the fissure for ligament venosum, 2 at middle of the caudate lobe & 3 from groove for inferior vena cava.

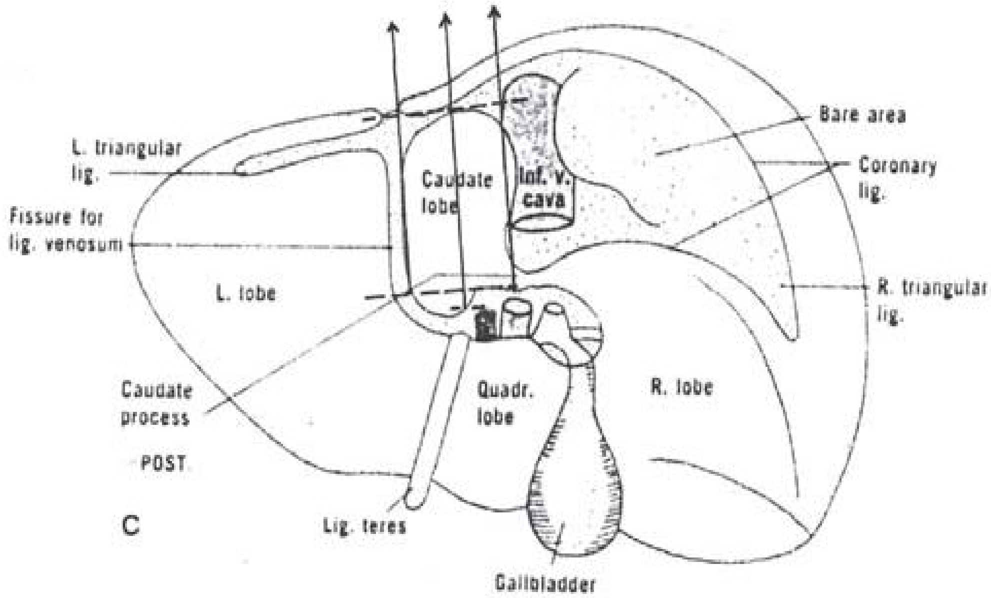


Figure 3.4: show Antro-posterior measurement of caudate lobe

Right to left measurement of caudate lobe: Three measurements were taken. First at the superior border, 2 at middle & 3 at post. margin of porta hepatis.

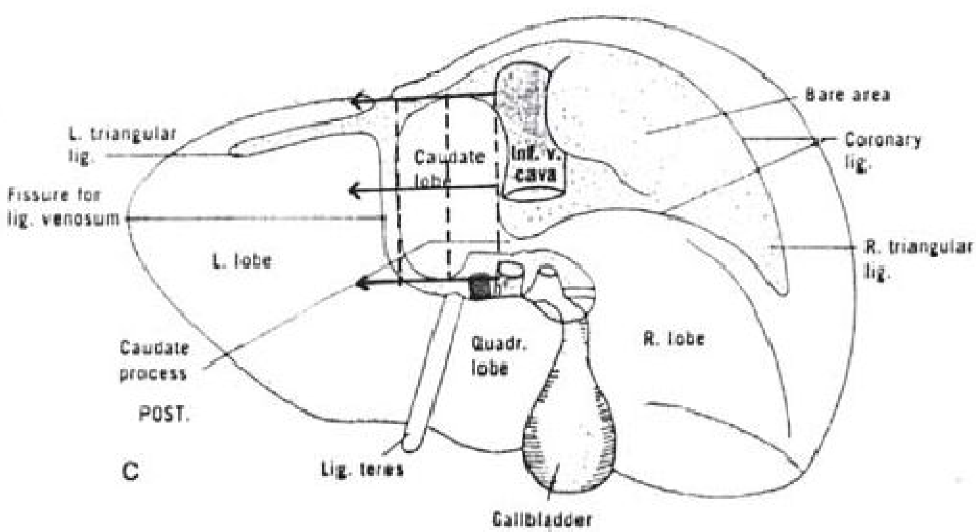


Figure 3.5: Show Right to left measurement of caudate lobe.

Caudate right-lobe ratio (CRL-R): In axial planes distances of the right lateral border of the right portal vein bifurcation to the lateral margin of the right hepatic lobe (a) and to the most medial margin of the caudate lobe (b) are measured in an exactly horizontal direction. The two distances were divided b / a (caudate lobe / right lobe) and defined as the caudate-right-lobe ratio (CRL-R).

Figure 3.6: Show Caudate right-lobe ratio (CRL-R).

Chapter four

Results

Chapter four

Results

The following tables and figures represent data obtained from randomly selected sample of patients (18males and 32females) who underwent CT abdomen for other indications without evidence of liver diseases.

Table 4.1: Show Study group gender distribution.

Gender	Frequency	Percentage %
Male	**18**	**36%**
Female	**32**	**64%**
Total	**50**	**100%**

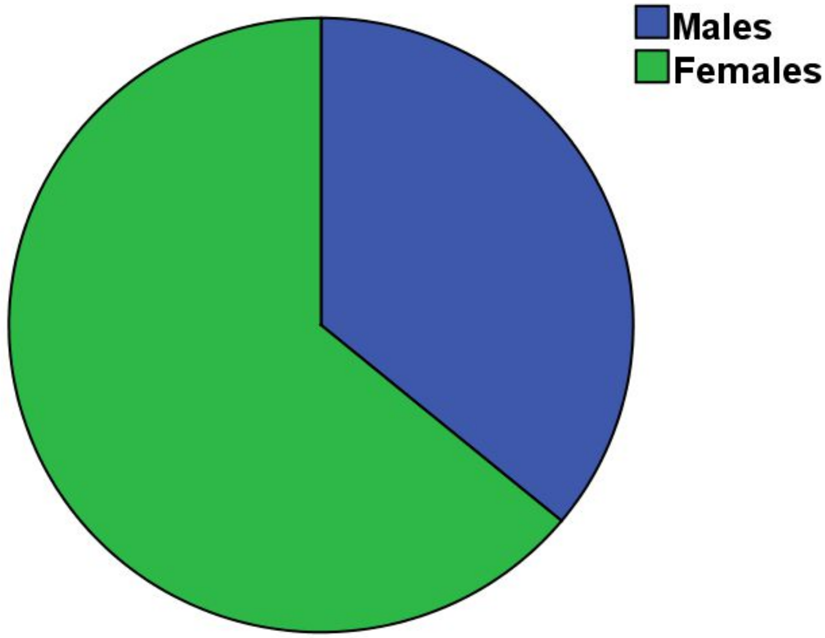
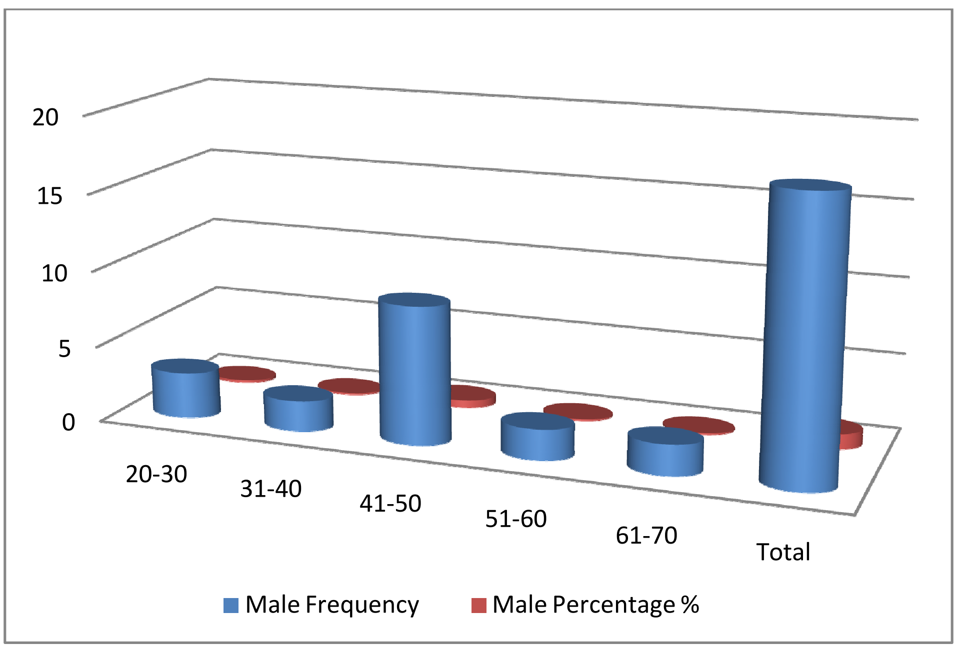


Figure 4.1: Study group gender distribution.

Table 4.2: Study group Age distribution of Male.

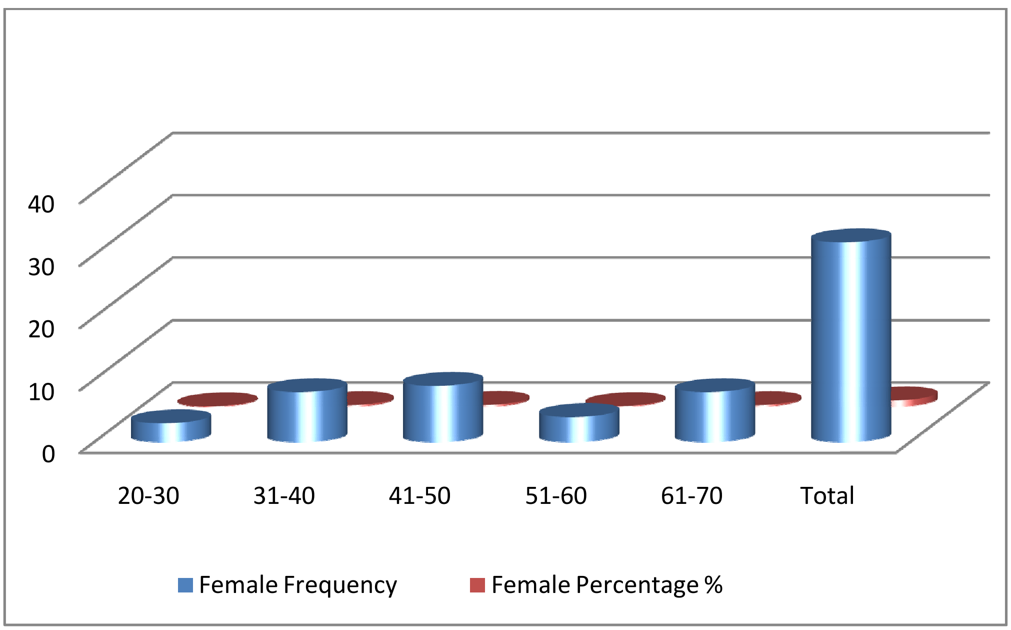
Age classes	Male	
	Frequency	Percentage %
20-30	3	16%
31-40	2	11%
41-50	9	50%
51-60	2	11%
61-70	2	11%
Total	18	100%



Figures 4.2: Show age group distribution of male.

Table 4.3: Show Study group Age distribution of female.

Age classes	Female	
	Frequency	Percentage %
20-30	3	9%
31-40	8	25%
41-50	9	28%
51-60	4	12%
61-70	8	25%
Total	32	100%



Figures 4.3: Show age group distribution of female

Table 4.4: Mean of study group Age.

Gender	Mean
Male	**43**
Female	**48**

Table 4.5: Study group shapes distribution.

Shapes	Frequency	Percentage
Rectangular	**45**	**90 %**
Triangular	**4**	**8 %**
Columnar	**1**	**2 %**
Pear	**0**	**0 %**
Oval	**0**	**0 %**
Other	**0**	**0 %**
Total	**50**	**100 %**

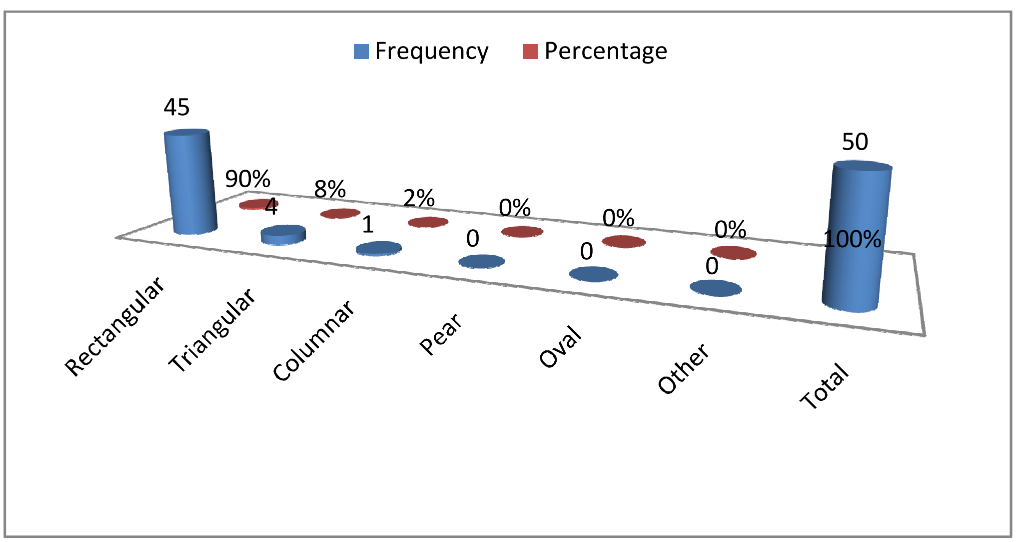


Figure4.4: Study group shapes distribution.

Table 4.6: Mean of Measurements

Measurements	Mean
RT to LT Diameter	5.1
AP Diameter	2.3
RT lobe Diameter	6.8
C/RT lobe ratio	0.74

Table 4.7: Mean of texture.

Texture	Mean
Male	56
Female	55

Table 4.8: Show correlation between age and texture of caudate lobe.

		Age	Texture
Age	Pearson Correlation	1	.918**
	Sig. (2-tailed)		.000
	N	50	50
Texture	Pearson Correlation	.918**	1
	Sig. (2-tailed)	.000	
	N	50	50

**** Correlation is significant at the 0.01 level.**

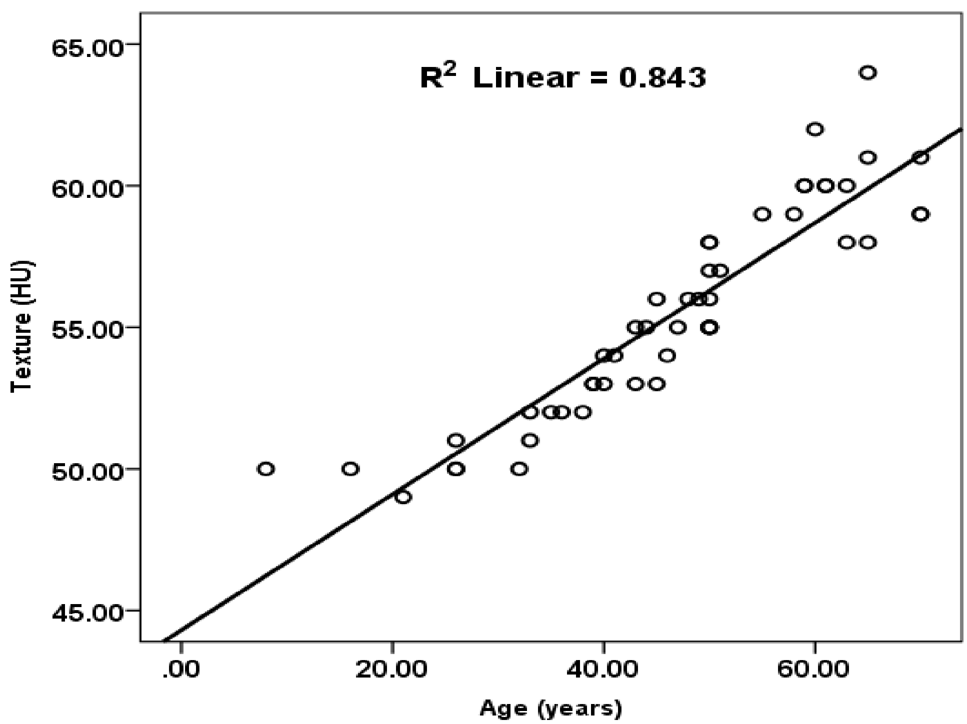


Figure 4.5: Scatter plot diagram shows the correlation between the age the texture.

Table 4.9 show correlation between age and right to left diameter of caudate lobe.

		Age	Rt to .Lt
Age	Pearson Correlation	1	.885**
	Sig. (2-tailed)		.000
	N	50	50
Rt.Lt	Pearson Correlation	.885**	1
	Sig. (2-tailed)	.000	
	N	50	50

**** Correlation is significant at the 0.01 level.**

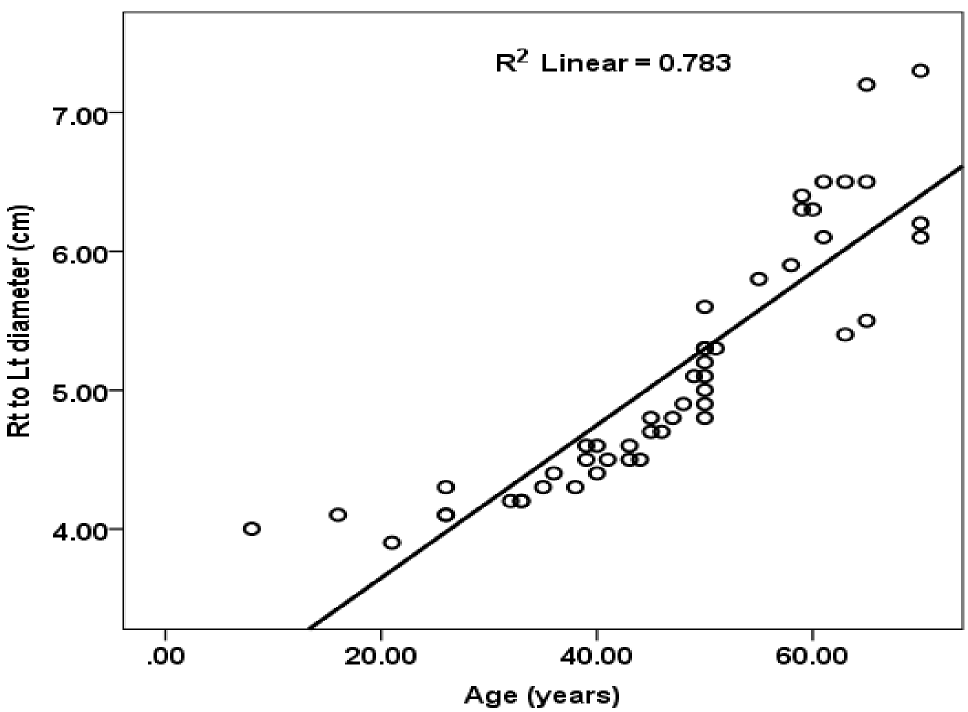


Figure 4.6: Scatter plot diagram shows the correlation between the age the right to left diameter of caudate lobe.

Table 4.10: Show correlation between age and AP diameter of caudate lobe.

		Age	AP
Age	Pearson Correlation	1	.816**
	Sig. (2-tailed)		.000
	N	50	50
AP	Pearson Correlation	.816**	1
	Sig. (2-tailed)	.000	
	N	50	50

**** Correlation is significant at the 0.01 level.**

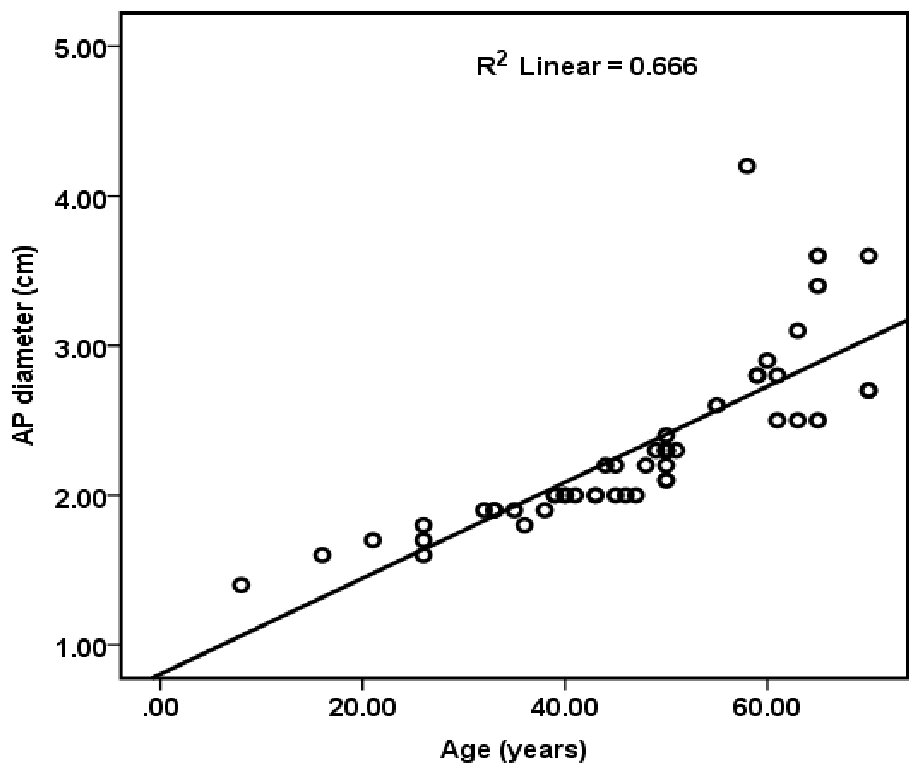


Figure 4.7: Scatter plot diagram shows the correlation between the age the AP diameter of caudate lobe.

Table 4.11: Show correlation between age and right lobe diameter.

		Age	Rt.Lobe dimeter
Age	Pearson Correlation	1	.900**
	Sig. (2-tailed)		.000
	N	50	50
Rt.Lobe	Pearson Correlation	.900**	1
	Sig. (2-tailed)	.000	
	N	50	50

**. Correlation is significant at the 0.01 level (2-tailed).

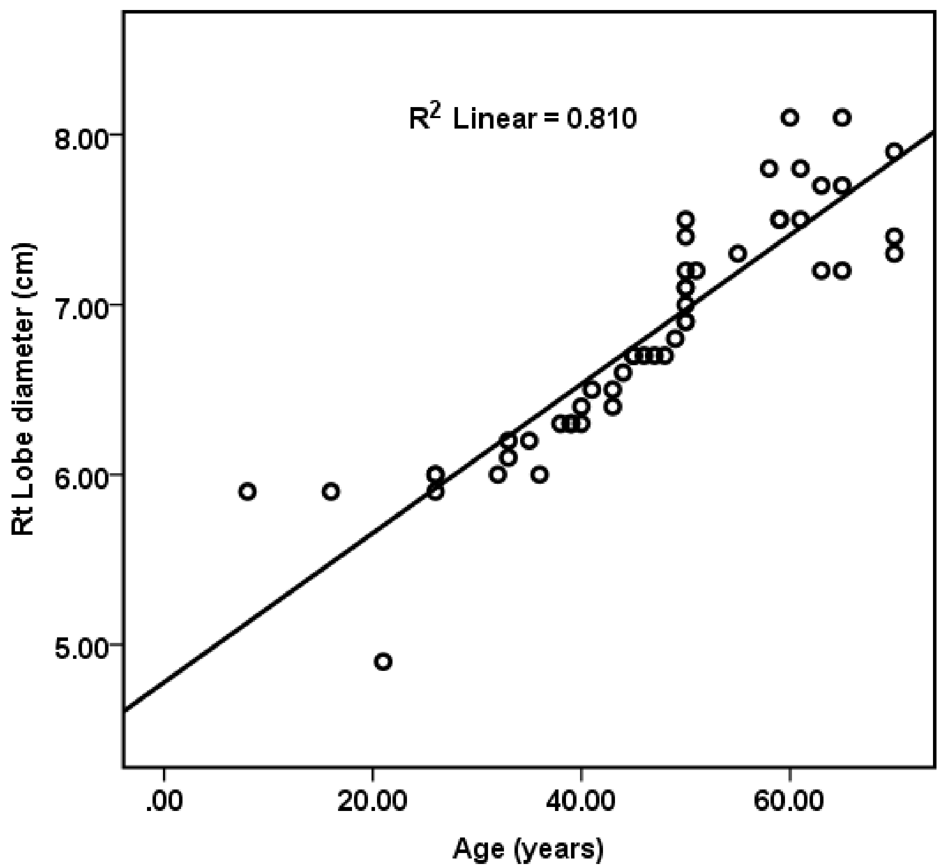


Figure 4.8: Scatter plot diagram shows the correlation between the age and the right lobe diameter.

Table 4.12: Show correlation between age and C/RT lobe ratio.

		Age	C.Rt.ratio
Age	Pearson Correlation	1	.232
	Sig. (2-tailed)		.105
	N	50	50
C/Rt.ratio	Pearson Correlation	.232	1
	Sig. (2-tailed)	.105	
	N	50	50

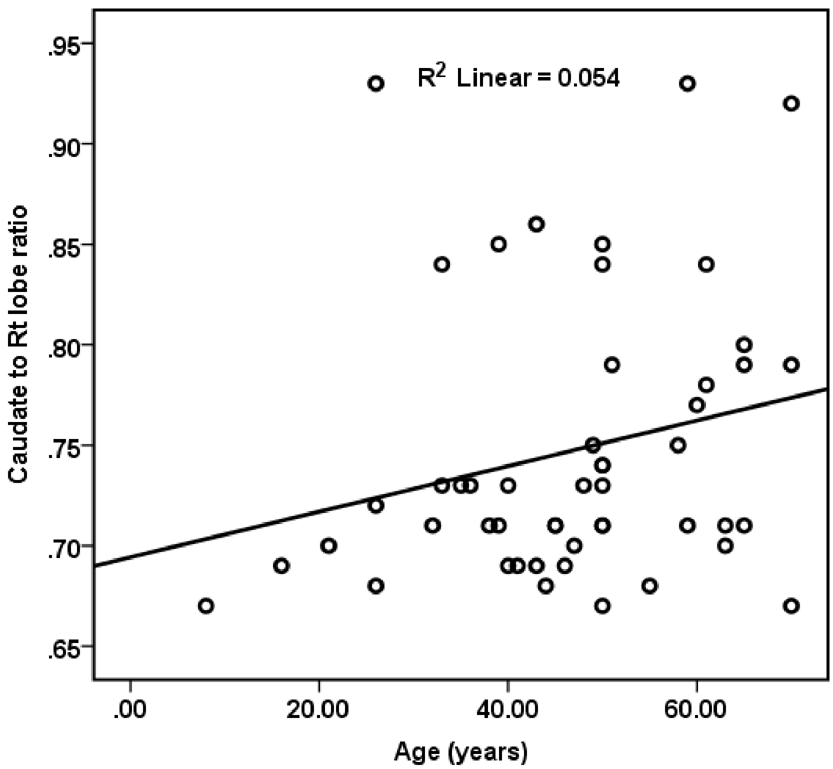


Figure 4.9: Scatter plot diagram shows the correlation between the age and C/RT lobe ratio.

Chapter five

(Discussion, Conclusion, Recommendation)

Chapter five

5.1 Discussion:

Prior studies took the morphology of the caudate lobe of liver and the results of this study are various shapes of the caudate lobe were observed, rectangular being the commonest.

The aim of this study was to characterize the caudate lobe in Sudanese population with computed tomography. The study took into consideration the normal caudate lobe measurements and correlated that with age and gender.

The normal caudate lobe measurements were right to left Diameter (5.1 Mean, ± 0.88 SD), the anteroposterior diameter were (2.3 Mean, ± 0.5 SD), right Lobe diameter were (6.8 Mean, ± 0.69 SD) and caudate to right lobe ratio (0.74 Mean, ± 0.69SD).

The mean of age in males was 43 years and in females was 48 years, and the mean of texture in males was 56 HU and in females was 55 HU.

The study showed that the caudate lobe location in all patients was in the inferior and posterior surfaces to the right of the groove formed by the ligamentum venosum: it lies posterior to the porta hepatis. And the most common shape of the caudate lobe was rectangular 90 %.

After applying the correlation between the age e and the texture of caudate lobe the study showed that there was significant correlation at the 0.01 level and the texture of caudate lobe increased by factor of 0.92 as age increased

The correlation between the age and the RT to LT Diameter of caudate lobe the study showed that there was significant correlation at the 0.01 level and the RT to LT Diameter of caudate lobe increased by factor of 0.88 as the age increased.

The correlation between the age and the antroposterior Diameter of caudate lobe the study showed that there was significant correlation at the 0.01 level and the antroposterior Diameter of caudate lobe increased by factor of 0.81 as the age increased.

The correlation between the age and the right Lobe Diameter the study showed that there was significant correlation at the 0.01 level and the right Lobe Diameter increased by factor of 0.9 as the age increased.

The correlation between the age and the caudate to right lobe ratio the study showed that there was significant correlation at the 0.01 level and the caudate to right lobe ratio increased by factor of 0.23 as the age increased.

5.2 Conclusion:

The researcher concluded that the incidence of morphological variations of caudate lobe is very high in this study. The papillary process of caudate lobe is a potential source of pitfalls in interpretation of CT images at and just below the porta hepatis. Knowledge of these variations is important for radiologists to achieve correct diagnosis and for surgeons to plan for surgery and to achieve good surgical outcome.

Midpoint of IVC should be taken as standard reference point to measure the transverse width of CL for finding CL/RL ratio, for diagnosing conditions of liver.

The study showed that the caudate lobe measurements (right to left Diameter antroposterior Diameter, caudate to right lobe ratio) and the right lobe diameter increased with age and this indicate that the size of liver and caudate lobe increased as the age increased.

Also the study showed that the texture of caudate lobe increased with age.

5.3 Recommendations:

- For further assessment another study should be done using large sample of patient.
- Another researches should be done with MRI and compare it with CT to evaluate which the best modality to characterize the caudate lobe clearly.
- Another study should be done use PET/ CT scan.

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Appendices

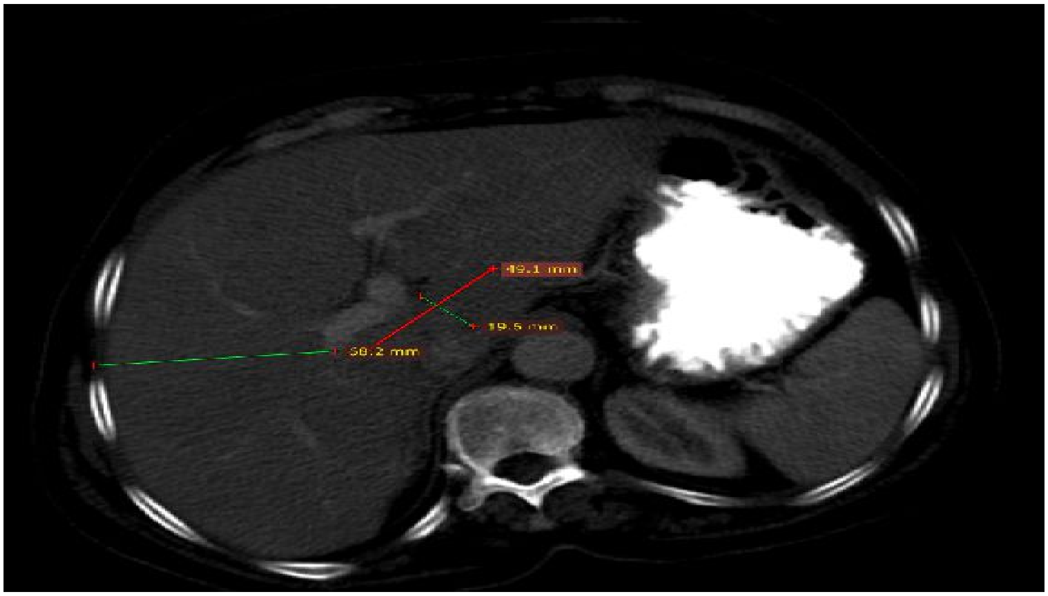

Figure 5-1: Axial CT image for female (59 years) show measurements of caudate lobe right to left, Antroposterior and right lobe diameters.

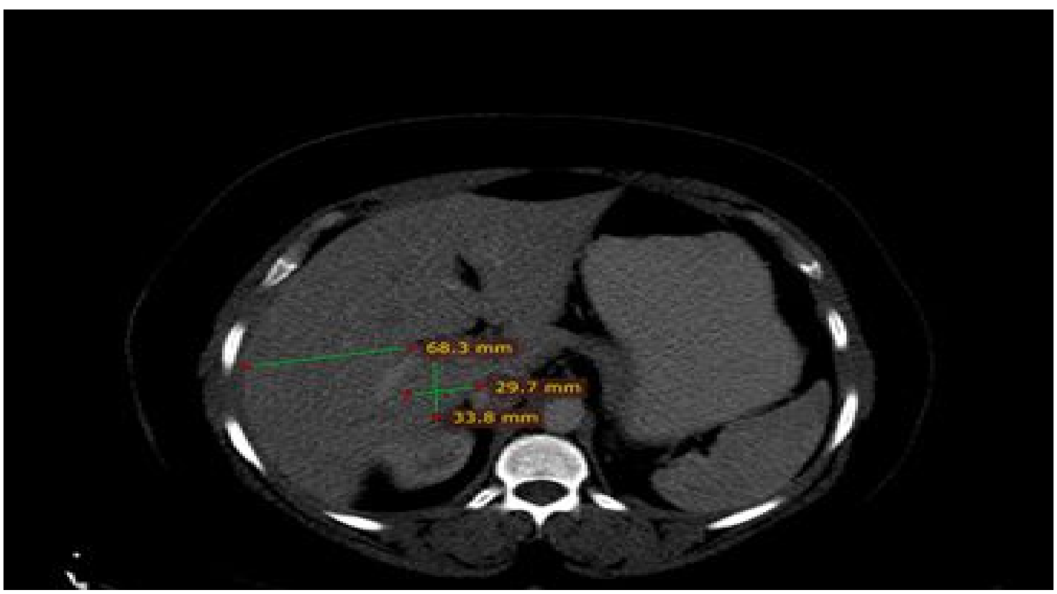

Figure 5.2: Axial CT image for Female (41 years) shows measurements of caudate lobe right to left, Antroposterior and right lobe diameters.

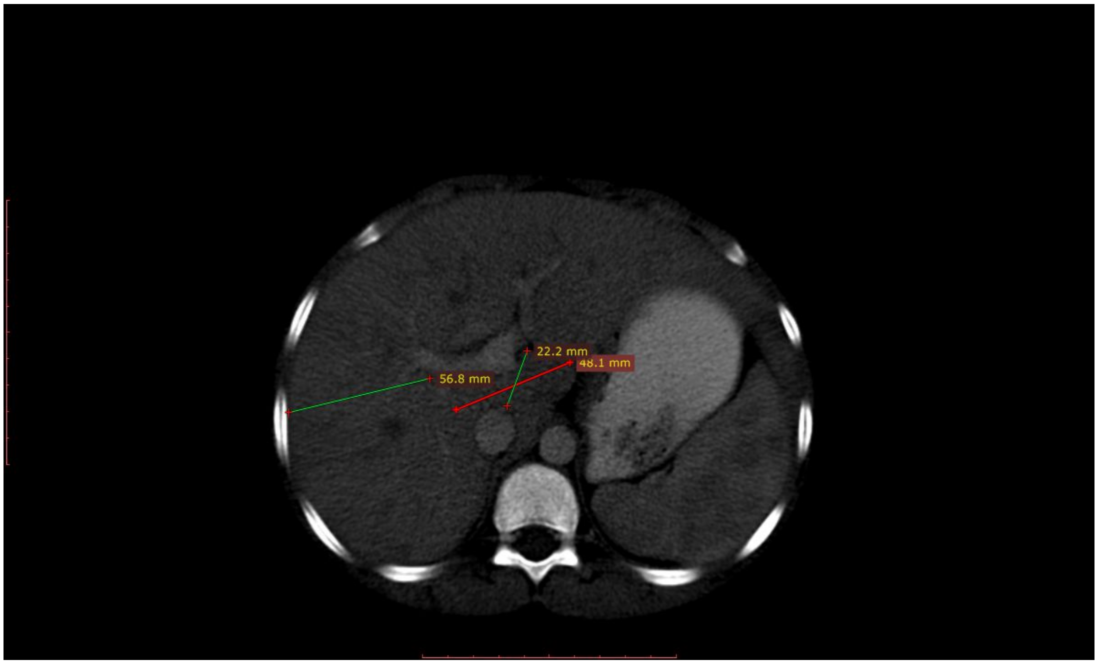

Figure 5.3 Axial CT image for male (50 years) shows measurements of caudate lobe right to left, Antroposterior and right lobe diameters.

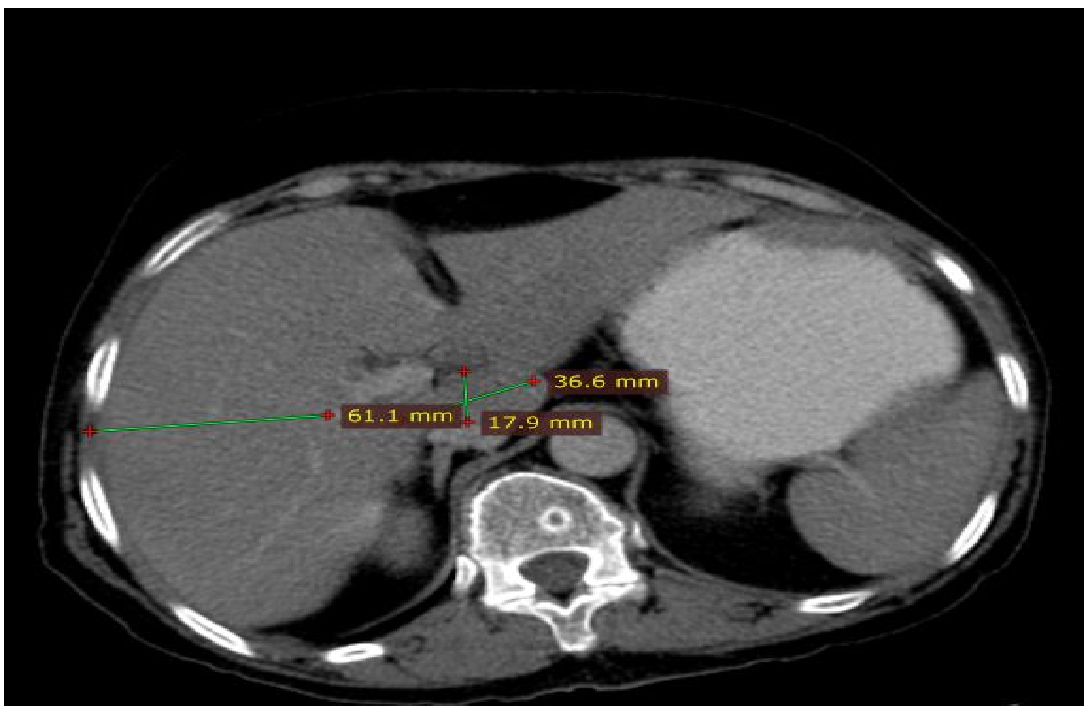

Figure 5.4 Axial CT image for male (60 years) shows measurements of caudate lobe right to left, Antroposterior and right lobe diameters.

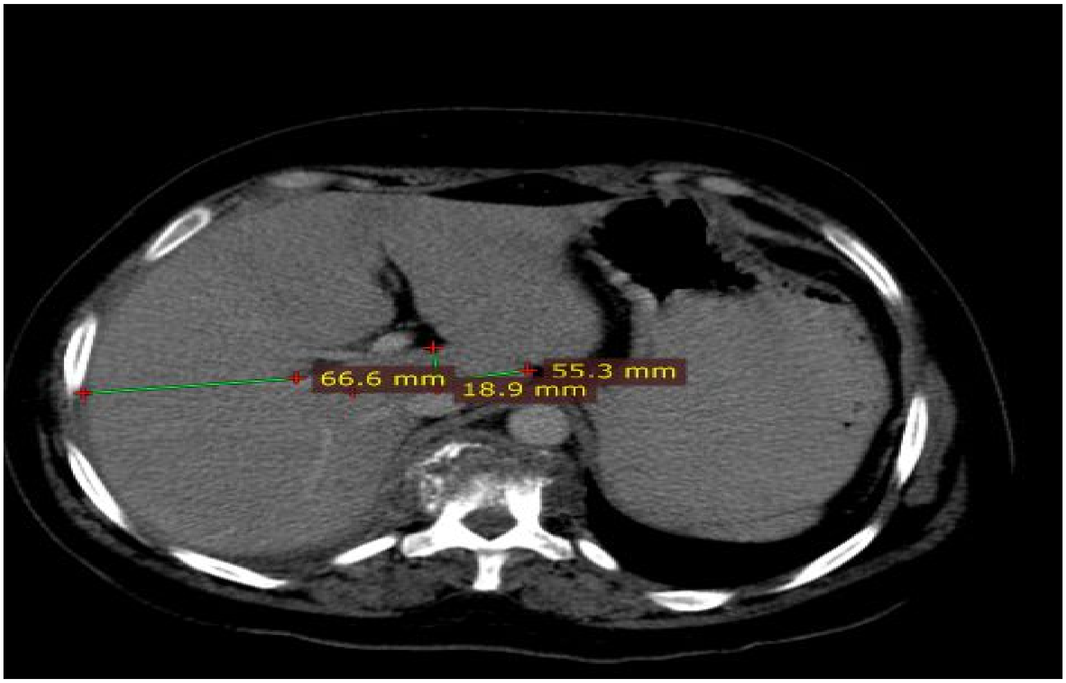

Figure 5.5 Axial CT image for female (61 years) shows measurements of caudate lobe right to left, Antroposterior and right lobe diameters.

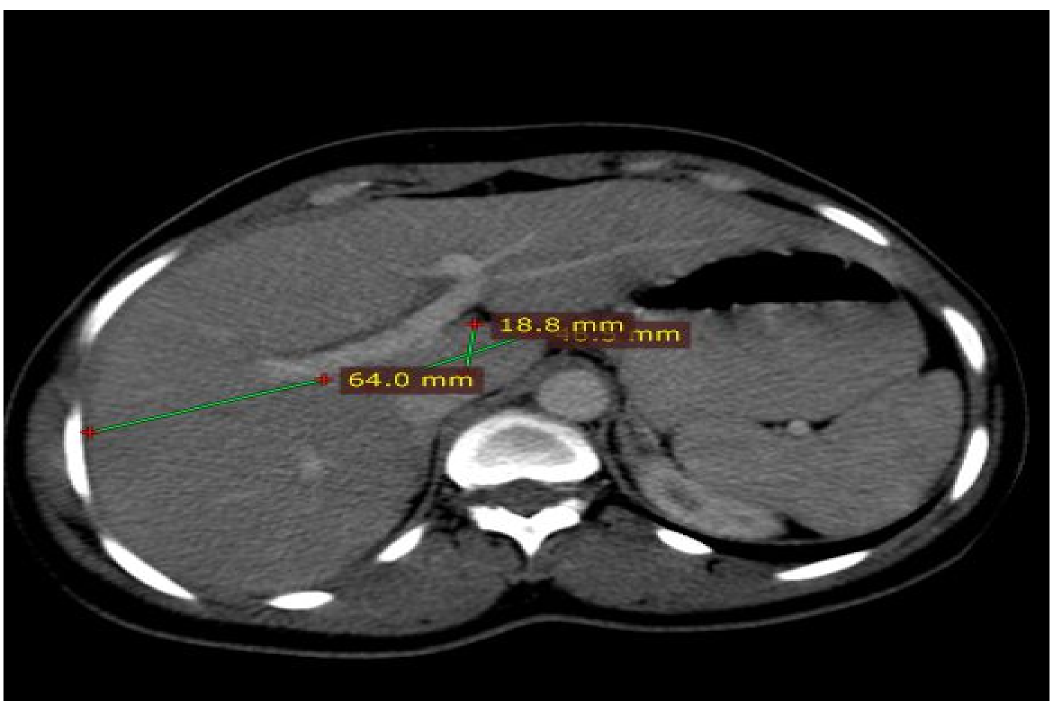

Figure 5.6 Axial CT image for male (66 years) shows measurements of caudate lobe right to left, Antroposterior and right lobe diameters.

Sudan University of Science and Technology

College of Graduate Study

Characterization of Normal Caudate Lobe in Sudanese Population by using Computed Tomography

Data collection sheet (1)

Pt. NO	Gender	Age	Shape	Location	Texture (HU)	Caudate lobe diameter(cm)		RT lobe Diameter(cm)	C/RT lobe ratio	CT findings
						RT to LT	AP			
1	Male	16	1	1	50	4.1	1.6	5.9	0.69	Ilio-psoas abscess and inflamed appendix.
2	Male	61	1	1	60	6.1	2.5	7.8	0.78	Renal stone
3	Male	65	1	1	64	6.5	3.4	8.1	0.80	________
4	Male	26	1	1	51	4.3	1.6	5.9	0.72	Renal Hydronefrosis
5	Male	60	1	1	62	6.3	2.9	8.1	0.77	________
6	Male	50	1	1	56	5.2	2.3	7.0	0.74	________
7	Male	8	1	1	50	4.0	1.4	5.9	0.67	________
8	Male	58	2	1	59	5.9	4.2	7.8	0.75	________
9	Male	49	1	1	56	5.1	2.3	6.8	0.75	________
10	Male	45	1	1	56	4.8	2.2	6.7	0.71	Renal cyst.

Shapes: 1. Rectangular. 2. Triangular. 3. Columnar. 4. Pear. 5. Oval. 6. Other.

Location: 1. Inferior and posterior surfaces to the right of the groove formed by the ligamentum venosum: it lies posterior to the porta hepatis. 2. Other.

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Data collection sheet (2)

Pt. NO	Gender	Age	Shape	Location	Texture (HU)	Caudate lobe diameter(cm)		RT lobe Diameter(cm)	C/RT lobe ratio	CT findings
						RT to LT	AP			
11	Male	50	1	1	58	5.6	2.4	7.5	0.74	____________
12	Male	41	1	1	54	4.5	2.0	6.5	0.69	Sigmoid colon mass.
13	Male	43	1	1	55	4.5	2.0	6.5	0.69	____________
14	Male	48	2	1	56	4.9	2.2	6.7	0.73	Gastric tumor.
15	Male	50	1	1	58	5.3	2.3	7.4	0.71	____________
16	Male	40	1	1	54	4.4	2.0	6.3	0.69	____________
17	Male	36	1	1	52	4.4	1.8	6.0	0.73	____________
18	Male	44	1	1	55	4.5	2.2	6.6	0.68	Left renal cyst.
19	Female	70	1	1	61	7.3	3.6	7.9	0.92	____________
20	Female	26	1	1	50	4.1	1.7	6.0	0.68	____________

Shapes: 1. Rectangular. 2. Triangular. 3. Columnar. 4. Pear. 5. Oval. 6. Other.

Location: 1. Inferior and posterior surfaces to the right of the groove formed by the ligamentum venosum: it lies posterior to the porta hepatis. 2. Other.

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Data collection sheet (3)

Pt. NO	Gender	Age	Shape	Location	Texture (HU)	Caudate lobe diameter(cm)		RT lobe Diameter(cm)	C/RT lobe ratio	CT findings
						RT to LT	AP			
21	Female	65	1	1	58	5.5	2.5	7.2	0.71	________
22	Female	63	1	1	58	5.4	2.5	7.2	0.70	Mild splenomegaly.
23	Female	70	1	1	59	6.1	2.7	7.3	0.79	________
24	Female	26	1	1	50	4.1	1.8	6.0	0.93	Staghorn stone in renal pelvic.
25	Female	50	2	1	55	5.0	2.2	7.1	0.84	________
26	Female	70	1	1	59	6.2	2.7	7.4	0.67	Intestinal obstruction.
27	Female	33	1	1	51	4.2	1.9	6.1	0.73	________
28	Female	50	1	1	55	4.8	2.1	6.9	0.71	Un remarkable study.
29	Female	50	1	1	55	4.9	2.1	6.9	0.85	Calcified uterine fibroid.
30	Female	39	1	1	53	4.6	2.0	6.3	0.71	________

Shapes: 1. Rectangular. 2. Triangular. 3. Columnar. 4. Pear. 5. Oval. 6. Other.

Location: 1. Inferior and posterior surfaces to the right of the groove formed by the ligamentum venosum: it lies posterior to the porta hepatis. 2. Other.

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Data collection sheet (4)

Pt. NO	Gender	Age	Shape	Location	Texture (HU)	Caudate lobe diameter(cm)		RT lobe Diameter(cm)	C/RT lobe ratio	CT findings
						RT to LT	AP			
31	Female	40	1	1	53	4.6	2.0	6.4	0.73	Un remarkable study.
32	Female	45	1	1	53	4.7	2.0	6.7	0.71	________
33	Female	21	1	1	49	3.9	1.7	4.9	0.70	________
34	Female	65	1	1	61	7.2	3.6	7.7	0.79	Right renal pelvic stone.
35	Female	59	1	1	60	6.3	2.8	7.5	0.93	________
36	Female	33	1	1	52	4.2	1.9	6.2	0.84	________
37	Female	50	2	1	57	5.3	2.3	7.2	0.67	Para neoplastic syndrome.
38	Female	50	1	1	55	5.1	2.3	7.1	0.73	________
39	Female	59	1	1	60	6.4	2.8	7.5	0.71	Renal stone.
40	Female	39	1	1	53	4.5	2.0	6.3	0.85	________

Shapes: 1. Rectangular. 2. Triangular. 3. Columnar. 4. Pear. 5. Oval. 6. Other.

Location: 1. Inferior and posterior surfaces to the right of the groove formed by the ligamentum venosum: it lies posterior to the porta hepatis. 2. Other.

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Characterization of Normal Caudate Lobe in Sudanese Population by using Computed Tomography
Data collection sheet (5)

Pt. NO	Gender	Age	Shape	Location	Texture (HU)	Caudate lobe diameter(cm)		RT lobe Diameter(cm)	C/RT lobe ratio	CT findings
						RT to LT	AP			
41	Female	32	1	1	50	4.2	1.9	6.0	0.71	____________
42	Female	47	1	1	55	4.8	2.0	6.7	0.70	Intestinal obstruction.
43	Female	63	1	1	60	6.5	3.1	7.7	0.71	____________
44	Female	61	1	1	60	6.5	2.8	7.5	0.84	Left large renal cyst.
45	Female	43	1	1	53	4.6	2.0	6.4	0.86	____________
46	Female	38	1	1	52	4.3	1.9	6.3	0.71	Uterine mass.
47	Female	55	3	1	59	5.8	2.6	7.3	0.68	____________
48	Female	51	1	1	57	5.3	2.3	7.2	0.79	____________
49	Female	35	1	1	52	4.3	1.9	6.2	0.73	Colonic tumor.
50	Female	46	1	1	54	4.7	2.0	6.7	0.69	____________

Shapes: 1. Rectangular. 2. Triangular. 3. Columnar. 4. Pear. 5. Oval. 6. Other.
Location: 1. Inferior and posterior surfaces to the right of the groove formed by the ligamentum venosum: it lies posterior to the porta hepatis. 2. Other.

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Characterization of Normal Caudate Lobe in Sudanese Population by using Computed Tomography

Data collection sheet

Pt. NO	Gender	Age	Shape	Location	Texture (HU)	Caudate lobe diameter(cm)		RT lobe Diameter(cm)	C/RT lobe ratio	CT findings
						RT to LT	AP			

Shapes: 1. Rectangular. 2. Triangular. 3. Columnar. 4. Pear. 5. Oval. 6. Other.

Location: 1. Inferior and posterior surfaces to the right of the groove formed by the ligamentum venosum: it lies posterior to the porta hepatis. 2. Other.