جـــــــامعـــــــــــــــــــة الســـــــــودان للعلوم والتكنولوجيا

SUDAN UNIVERSITY OF SCIENCE AND TECHNOLOGY

COLLEGE OF GRADUATE STUDEIS

Assessment of Liver Segment's Density in Sudanese Adult patients by using Computed Tomography

تقويم كثافة فصوص الكبد بوسيلة الأشعة المقطعية لدي المرضى السودانيين البالغين

A-thesis submitted for partial fulfillment of M.S.C degree Medical Daignostic RadiologyImaging

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April 2015

بسم الله الرحمن الرحيم

الأيـــــــة الكريمـــة

قال تعالى:

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سُبْحَانَكَلاَعِلْمَلَنَاإِلاَّمَاعَلَّمْتَنَاإِنَّكَأَنتَالْعَلِيمُالْحَكِيم

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البـ قرة(32)

.

صدق الله العظيم

Dedication

:This project is dedicated

To my father

To my mother

To my brothers

To my sisters

To my friends

ACKNOWLEDGEMENT

It is with immense gratitude that l knowledge that support and help of my supervisor Dr. Caroline Edward Ayad.

I consider it an honor to work with her, with her encouragement guidance and support from the initial to the final level enabled me to develop an understanding of the subject . Her belief that it was, indeed possible to finish, kept me going .

This work would not have been possible unless the invaluable assistance of patient's and our colleagues in royal care so special thanks to all the staff

I cannot Find wards to express my graduated to my friends specially Mohamed Abdelwhab, Elnagar Mohammed, Arig Abdallha and Mustafa Hassan heart fully Think's to them for share the credit of my work with them and Iam indebted to my many colleagues whom supported me.

Finally I offer my regards and blessings to all of those whom supported me in any respect during the completion of the project.

Abbreviation

NAFLD = Non Alcoholic Fatty Liver Disease

NASH = Non Alcoholic Steato Hepatitis

DM = Diabetes Mellitus

VF = Visceral Fat

SF = Substances Fat

CT = Computer Tomography

MR = Magnetic Resonance

U/S =Ultra Sonography

DMIs = Body Mass Index

TF = Total Fat

AP = Antero Posterior

HCC = Hepato Cellular Carcinoma

GIT = Gastro Intestinal Tract

CM = Contrast Media

RNA = Ribo Nucleic Acid

KUB = Kidney Ureter Bladder

MM = Millimeter

KG = Kilo Gram

HU = Hounsfield Uni

Abstract

The Hounsfield unit (HU) scale is a linear transformation of the original linear attenuation coefficient measurement into one in which the radiodensity of distilled water at standard pressure and temperature (STP) is defined as zero Hounsfield units (HU), while the radiodensity of air at . STP is defined as -1000 HU

The study was done in Royal Care International Hospital in period from April 2014 up to April 2015 , using Toshiba 64 slice ,KV=120 ,mA=300 , Time of rotation =0.75s . The study was done to evaluate the relation between CT number and AP Abdominal diameter , And to correlate the finding with age , weight , in both gender . 50 patients . were selective there ages between 24 up to 78 years old

All were scaned for Axial CT for abdomen , All liver segment were evaluated and measured using Hounsfield unit . the AP dimension at the same level was measured of the distant frpm superior abdominal wall to superior . (end of the abdominal muscles in (mm

The current study aimed to study the liver of Sudanese patients by measuring(mm) the CT number (51.2, 50.9, 52.2, 53.5, 52, 51.8, 52.1, 50.2) in segment 1,2,3,4,5,6,7,8, and Correlations are Significant at P-Value= 0.005 for all of the values including segment's with age , weight and AP fat thickness .There were significant . difference between both gender for the measured values

The equation were established to predict the CT number of the liver for the subjects with known AP abdominal fat

thickness . The study concluded that CT scan is a non invasive a knowledge muscle to measure the liver CT . number and evaluate its Texture

خلاصة البحث

تدرج وحدة الهاونسفيلد وتعتبر تحول خطي لمعامل التوهين التوهين الاساسي حيث تقاس الكثافة الاشعاعية للماء المقطر تحت الضغط ودرجة الحرارة القياسية خيث تعتبر صفرا للماء وتعتبر الكثافة الاشعاعية للهواء 1000 وحدة هاونسفيلد .

اجريت هذه الدراسة في مستشفي رويال كير العالمي في الفترة من ابريل 2014 الي ابريل 2015 با ستخدام جهاز الاشعة المقطعية من صناعة شركة توشيبا 64 متعددة المقاطع ، كيلوفولت 120 ، ملي امبير 300 وزمن دوران 0.75 ملي ثانية .

وقد أجريت الدراسة لتقويم العلاقة بين قياس وحدة الهاونسفيلد (رقم الاشعة المقطعية) والبعد الامامي الخلفي للبطن وايضا لربط النتائج بالعمر والوزن لكل من الجنسين. تم اختيار 50 مريضا تتراوح أعمارهم بين 24 حتى 78 سنة وكل الحالات تم فحصها بمقاطع محورية للبطن باستخدام الاشعة المقطعية المحوسبة وتم تقويم كل فصوص الكبد وتم قياسها بوحدة الهاونسفيلد . تم قياس البعد الامامي الخلفي للبطن في مستوي المقطع بقياس المسافة من الحافة العليا لجدار البطن والحافة العليا لعضلة البطن حيث تم القياس بالملميتر . تم قياس رقم الاشعة المحوسبة للكبد لكل الفصوص ووجدت كالاتي :

(51.2, 50.9, 52.2, 53.5, 52, 51.8, 52.1, 50.2) للفصوص من 1 ،2،3،4،5،6،7،8 ووجد ارتباط معنوي بين كل القيم واعمار المرضي والاوزان والسمك الامامي الخلفي لدهون البطن .

يوجد فرق معنوي بين الجنسين لكل القيم التي تم قياسها وتم تكوين معادلات التنبؤ برقم قياس الاشعة المحوسب للكبد للمرضي المعلوم سمك الطبقة الامامية الخلفية للبطن .

خلصت الدراسة بان التصوير بالاشعة المقطعية هي وسيلة غير تداخلية و الموصي بها لقياس رقم معامل توهين الكبد وتقييم فصوصه .

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Chapter one

Introduction .

Chapter one

Introduction 1-1

The liver is the largest internal organ. It lies under your right ribs just beneath your right lung. It is shaped like a

pyramid and divided into right and left lobes. The lobes .are further divided into segments

Unlike most other organs, the liver gets blood from 2 sources: the *hepatic artery* supplies the liver with blood rich in oxygen from the heart, and the *portal vein* brings .(nutrient-rich blood from the intestines (snell 2003

You cannot live without your liver. It has several important :functions

- It breaks down and stores many of the nutrients absorbed from the intestine that your body needs to function. Some nutrients must be changed (metabolized) in the liver before they can be used by the rest of the body for energy or to build and repair .body tissues
- It makes most of the clotting factors that keep the body from bleeding too much when you are cut or .injured
- It secretes bile into the intestines to help absorb .(nutrients (especially fats
- It filters out and breaks down toxic wastes in the .blood, which are then removed from the body

The liver is made up mainly of cells called *hepatocytes*. It also contains other types of cells, including cells that line its blood vessels and cells that line small tubes in the liver called *bile ducts*. The bile ducts extend out of the liver and carry bile from the liver to the gallbladder or directly to .(the intestines(snell 2003

These different types of cells in the liver can form several types of malignant (cancerous) and benign (non-cancerous) tumors. These tumors have different causes, . are treated differently, and have a different prognosis Histologic confirmation is the gold standard for diagnosing fatty liver . However, biopsy sees are invasive, induce pain and require six or more hours of bed rest; they also modestly increase the risk of mortality . Given the potential risks, biopsies are not performed in all patients. As a substitute for biopsy, imaging techniques, including US, CT, and MR, are now widely used. Of these, CT had been chosen as the method for this study . CT attenuation values of the liver were strongly correlated with histological evidence of hepatic steatosis (Nugent C, .(Younossi ZM. 2007

To the best of our knowledge, no prior studies have explored the relationship between fatty liver and abdominal fat using CT. The purpose of this study was to identify any possible correlations between hepatic fat infiltration expressed as a CT liver attenuation value [in Hounsfield units (HU)] and abdominal fat volume, which was also measured directly from CT.(Nugent C, Younossi .(ZM.2007

:Problem of study 1-2

The liver density may changes due to many diseases and it can be diagnosed by different laboratory or biopsy .methods to evaluate the change in density

But all were invasive, this study used the Computer Tomography scan as noninvasive method for patient safety and were evaluated used hounsefinld unit (CT .(Number

There for Computer Tomography were used to evaluate .the liver density measured in houns field units

:Objectives 1-3

:General objective 1-3-1

To determine the relation between fatty liver and Antro - . posterior Abdominal diameter

:Specific objectives 1-3-2

To measure the CT number of all the liver segment in - .(adult Sudanese patients(males and females

To study the CT values in both genders with age ,weight , - . and AP abdominal thickness

: Thesis over view 1-4

Chapter one included introduction, problem of study,objectives. Chapter two dealt with the literature review and previous study , chapter three discus the material and methods , chapter four dealt with the result and five with data discussion and conclusion and . recommendations

Chapter two

Literature review .

Chapter Two

Anatomy, physiology and pathology

2-1Anatomy of the liver

General arrangement of abdominal viscera are: liver, gall bladder ,esophagus ,stomach ,small intestine ,large intestine ,pancreas ,spleen ,kidneys ,supra renal glands .(and peritoneum (Snell2003

The liver is a vital organ present in vertebrates and some other animals. It has a wide range of functions, including detoxification, protein synthesis, and production of biochemical's necessary for digestion. The liver is necessary for survival, there is currently no way to compensate for the absence of liver function in the long term, although new liver dialysis techniques can be used (in the short terms (Snell2003

This organ plays a major role in metabolism and has a number of functions in the body, including glycogen storage, decomposition of red blood cells, plasma protein synthesis, hormone production, and detoxification. It lies below the diaphragm in the abdominal-pelvic region of the abdomen. It produces bile, an alkaline compound which aids in digestion via the emulsification of lipids. The liver's

highly specialized tissues regulate a wide variety of high-volume biochemical reactions, including the synthesis and breakdown of small and complex molecules, many of which are necessary for normal vital functions (Snell – .(2003

The liver is the largest gland in the body and has a wide variety of functions. Three of its basic functions are production and secretion of bile, which is passed into the intestinal tract involvement in many metabolic activities related to carbohydrate, fat, and protein metabolism, removing bacteria and other foreign particles that have gained entrance to the blood from the lumen of the .(intestine (Reeder SB, Ranallo F, Taylor AJ 2008

The liver synthesizes heparin, an anticoagulant substance, and has an important detoxicating function. It produces bile pigments from the hemoglobin of worn-out red blood corpuscles and secretes bile salts; these together are conveyed to the duodenum by the biliary .ducts

The liver is soft and pliable and occupies the upper part of the abdominal cavity just beneath the diaphragm . The greater part of the liver is situated under cover of the right costal margin, and the right hemi diaphragm separates it from the pleura, lungs, pericardium, and heart. The liver extends to the left hemidiaphram. The convex upper surface of the liver is molded to the under surf ace of the domes of the diaphragm. The poster inferior, or visceral surface, is molded to adjacent viscera

and is therefore irregular in shape; it lies in contact with the abdominal part of the esophagus, the stomach, the duodenum, the right colic flexure, the right kidney and suprarenal gland, and the gallbladder (Reeder SB, Ranallo .(F, Taylor AJ 2008

The liver may be divided into a large right lobe and a small left lobe by. the attachment of the peritoneum of the falciform ligament . The right lobe is further divided into a quadrate lobe and a caudate lobe by the presence of the gallbladder, the fissure for the ligamentumteres, the inferior vena cava, and the fissure for the ligamentumvenos um. Experiments have shown that, in fact, the quadrate and caudate lobes are a functional part of the left lobe of the liver. Thus, the right and left branches of the hepatic artery and portal vein, and the right and left hepatic ducts, are distributed to the right lobe and the left lobe (plus quadrate plus caudate lobes), respectively. Apparently, the two sides overlap very little. The portahepatis, or hilum of the liver, is found on the posterior inferior surface and lies between the caudate and quadrate lobes . The upper part of the free edge of the lesser omentum is attached to its margins. In it lie the right and left hepatic ducts, the right and left branches of the hepatic artery, the portal vein, and sympathetic and parasympathetic nerve fibers. A few hepatic lymph nodes lie here; they drain the liver and gallbladder and send their efferent vessels to the celiac lymph nodes (Reeder SB, Ranallo F, Taylor AJ 2008).

The liver is completely surrounded by a fibrous capsule but only partially covered by peritoneum. The liver is made up of liver lobules. The central vein of each lobule is a tributary of the hepatic veins. In the spaces between the lobules are the portal canals, which contain branches of the hepatic artery, portal vein, and a tributary of a bile duct (portal triad). The arterial and venous blood passes between the liver cells by means of sinusoids and drains (into the central vein(Snell 2003

Liver anatomy can be described using two different aspects: morphological anatomy and functional anatomy. The traditional morphological anatomy is based on the external appearance of the liver and does not show the internal features of vessels and biliary ducts branching, .which are of obvious importance in hepatic surgery Couinaud (1957) divided the liver into eight functionally .indepedent segments

This classification will be presented here with several .illustrations

Segmental anatomy 2-1-1

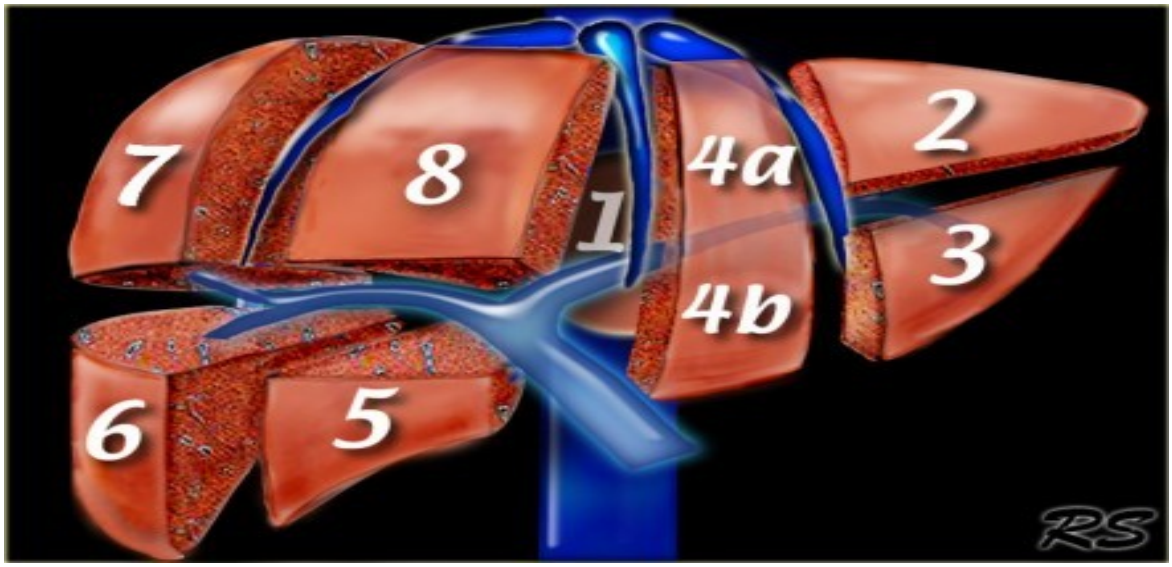


Figure 2-1 show Segmental anatomy according to Couinaud(http://www.encyclopedia.com/doc/1G2-(3451600630.html

CouinaudclassificationTheCouinaud classification of liver anatomy divides the liver into eight functionally indepedent segments. Each segment has its own vascular inflow, outflow and biliary drainage.In the centre of each segment there is a branch of the portal vein, hepatic artery and bile duct (Boyce CJ, Pickhardt PJ, Kim DH 2010). In the periphery of each segment there is vascular outflow through the hepatic veins :Right hepatic vein divides the right lobe into anterior and posterior segments.Middle hepatic vein divides the liver into right and left lobes (or right and left hemi liver). This plane runs from the inferior vena cava to the gallbladder fossa.Left hepatic vein divides the left lobe into a medial and lateral part. Portal vein divides the liver into upper and lowersegments ,The left and right portal veins branch superiorly and inferiorly

to project into the center of each segment (Boyce CJ, .(Pickhardt PJ, Kim DH 2010

Because of this division into self-contained units, each segment can be resected without damaging those remaining. For the liver to remain viable, resections must proceed along the vessels that define the peripheries of these segments. This means, that resection-lines parallel the hepatic veinsThe centrally located portal veins, bile ducts, and hepatic arteriesarepreserved. (Boyce CJ,

(Pickhardt PJ, Kim DH 2010

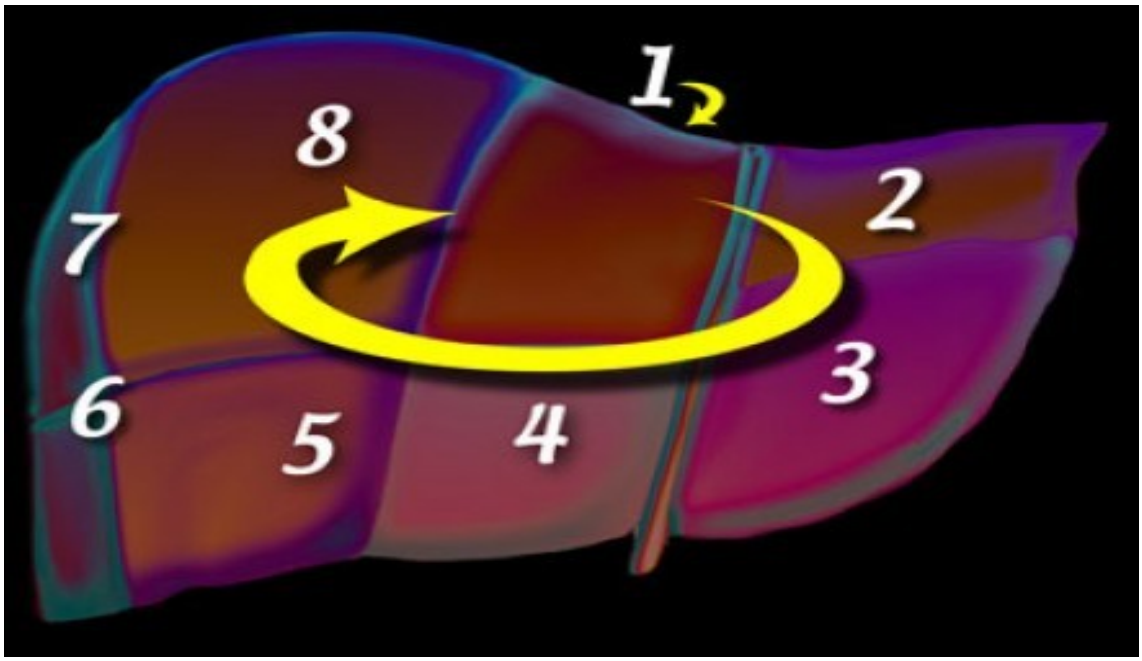


Figure 2-2 Clockwise numbering of the segments(http://www.encyclopedia.com/doc/1G2-(3451600630.html

:Segments numbering 2-1-2

There are eight liver segments.Segment 4 is sometimes .divided into segment 4a and 4b according to Bismuth

The numbering of the segments is in a clockwise manner .((figure 2.2

Segment 1 (caudate lobe) is located posteriorly. It is not visible on a frontal view (Boyce CJ, Pickhardt PJ, Kim DH (2010

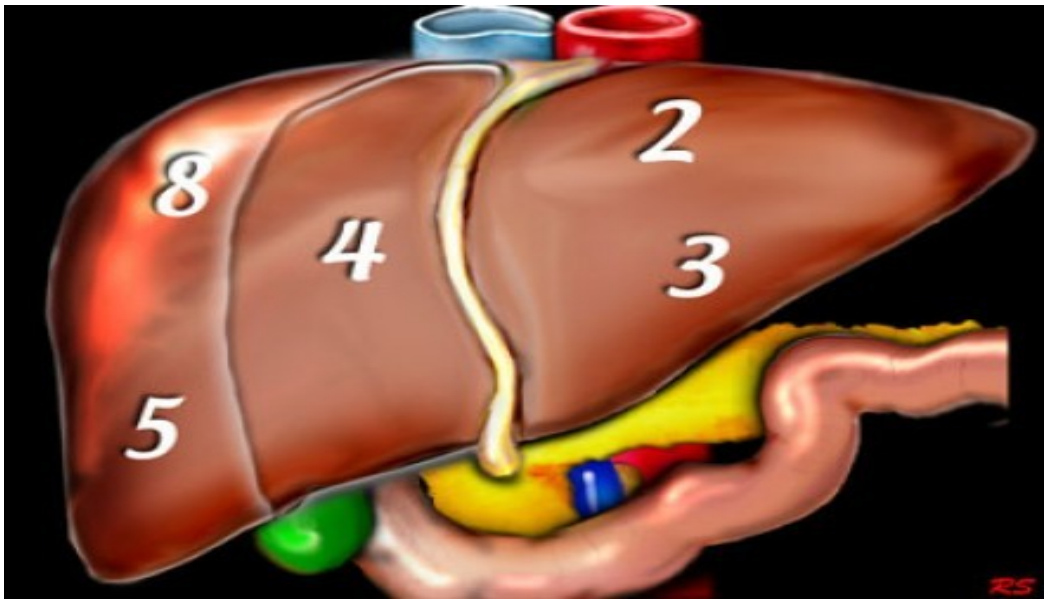


Figure 2-3 On a frontal view of the liver the posteriorly located segments 6 and 7 are not visible(http://www.encyclopedia.com/doc/1G2-.(3451600630.html

The illustrations above are schematic presentations of the liversegments. In reality however the proportions are different .On a normal frontal view the segments 6 and 7 are not visible because they are located more posteriorly The right border of the liver is formed by segment 5 and 8 (Boyce CJ, Pickhardt PJ, Kim DH 2010) Although segment 4 is part of the left hemiliver, it is situated more to the right .Couinaud divided the liver into a functional

left and right liver (in French 'gauche et droitefoie') by a main portal scissurae containing the middle hepatic vein. This is known as Cantlie'slinecantlie's line runs from the middle of the gallbladder fossa anteriorly to the inferior vena cavaposteriorly . On this illustration it looks as if the medial part of the left lobe is separated from the lateral part by the falciform ligament. However it actually is the left hepatic vein, that separates the medial part (segment 4) from the lateral part (segments 2 and 3)the left hepatic vein is located slightly to the left of the falciform ligament . ((Boyce CJ, Pickhardt PJ, Kim DH 2010

Righ t

Lift

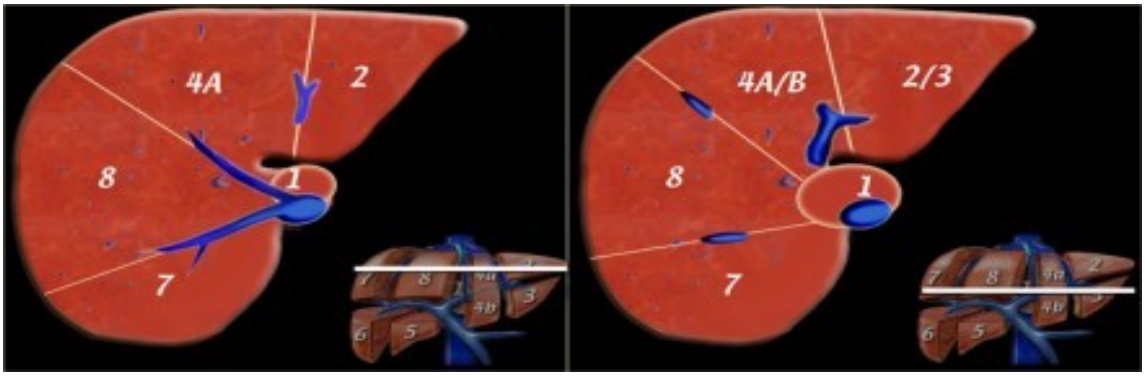


Figure 2-4 Lift level of the left portal vein.Right at the level of the left portal vein

Transverse anatomy 2-1-3

The far left figure is a transverse image through the superior liver segments, that are divided by the hepatic vein the right figure shows a transverse image at the level of the left portal vein , at this level the left portal vein divides the left lobe of the liver into the superior segments (2 and 4A) and the inferior segments (3 and 4B),the left portal vein is at a higher level than the right portal vein. ((Neuschwander-Tetri BA, Caldwell SH 2003

Righ t

Lift

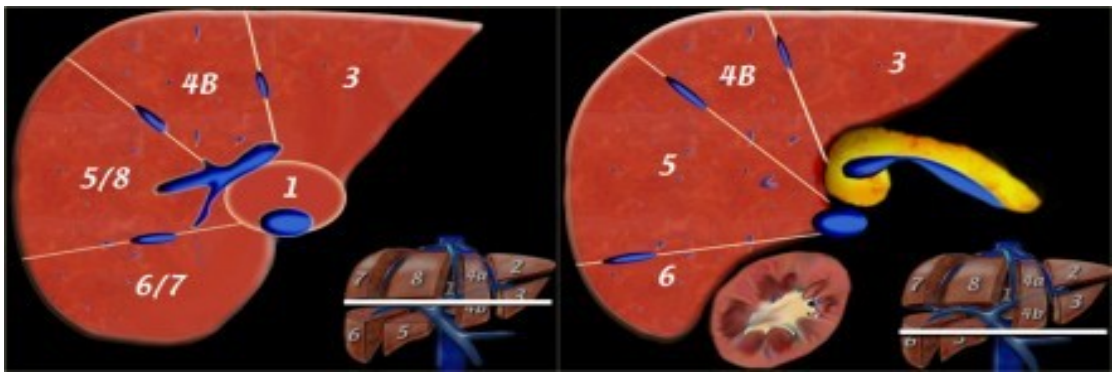


Figure 2-5LEFT: at the level of the right portal vein. RIGHT: at the level of the splenic vein(http://www.encyclopedia.com/doc/1G2-(3451600630.html

The image on the far left is at the level of the right portal vein. At this level the right portal vein divides the

right lobe of the liver into superior segments (7 and 8) and .(the inferior segments (5 and 6

The level of the right portal vein is inferior to the level of the left portal vein , at the level of the splenic vein, which is below the level of the right portal vein, only .(the inferior segments are seen (right image

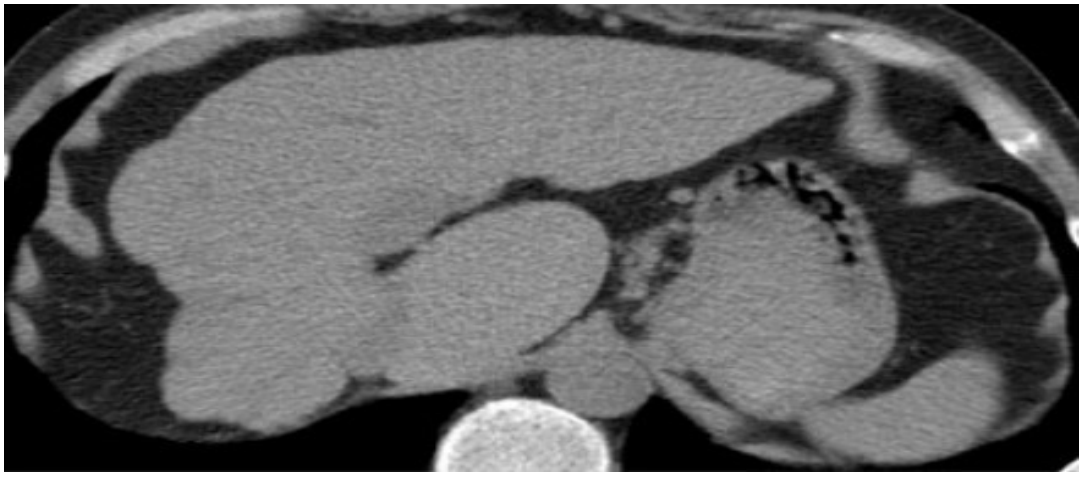


Figure 2-6 Hypertrophy of caudate lobe in a patient with .livercirrhosis. Notice the small lobulated right hemiliver

:Caudate lobe 2-1-4

The caudate lobe or segment 1 is located posteriorly. The caudate lobe is anatomically different from other lobes in that it often has direct connections to the IVC through hepatic veins, that are separate from the main hepatic veins.The caudate lobe may be supplied by both right and left branches of the portal vein . On the left a patient with cirrhosis with extreme atrophy of the right lobe, normal volume of the left lobe and hypertrophy of the caudate lobe. Due to a different blood supply the caudate lobe is spared from the disease process and

hypertrophied to compensate for the loss of normal liver .(parenchyma .(Neuschwander-Tetri BA, Caldwell SH 2003

Other Classifications and Variants 2-2

There are many other anatomical and functional descriptions of the liver anatomy.In the classical description the external appearance of the liver is used to describe the anatomy. However there are many differences between this classical model and the fuctional models, as popularized by Couinaud and Bismuth .((Neuschwander-Tetri BA, Caldwell SH 2003

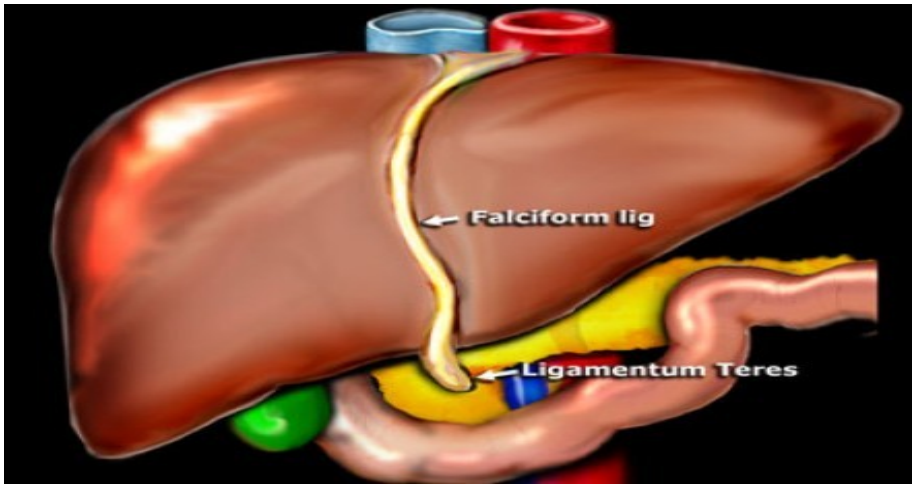


Figure 2-7: Falciform Ligament and LigamentumTeres..
((http://www.encyclopedia.com/doc/1G2-3451600630.html

Classical Anatomy 2-2-1

The classical description of the liver anatomy is based on the external appearance ,on the diaphragmatic surface, the ligamentumfalciforme divides the liver into the right and left anatomic lobes, which are very different from the functional right and left lobes (or right and left hemi

liver),in this classical description, the quadrate lobe belongs to the right lobe of the liver, but functionally it is .part of left lobe

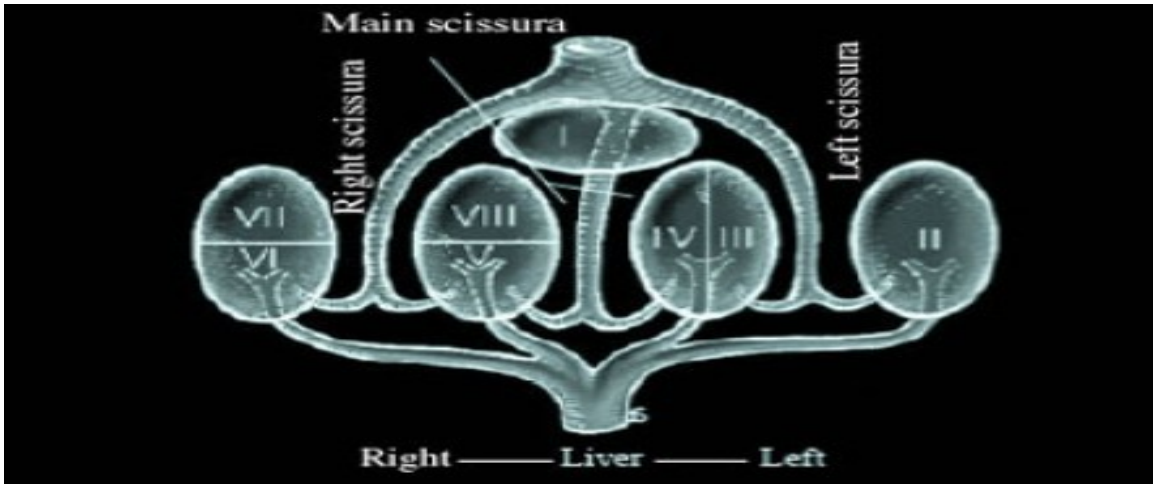


Figure 2-8 Bismuth's classification.
(.(http://www.encyclopedia.com/doc/1G2-3451600630.html

Bismuth's classification 2-2-2

This classification is very similar to the Couinaud classification, although there are small differences. It is popular in the United States, while Couinaud's .classification is more popular in Asia and Europe
According to Bismuth three hepatic veins divide the liver into four sectors, further divided into segments. These sectors are termed portal sectors as each is .supplied by a portal pedicle in the centre
The separation line between sectors contain a .hepatic vein
The hepatic veins and portal pedicels are intertwined, as are the fingers of two hands.The left portal scissura divides the left liver into two sectors: anterior and

posterior. Left anterior sector consists of two segments: segment IV, which is the quadrate lobe and segment III, which is anterior part of anatomical left lobe. These two segments are separated by the left hepatic fissure or umbilical fissure. Left posterior sector consists of only one segment II. It is the posterior part of left lobe.(Reeder SB, .(Ranallo F, Taylor AJ 2008

Variations 2-2-3

In the Couinaud classification little attention is given to the high prevalence of anatomical variations which occur, especially in the right hemi liver using volumetric acquisition techniques, such as magnetic resonance imaging or spiral computed tomography scanning, detailed insight into the individual segmental anatomy can now be obtained in a non-invasive manner.The significance of this anatomical insight lies in the planning of anatomical resections, whereby the relationship between tumour and individual segmental anatomy can be depicted in a three-dimensional format.(Reeder SB, .(Ranallo F, Taylor AJ 2008

Three dimensional liver imaging is of most practical value if a resection of one or more segments or sectors is considered, especially in the right hemiliver, In these cases, 3D liver imaging can demonstrate the precise location of the scissuras to the surgeon pre-operatively,portal venous and segmental anatomy of the

right hemiliver: observations based on three-dimensional spiral CT renderings ,Clinical and anatomical basis for the classification of the structural parts of liver(Reeder SB, .(Ranallo F, Taylor AJ 2008

:Important relations of the liver and organs 2-2-4

.

Anteriorly:Diaphragm, right and left costal margins, right and left pleura and lower margins of both lungs, xiphoid process, and anterior abdominal wall in the sub costal angle (el-Hassan AY, Ibrahim EM, Al-Mulhim FA, . . (Nab-han AA, Chammas MY 1992 2-2-4-1

Posteriorly :Diaphragm, right kidney, hepatic flexure of the colon, duodenum, gallbladder, inferior vena cava, and esophagus and fundus of the stomach. (el- . (Hassan AY 1992 2-2-4-2

:2-2-5Peritoneal Ligaments of Liver

The falciformligament,which is a two-layered fold of the peritoneum, ascends from the umbilicus to the live .ft has a sickle-shaped free margin that contains the ligamentumteres, the remains of the umbilical vein. The falciform ligament passes on to the anterior and [hen the superior surfaces of the liver and then splits into two layers. The right layer forms the upper layer of the coronaryligament; the left layer form the upper layer of the lefttriangularligament . The right extremity of the coronary ligament is known as the right triangular ilgament of the liver. it should be noted that the peritoneal

layers forming the cronary ligament are widely separated, leaving an area of liver devoid of peritoneum. Such an area is referred to as a bare area of the liver (el-Hassan . (AY, 1992

The ligamentumterespasses into a fissure on the visceral surface of the liver and joins the left branch of the portal vein in the portahepatis . The ligamentumvenosum, a fibrous band that is the remains of the ductusvenosus,is attached to the left branch of the portal vein and ascends in a fissure on the visceral surface of the liver to be attached above to the inferior vena cava . In the fetus, oxygenated blood is brought to the liver in the umbilical vein (ligamentumteres). The greater proportion of the blood bypasses the liver in the ductusvenosus (ligamentumvenosum) and / joins the inferior vena cava. At birth, the umbilical vein and ductusvenosus close and become fibrous cords , The lesser omentum arises from the edges of the portahepatis and the fissure for the ligamentumvenosum and passes down to the lesser curvature of the stomach (Snell – clinical Anatomy Edition .(7th

Blood Supply of the Liver 2-2-6

Arteries 2-2-6-1

The hepatic artery, a branch of the celiac artery, divides into right and left terminal branches that enter the .(portahepatis (Birnbaum BA, 2007

Veins 2-2-6-2

The portal vein divides into right and left terminal branches that enter the portahepatis behind the arteries. The hepatic veins (three or more) emerge from the posterior surface of the liver and drain into the inferior .(vena cava (Birnbaum BA, 2007

:Portal Circulation 2-2-7

The blood vessels conveying blood to the liver are the hepatic artery (30%) and portal vein (70%). The hepatic artery brings oxygenated blood to the liver, and the port al vein brings venous blood rich in the products of digest ion, which have been absorbed from the gastrointestinal tract. The arterial and venous blood is conducted to the central vein of each liver lobule by the liver sinusoids. The central veins drain into the right and left hepatic veins, and - these leave the posterior surface of the liver and open directly into the inferior vena cava. (Birnbaum BA, .(Hindman N, Lee J, Babb JS 2007

Lymph Drain of the liver 2-2-8

The liver produces a large amount of lymph—about one third to one half of all body lymph. The lymph vessels leave the liver and enter several lymph nodes in the portahepatisThe efferent vessels pass to the celiac nodes. A few vessels pass from the bare area of the liver through

the diaphragm to the posterior mediastinal lymph .(nodes(Birnbaum BA, Hindman N, Lee J, Babb JS 2007

: Nerve Supply of the liver 2-2-9

Sympathetic and parasympathetic nerves form the celiac plexus .the anterior vagal trunk gives rise to a large hepatic branch, which passes directly to the .(liver(Birnbaum BA, Hindman N, Lee J, Babb JS 2007

Bile Ducts of the 2-2-10

Bile is secreted by the liver cells at a constant rate of about 40 mL per hour. When digestion is not taking place, the bile is stored and concentrated in the gallbladder; later is delivered to the duodenum. The bile ducts of the liver consist of the right and left hepatic ducts, the common hepatic duct, the bile duct, the gallbladder, and the cystic ..(duct(Birnbaum BA, Hindman N, Lee J, Babb JS 2007

The smallest interlobular tributaries of the bile ducts are situated in the portal canals of the liver; they receive the bile canaliculi. The interlobular ducts join one another to form progressively larger ducts and, eventually, at the portahepa tis, form the right and left hepatic ducts. The right hepatic duct drains the right lobe of the liver and the left duct drains the left lobe, caudate lobe, and quadrate .(lobe(Birnbaum BA, Hindman N, Lee J, Babb JS 2007

:HepaticDucts 2-2-10-1

The right and left hepatic ducts emerge from the right and left lobes of the liver in the portahepatis . After a short course, the hepatic ducts unite to form the common hepatic duct , The common hepatic duct is about 1.5 in. (4

cm) long and descends within the free margin of the lesser omentum. It is joined on the right side by the cystic duct from the gall bladder to form the bile duct .(Nelson RC, . (McDermott VG, Paulson EK 1995

:(CommonBileDuct(CBD 2-2-10-2

The bile duct (common bile duct) is about 3 in. (8cm) long. In the first part of its course, it lies in the right free margin of the lesser omentum in front of the opening into the lesser sac. Here, it lies in front of the right margin of the portal vein and on the right of the hepatic artery . In the second part of its course, it is situated behind the first part of the duodenum to the right of the gastro duodenal artery . In the third part of its course, it lies in a groove on the posterior surface of the head of the pancreas . Here, the bile duct comes into contact with the main pancreatic . (duct.(Nelson RC EK 1995

The bile duct ends below by piercing the medial wall of the second part of the duodenum about halfway down its length . It is usually joined by the main pancreatic duct, and together they open into a small ampulla in the duodenal wall, called the hepato pancreatic ampulla (ampulla of Vater).The ampulla opens into the lumen of the duodenum by means of a small papilla, the major duodenal papill . The terminal parts of both ducts and the ampulla are surrounded by circular muscle, known as the sphincter of the hepatopancreatic ampulla (sphincter of

Oddi) . Occasional, the bile and pancreatic ducts open
. (separately into the duodenum.(Nelson RC, 1995

:Gallbladder 2-2-11

:Location and Description of Gallbladder 2-2-11-1

The gallbladder is a pear-shaped sac lying on the under surf ace of the liver . It has a capacity of 30 to 50 ml and stores bile, which it concentrates by absorbing water. For descriptive purposes, the gallbladder is divided into the funds. body, and neck. The funds is rounded and usually projects below the inferior margin of the liver, where it comes in contact with the anterior abdominal wall at the level of the tip of the ninth right costal cartilage. The body lies in contact with the visceral surface of the liver and is directed upward, backward, and to the left. The neckbecomes continuous with the cystic duct, which turns into the lesser omentum to join the right side of the common hepatic duct, to form the bile duct , The peritoneum completely surrounds the funds of the gallbladder and binds the body and neck to the visceral surf ace of the liver .(Nelson RC, McDermott VG, Paulson
. (EK 1995

:Relations of Gallbaldder& organs 2-2-11-2

Anteriorly: The anterior abdominal wall and the inferior
. surface of the liver

Posteriorly: The transverse colon and the first and second parts of the duodenum.(Nelson RC, McDermott VG,
. (Paulson EK 1995

:Blood Supply of gallbladder 2-2-11-3

The cystic artery, abranch of the right hepatic artery , supplies the gallbladder. The cystic veindrains directly into the portal vein. Several very small arteries and veins also run between the liver and gallbladder.(Nelson RC,
. (McDermott VG, Paulson EK 1995

:Lymph Drainage of gallbladder 2-2-11-4

The lymph drains into a cystic lymph nodesituated near the neck of the gallbladder. From here, the lymph vessels pass to the hepatic nodes along the course of the hepatic .artery and then to the celiac nodes

:Nerve Supply of gallbladder 2-2-11-5

Sympathetic and parasympathetic vagal fibers form the celiac plexus. The gallbladder contracts in response to the hormone cholecystokinin, which is produced by the mucous membrane of the duodenum on the arrival of fatty food from the stomach.(Nelson RC, McDermott VG,
. (Paulson EK 1995

:Cystic Duct 2-2-12

The cystic duct is about 1.5 in. (3.8 cm) long and connects the neck o the gallbladder to the common hepatic duct to form the bile duct . It usually is somewhat S 3.ia)eel and descends for a variable distance in the right free margin o f the lesser omentum the mucous membrane of the cystic duct is raised to form a spiral fold that is continuous with a similar fold in the neck of the gallbladder. The fold is

commonly known as the spiral valve.” The function of the spiral valve is to keep the lumen constantly open (Scherer .(U, Santos M, Lissner J 1979

: Physiology 2-3

The various functions of the liver are carried out by the liver cells or hepatocytes. Currently, there is no artificial organ or device capable of emulating all the functions of the liver. Some functions can be emulated by liver dialysis, an experimental treatment for liver failure. The liver is thought to be responsible for up to 500 separate functions, usually in combination with other systems and .organs

:Synthesis Functions of the Liver 2-3-1

Further information : Proteins produced and secreted by the liver

A large part of amino acid synthesis. The liver performs :several roles in carbohydrate metabolism

Gluconeogenesis (the synthesis of glucose from certain amino acids , lactate or glycerol).Glycogenolysis (the breakdown of glycogen into glucose) Glycogenesis (the formation of glycogen from glucose)(muscle tissues can also do this). The liver is responsible for the mainstay of protein metabolism, synthesis as well as degradation , The liver also performs several roles in lipid metabolism: .Cholesterol synthesis

Lipogenesis, the production of triglycerides(fats).A bulk of the lipoproteins are synthesized in the liver.The liver produces coagulation factors I (fibrinogen), II

(prothrombin), V,VII, IX, X and XI, as well as protein C, protein S and antithrombin.In the first trimester fetus, the liver is the main site of red blood cell production. By the 32nd week of gestation, the bone marrow has almost completely taken over that task.The liver produces and excretes bile (a yellowish liquid) required for emulsifying .fats and help the absorption of vitamin K from the diet Some of the bile drains directly into the duodenum, and some is stored in the gallbladder. The liver also produces insulin-like growth factor 1 (IGF-1), a polypeptide protein hormone that plays an important role in childhood growth and continues to have anabolic effects in adults.The liver is a major site of thrombopoietin production. Thrombopoietin is a glycoprotein hormone that regulates .the production of platelets by the bone marrow

: Breakdown Function of the Liver 2-3-2

The breakdown of insulin and other hormones The liver glucoronidates bilirubin, facilitating its excretion into bile. The liver breaks down or modifies toxic substances (e.g., methylation) and most medicinal products in a process called drug metabolism. This sometimes results in toxication, when the metabolite is more toxic than its precursor. Preferably, the toxins are conjugated to avail excretion in bile or urine The liver converts ammonia to urea (urea cycle).The liver is responsible for immunological effects-the reticuloendothelial system of the liver contains many immunologically active cells,

acting as a sieve’ for antigens carried to it via the portal .(system .(Snell – clinical Anatomy Edition 7th

The liver produces albumin, the majorosmolar component of blood serum.The liver synthesizes angiotensinogen, a hormone that is responsible for raising the blood pressure when activated by □ ennin, an enzyme that is released when the kidney senses low blood pressure.(Snell – .(clinical Anatomy Edition 7th

Function of the Gallbladde 2-3-3

When digestion is not taking place, the sphincter of Oddi remains closed and bile accumulates in the gallbladder. The gallbladder concentrates bile; stores bile; selectively abs orbs bile salts, keeping the bile acid; excretes cholesterol; and secretes mucus. To aid in these functions, the mucous membrane is thrown into permanent folds that unite with each other, giving the surface a honeycombed appearance. The columnar cells lining the surface also have numerous microvilli on their free .surface

Bile is delivered to the duodenum as the result of contract ion and partial emptying of the gallbladder. This mechanism is initiated by the entrance of fatty foods into the duodenum. The fat causes release of the hormone cholecystokinin from the mucous membrane of the duodenum; the hormone then enters the blood, causing the gallbladder to contract. At the same time, the smooth muscle around the distal end of the bile duct and the

ampulla is relaxed, thus allowing the passage of concentrated bile into the duodenum. The bile salts in the bile are important in emulsifying the fat in the intestine and in assisting with its digestion and absorption.(Snell – .(clinical Anatomy Edition 7th

Relation of the Liver to medicine and pharmacology: 2-3-4

The oxidative capacity of the liver decreases with aging and therefore any medications that require oxidation (for instance, benzodiazepines) are more likely to accumulate to toxic levels However, medications with shorter half-lives, such as lorazepam and oxazepam, are preferred in most cases when benzodiazepines are required in regards (to geriatric medicine(Scherer U, Santos M, Lissner J 1979

: Pathology 2-4

Fatty Liver Disease 2-4-1

Is a condition in which there is excess levels of fat being deposited on the liver in people who do not drink alcohol or drink very less .there is a high level of accumulation of triglycerides and other fats in the liver cells and may lead to inflammation called steatohepatitis while every liver has some amount of fat , if percentage of fat account for more them 10 percent of it’s weight . it is a case of fatly liver In general, people with Fatty liver disease have no symptoms and go about their life in regular fashion. There are case where symptoms like discomfort in the abdomen

at level of the liver , Fatigue , a general feeling of being (unwell may appear (Joy D, Thava VR, Scott BB 2003

Cause of Fatty liver 2-4-1-1

It not induced by alcohol, is obesity besides obesity there are other cause that can causes fatty liver include case of malnutrition and hunger, type2 diabetes dyslipidemia ,insulin resistance and rapid weight loss . otherrane cause like disorder in lipid metabolism .mutation in gene , forms of glycogen storage disease and abuse of drugs and chemicals , corticosteroids, tetracycline and (carbon tetrachloride (Joy D, Thava VR, Scott BB 2003

Risk Factor For fatty liver 2-4-1-2

High cholesterol , high level of triglycerides in blood, Metabolic syndrome, Obesity, Certain medication, malnutrition, Gastric by passsurgery, Rapid weight loss, Type2 diabetes and Wilson’s disease (Joy D, Thava VR, (Scott BB 2003

:Diagnosis of fatty liver 2-4-1-3

Most case is discovered by chance when testing for some .problem

.Blood test – measure liver foundation and lipid profile

Imaging ultra sound and CT(Liver Biopsy) Songraphic appearance of fatty liver, Bigger liver, Brighter liver (i-e much brighter then renal cortex) , Loss of portal view wall

definition and Post attenuation fallout (Joy D, Thava VR, (Scott BB 2003

:Jaundice and Cholestasis 2-4-2

Jaundice occurs when retention of bilirubin leads to serum levels above 2.0 mg/dL.Hepatitis and intra- or extra-hepatic obstruction of bile flow are the most common causes of jaundice involving the accumulation of conjugated bilirubin.Hemolyticanemias are the most common causes of jaundice involving the accumulation of unconjugated bilirubin.Cholestasis is the impairment of bile flow resulting in the retention of bilirubin, bile acids, and cholesterol.Serum alkaline phosphatase is usually elevated in cholestatic conditions. (Robbin Basic pathology (8th Ed

: Hepatitis 2-4-3

Viral hepatitis is the most common primary liver infection. Autoimmune hepatitis is much less frequent.HAV causes a self-limited disease that never becomes chronic; HBV can produce acute, chronic, and fulminant disease (1% or less), but the frequency of chronic disease is about 10%.HCV causes acute and chronic hepatitis; the acute phase is often difficult to detect and the frequency of chronic disease may reach 85%; cirrhosis develops in 20% of cases of chronic disease.In both acute and chronic hepatitis there is hepatocyte injury and cell death, and inflammation of portal tracts; chronic hepatitis may show bridging necrosis and fibrosis.Patients with longstanding

HBV or HCV infections are at increased risk of developing hepatocellular carcinomas. (Robbin Basic pathology 8th (Ed

Table 2-1 The Hepatitis Viruses (Robbin Basic pathology (8th Ed

Hepatitis E	Hepatitis D	Hepatitis C	Hepatitis B	Hepatitis A	Virus
ssRNACalicivirus	Circular defective ssRNASubviral particle in Deltaviridae family	ssRNAFlaviridae	partially dsDNAHepadnavirus	ssRNAHepatovirus; related to picornavirus	Type of virus Viral family
Fecal-oral	Parenteral	Parenteral; intranasal cocaine use is a risk factor	Parenteral, sexual contact, perinatal	Fecal-oral (contaminated food (or water	Route of transmission
weeks 4-5	Same as HBV	weeks 7-8	months 1-4	weeks 2-4	Mean incubation period
Never	) 5% coinfection);	80%∽	10%	Never	Frequency of chronic

	≤70% for superinfection				liver disease
PCR for HEV RNA; detection of serum IgM and IgG antibodies	Detection of IgM and IgG antibodies; HDV RNA serum; HDAg in liver	PCR for HCV RNA; 3rd-generation ELISA for antibody detection	Detection of HBsAg or antibody to HBcAg	Detection of serum IgM antibodies	Diagnosis

Alcohol and Drug-Induced Liver Disease 2-4-4

Alcoholic liver disease has three main components: hepatic steatosis, alcoholic hepatitis, and cirrhosis; these conditions do not necessarily evolve as a continuum.Consumption of 50-60 gm/day of alcohol is considered to be the threshold for the development of alcoholic liver disease.It may take 10 to 15 years of drinking for the development of cirrhosis, which occurs only in a small proportion of chronic alcoholics; alcoholic cirrhosis has the same morphologic and clinical features as cirrhosis caused by viral hepatitis.The multiple pathologic effects of alcohol include changes in lipid metabolism and decreased export of lipoproteins, and cell injury caused by reactive oxygen species and cytokines.Drug-induced liver disease may cause multiple patterns of injury, including cholestasis, hepatitis,

steatosis, necrosis and acute liver failure, sinusoidal obstruction, acute liver failure, and neoplasms.Drug-induced chronic hepatitis is clinically and morphologically similar to viral or autoimmune hepatitis. (Robbin Basic (pathology 8th Ed

:Circulatory Disorders 2-4-5

Circulatory disorders of the liver can be caused by impaired blood inflow, defects in intrahepatic blood flow, and obstruction of blood outflow.Portal vein obstruction by intra or extrahepatic thrombosis may cause portal hypertension, esophageal varices, and ascites.The most common cause of impaired intrahepatic blood flow is cirrhosis.Obstructions of blood outflow include hepatic vein thrombosis (Budd-Chiari syndrome) and sinusoidal obstruction syndrome, previously known as veno-occlusive (disease. (Robbin Basic pathology 8th Ed

:Tumors 2-4-6

The liver is the most common site of metastatic cancers from primary tumors of the colon, lung, and breast.The main primary tumors are hepatocellular carcinomas and cholangiocarcinomas; hepatocellular carcinomas are by far the most common.HCC is a common tumor in regions of Asia and Africa, and its incidence is increasing in the United States.The main etiologic agents for hepatocellular

carcinoma are hepatitis B and C, alcoholic cirrhosis, hemochromatosis, and more rarely, tyrosinemia. In the Western population about 90% of hepatocellular carcinomas develop in cirrhotic livers; in Asia almost 50% of cases develop in noncirrhoticlivers.The chronic inflammation and cellular regeneration associated with viral hepatitis may be predisposing factors for the development of carcinomas.Hepatocellular carcinomas may be unifocal or multifocal, tend to invade blood vessels, and recapitulate normal liver architecture to (varying degrees. (Robbin Basic pathology 8th Ed

Diseases of the Gallbladder and Extrahepatic 2-4-7 :Bile Ducts

Gallbladder diseases include cholelithiasis and acute and chronic cholecystitis.Gallstone formation is a common condition in Western countries. The great majority of the gallstones are cholesterol stones. Pigmented stones containing bilirubin and calcium are most common in Asian countries.Risk factors for the development of cholesterol stones are advancing age, female gender, estrogen use, obesity, and heredity.Cholecystitis almost always occurs in association with cholelithiasis, although in about 10% of cases it occurs in the absence of gallstones.Acutecalculouscholecystitis is the most common reason for emergency cholecystectomy. (Robbin (Basic pathology 8th Ed

:Carcinoma of the Gallbladder 2-4-8

Carcinoma of the gallbladder, which develops from the

epithelial lining of the organ, is the most frequent malignant tumor of the biliary tract. It is slightly more common in women and occurs most frequently in the seventh decade of life. For unknown reasons carcinoma of the gallbladder is more frequent in Mexico and Chile. In the United States the incidence is highest in Hispanics and Native Americans. Only rarely is it discovered at a resectable stage, and the mean 5-year survival has remained at a dismal 5% rate. Gallstones are present in 60% to 90% of cases. However, in Asia, where pyogenic and parasitic diseases of the biliary tree are more common, gallstones are less important. Presumably, gallbladders containing stones or infectious agents develop cancer as a result of recurrent trauma and chronic inflammation. The role of carcinogenic derivatives of bile acids is unclear, but the presence of a abnormal choledochopancreatic duct junction is considered to be a (risk factor. (Robbin Basic pathology 8th Ed

Indications for Liver CT Scan 2-5

Primary or metastasis lesions of the liver, pancreas, kidney and spleen -.

.Adrenal gland pathology -

.Pancreatitis -

.Abscesses -

.Hepatic or splenic hematoma-

: Preparation for abdominal CT Scan 2-6

Make sure The patient has not had GIT study over the past three days, The patient fasting for four hour before the examination and Bowel preparation : Oral only : 1200-1500 ml 45 min prior to scan , 300 ml immediately before scan , Right lateral decubitus position 3-5 min. before .scan

Light dinner ,In patients with suspected renal dysfunction, base line urea creatinine level Should be obtained.(CM should be given in a very narrow range of indication when creatinine level is high).In cases where CM was absolutely necessary for dialysis patients, CT exam was scheduled so that dialysis followed immediately.CT of abdomen should .be delayed for 3 days after a conventionalBastudies

Upper abdomen only (oral only) :400-600 ml orally 45-60 min. prior to scan,300 ml orally immediately before scan , .Right lateral decubitus 3-5 min. before scan

Position of the patient 2-6-1

The patient with his arms behind his head resting on the arm support and his, Patient positioning: use the arm support and knee and leg support , Positionlegs on the legs and knee support. Slice 5 mm feed 5mm 3zoom

Scanning technique 2-6-2

Patient is scanned from diaphragm to pubic symphysis by

7 mm cuts, usually with oral and iv contrast,In abdomen axial scan respiration must e suspended in consistent .manner to produce high quality image

Triple Phase CT of Liver Scanning of liver is performed pre-contrast, during arterial phase of contrast enhancement, and during portal venous phase of contrast enhancement. The abdominal CT is then completed to iliac crest level. If hemangioma is suspected, additional delayed images are .obtained to assess for filling in of hemangioma

The most important technical factor that affects scan timing is the duration of contrast medium injection ; Duration of contrast medium injection is determined by, the volume of contrast medium and the rate at which it is a

.dministered

: Hounsfield of Organs 2-7

The Hounsfield unit (HU) scale is a linear transformation of the original linear attenuation coefficient measurement into one in which the radiodensity of distilled water at standard pressure and temperature (STP) is defined as zero Hounsfield units (HU), while the radiodensity of air at STP is defined as -1000 HU. In a voxel with average linear attenuation coefficient μ , the corresponding HU value is :therefore given by

$$HU = 1000 \times \frac{\mu - \mu_{water}}{\mu_{water} - \mu_{air}}$$

Where μ_{water} and μ_{air} are respectively the linear attenuation .coefficients of water and air

Thus, a change of one Hounsfield unit (HU) represents a change of 0.1% of the attenuation coefficient of water since the attenuation coefficient of air is nearly zero.It is the definition for CT scanners that are calibrated with reference to water (Yajima Yet al 1997)Thus, a change of one Hounsfield unit (HU) represents a change of 0.1% of the attenuation coefficient of water since the attenuation coefficient of air is nearly zero. It is the definition for CT .scanners that are calibrated with reference to water

.(**Tissue CT number (HU)**(VanDyk 2001

(CT (N	Tissue
1000	Bone
60 – 40	Liver
20-30~ HU	White matter
37-45~ HU	Grey matter
40	Blood
40 – 10	Muscle
30	Kidney
15	Cerebrospinal fluid
0	Water
- - 50-	Fat

100	
1000-	Air

:previous studies 2-8

The spectrum of nonalcoholic fatty liver disease ranges from fatty liver alone to nonalcoholic steatohepatitis. Most previous studies have short follow-up and have not carefully delineated different histological types when determining clinical outcomes. One study aimed to compare clinical characteristics and outcomes of patients with different .types of nonalcoholic fatty liver

All liver biopsy specimens from 1979 to 1987 with fat accumulation were assessed for inflammation, ballooning degeneration, Mallory hyaline, and fibrosis. Biopsy specimens were also assessed for histological iron and hepatitis C RNA. Outcomes were cirrhosis, mortality, and .liver-related mortality

Of 772 liver biopsy specimens, complete data were available in 132 patients. Fatty liver (type 1) did not differ from the other three types combined with respect to gender, race, age, or obesity. Cirrhosis was more common in the other types combined (22%) than fatty liver alone (4%; $P \leq 0.001$). Overall mortality, histological iron, and hepatitis C did not differ between groups. Most of the liver-related deaths were in type

The outcome of cirrhosis and liver-related death is not uniform across the spectrum of nonalcoholic fatty liver. These poor outcomes are more frequent in patients in whom biopsies show ballooning degeneration and Mallory .(hyaline or fibrosis (I.M Jack Sharma 2007

The number of patients with morbid obesity is increasing worldwide. However, the prevalence of morbid obesity is still low in Japan, and therefore few systematic investigations of liver dysfunction in this population have so far been carried out. This study aimed to investigate the clinical characteristics in severe obese Japanese patients undergoing laparoscopic Roux-en-Y gastric bypass .(surgery (LRYGB

Eighty-four patients with severe obesity, including 61 .Japanese and 23 non-Japanese patients, were analyzed

The mean body mass index (BMI) was 43.7 +/- 7.8 kg/m(2), and there was no difference between Japanese and non-Japanese patients.
Nonalcoholic fatty liver disease (NAFLD) was observed in 45/59 (76.2%) of the Japanese patients. Although there were no differences in the BMI and body weight, serum ALT was higher in Japanese patients in comparison to non-Japanese patients ($P < 0.05$). The indices for insulin resistance were significantly higher in the Japanese patients in comparison to non-Japanese patients ($P < 0.01$) . The liver/spleen computed tomography (CT) ratios were lower in Japanese patients ($P < 0.05$). The

laboratory data and BMI significantly improved at 1 year .after LRYGB in both groups

Racial difference may exist difference may exist in NAFLD in patients with severe obesity. When the BMI is similar, liverdysfunction among Japanese patients with severe obesity tends to be higher than in non-Japanese patients. Japanese patients with severe obesity must therefore reduce their body weight to a greater degree in comparison to non-Japanese patients with the same BMI. LRYGB can achieve effective weight control and lower ALT .levels in Japanese patients with severe obesity

To evaluate the relationship between hepatic fat infiltration and abdominal fat volume by using CT Scan a .(study was obtained by (Kakizaki etal 2002

Three hundred and six patients who visited our obesity clinic betweenNovember 2007 and April 2008 underwent fat protocol CT Scan ,the age range of pt was 19 to 79 . years and the mean age was 49years

Abdominal fat was classified into total fat (TF) ,visceral fat .((VF) , AND subcutaneous fat (SF

Fatty infiltration of the liver was correlated with amount of abdominal fat and VF was more strongly associated with .(fatty liver than SF (Kakizaki e tal 2002

Chapter three

Methods and materials .

Chapter three

Materials and Methods

:Type of study 3-1

This is descriptive and analytic study

:Place and time of study 3-2

This study was performed at Radiology department of Royal care international hospital ,during the period from .((April-2014 up to April-2015

:Study sample 3-3

This study included 50 patients all selected from patients who were referred to the CT Scan department (20 were .(males and 30 were females

:Study variables 3-4

The variable that were collected from each subject included; gender(20 males and 30 females),ages from(24 .(up to 78yaers), weights from(58 upto128 kilograms

:Data collection 3-5

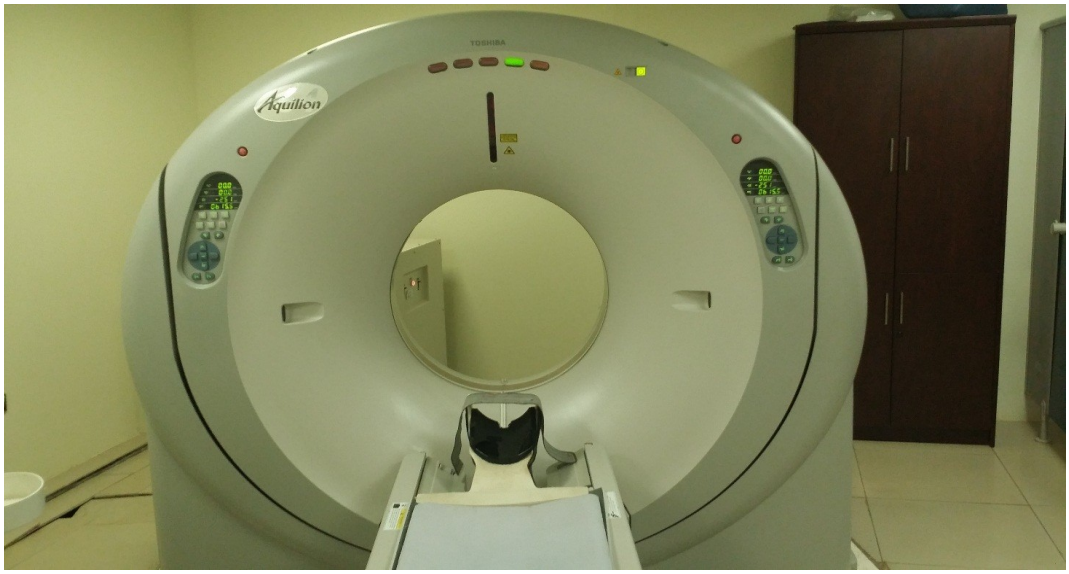
The data were collected by account the number of CT .(scans in master data table (appendices

:Data Analysis 3-6

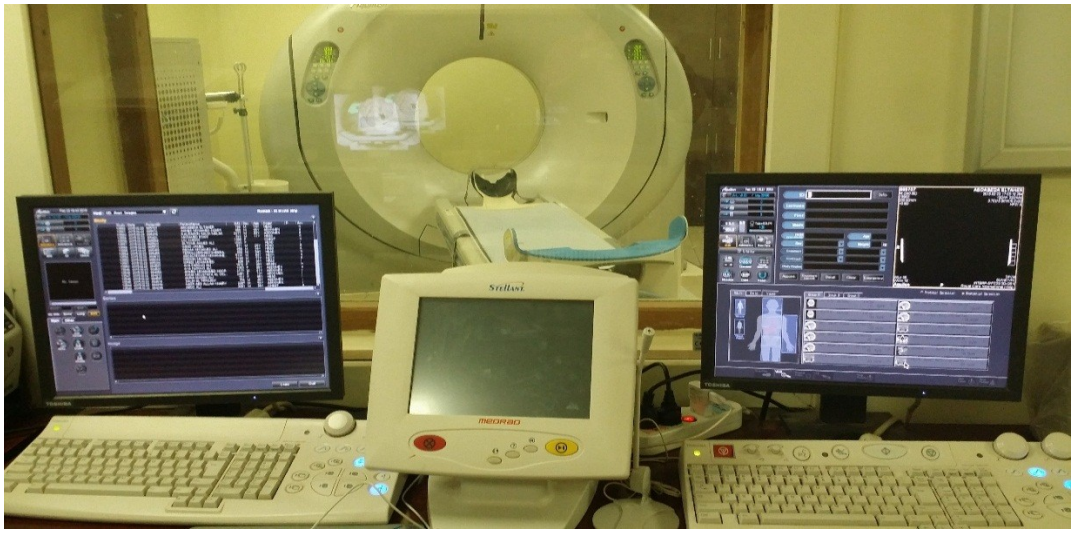
The data were analysed by using SPSS program version 16 and excel data sheet, variables usin descriptive tables , frequency, percentagedistributiontables, cross tabulation between the variables and then all data were presented in .graphs as bar graph and scatter plot diagram

:Materiles Used 3-7

Computed Tomography (CT), 64 slice Toshiba



(Figure 3-1 (gantry computer tomography

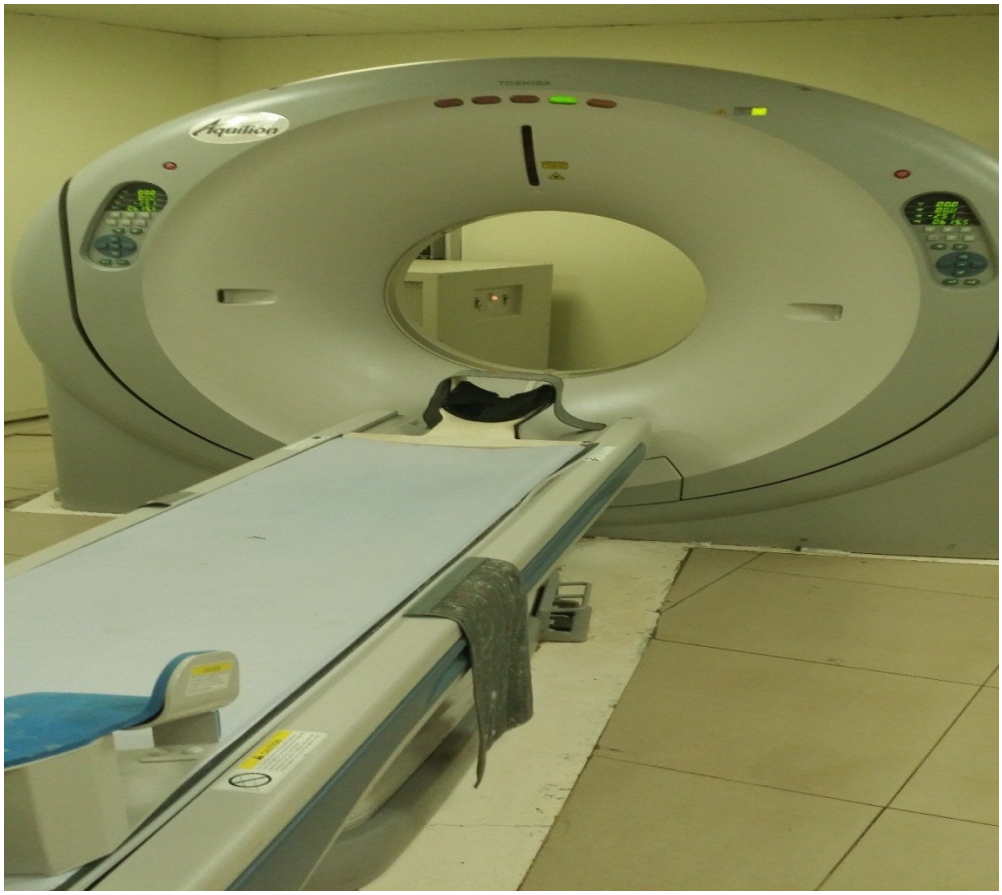


(Figure 3-2 (control computer tomography

:Methods 3-8

:computed tomography technique 3-8-1

Abdominal & KUB CT Scan , Most protocols of the abdomen and pelvis are performed while the patient lies in a supine position on the scan table with the arms elevated above the head. In afew instances changing the patient position and obtaining additionalslices can provide added information. Such is the case when initial scans fail to differentiate the margins of the pancreas from the duodenum. In this situation, the patient , is often given oral contrast material and additional slices are obtained with the patient lying in a right decubitus positionpt supine , feet first and suspended inspiration (KV =120 , MA =300 , Time of rotation = 0,75s), Axial cut with slice thickness 5mm



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. Figure 3-3 machine(CT) table

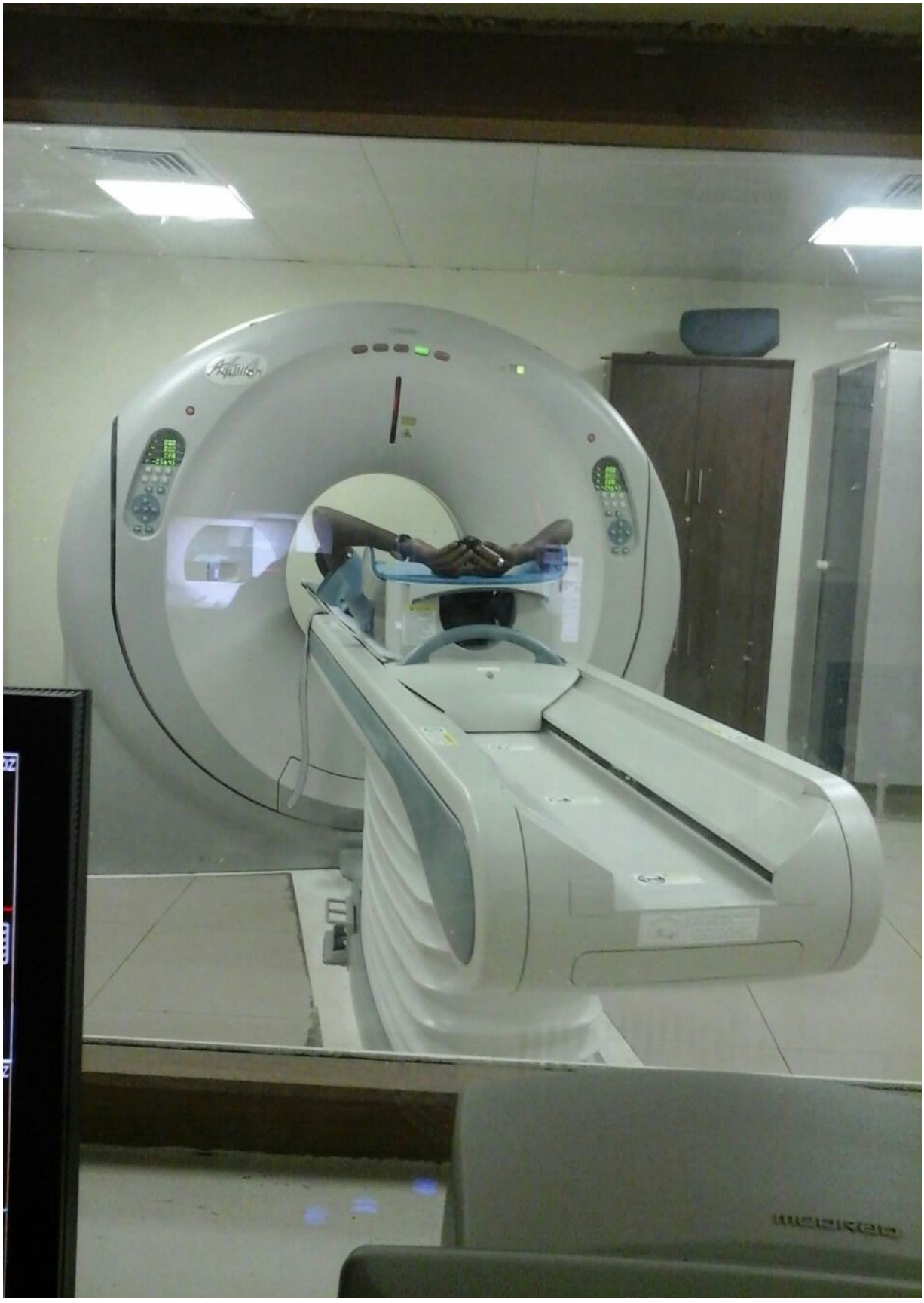

Figure 3-4 patient position

Chapter four

Results .

Chapter Four

Results

Table (4.1) Sample Distribution according To gender

Percentage	Frequency	Gender
40%	20	Male
60%	30	Female
100%	50	Total

Figure4.1 Gender Distribution, Frequency and Percentage

Table (4.2) Total Sample Demographic Data

Antro -Posterior(AP) Fat (Thickness (mm	Weight/Kg	Age/Years	Item
19.61	96.04	51.0	Mean Values
±7.20	±18.83	±15	STDV

Table (4.3)The mean ,Standard Deviation and P-values for the measured values of the variables (According to (gender

/AP	Weight/Kg	Age/Years	Gender
Abdominal Fat (Thickness/(mm			
Male			
17.5	95.4	57.6	Mean
±7.1	±18.6	±12.5	STDV
Female			
21.0	96.5	47.0	Mean
±7.0	±19.3	±14.6	STDV
0.002	0.018	0.026	P-Values

Difference are Significant at P-Value= 0.005

Table (4.4) The CT Number (Hounsfield) measured for each (liver Segment (Total Sample

Seg	Segme	Segme	Segme	Segme	Segme	Segme	Segme

ment	nt	nt	nt	nt	nt	nt	nt	
(8)	(7)	(6)	(5)	(4)	(3)	(2)	(1)	
50.2	52.1	51.8	52.0	53.5	52.2	50.9	51.2	Mean
±9.9	±8.7	±8.6	±9.3	±7.4	±8.5	±9.4	±7.9	STDV

Table (4.5) The CT Number (Hounsfield) ,P-Value measured (for each liver Segment (According to gender

Segment	Segment (nt (7	Segment (nt (6	Segment (nt (5	Segment (nt (4	Segment (nt (3	Segment (nt (2	Segment (nt (1	Gender
(8)								
51.4	54.5	52.9	53.5	55.7	54.4	55.1	53.7	Male
±10.4	±7.5	±7.9	±7.2	±7.4	±7.9	±9.3	±7.7	STDV
49.7	51.1	51.4	51.3	52.2	50.9	48.3	49.7	Female
±9.5	±9.1	±9.1	±10.5	±7.3	±8.8	±8.7	±8.0	STDV
0.046	0.036	0.032	0.042	0.052	0.001	0.014	0.021	P-Value

Correlations are Significant at P-Value= 0.005

Table (4.6) The Correlation Between CT Number, Sample .Weight, AP Fat Thickness and Age

P-Value			Item
AP abdominal Fat Thickness((mm	Sample Age/Years	Sample Weight/KG	Liver Segments
*0.000	*0.056	*0.000	CT Number For Liver at Segment ((1
*0.006	*0.058	*0.021	CT Number For Liver at Segment ((2
*0.007	*0.059	*0.003	CT Number For Liver at Segment ((3
*0.032	*0.045	*0.008	CT Number For Liver at Segment ((4
*0.012	*0.024	*0.029	CT Number For

			Liver at Segment ((5
*0.000	*0.049	*0.039	CT Number For Liver at Segment ((6
*0.037	*0.057	*0.08	CT Number For Liver at Segment ((7
*0.035	*0.047	*0.014	CT Number For Liver at Segment ((8

Correlations are Significant at P-Value= 0.005*

Figure 4.2 A scatter plot diagramme shows a linear relationship between the age and Antero-posterior abdominal fat thickness(mm) for the total Sample As The age increased The AP Fat thickness Decreased by0.036 starting from 21.48 y=-0.036X+21.4

Figure 4.3 A scatter plot diagramme shows a linear relationship between the Weight(Kg) and Antero-posterior abdominal fat thickness(mm) for the total SampleAs The Weight increased The AP Fat thickness increased by 0.226 starting from y= 0.226X+2.115

Figure 4.4 A scatter plot diagramme shows a linear relationship between the Antero-posterior abdominal fat thickness (mm) and CT Number(Hounsfield)For Liver Segment(1) for the total Sample , : As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.061 starting from CT number of Segment1=0.061AP diameter +52.40

Figure 4.5 A scatter plot diagramme shows a linear relationship between the Antero-posterior abdominal fat thickness(mm) and CT Number(Hounsfield)For Liver Sigment(2) for the total Sample , As The CT Number a linear relationship between the Antero-posterior

abdominal fat thickness by 0.159 starting fromCT number of Segment2=0.159AP diameter+47.89

Figure 4.6 A scatter plot diagramme shows a linear relationship between the Antero-posterior abdominal fat thickness(mm) and CT Number(Hounsfield)For Liver Sigment(3) for the total Sample, As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.103 starting from CT number of Segment3=0.103AP diameter+50.19

Figure 4.7 A scatter plot diagramme shows a linear relationship between the Antero-posterior abdominal fat thickness(mm) and CT Number(Hounsfield)For Liver Sigment(4) for the total Sample As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.088 starting from CT number ofSegment4=0.088AP diameter+55.20

Figure 4.8 A scatter plot diagramme shows a linear relationship between the Antero-posterior abdominal fat thickness(mm) and CT Number(Hounsfield)For Liver Sigment(5) for the total Sample As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.108 starting fromCT number of Segment5=0.108AP diameter+54.16

Figure 4.9 A scatter plot diagramme shows a linear relationship between the Antero-posterior abdominal fat thickness(mm) and CT Number(Hounsfield)For Liver Segment(6) for the total Sample , As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.065 starting from CT number of Segment6=0.065AP diameter+53.06

Figure 4.10 A scatter plot diagramme shows a linear relationship between the Antero-posterior abdominal fat thickness(mm) and CT Number(Hounsfield)For Liver Sigment(7) for the total Sample , As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.002 starting fromCT number of Segment7=0.002AP diameter+52.10

Figure 4.11 A scatter plot diagramme shows a linear relationship between the Antero-posterior abdominal fat thickness(mm) and CT Number(Hounsfield)For Liver Sigment(8) for the total Sample , As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.135 starting fromCT number of Segment8=0.135AP diameter+52.81

Chapter five

Discussion ; Conclusion .

Recommendation

Chapter Five

: Discussion -5-1

The sample included both genders 20 were males and 30 .were females

The frequency and percentage were presented in table 1 .and figure 1

The patients data including their age,weight, antero-posterior diameter thickness were evaluated and .measured after axial CT cut were obtained

15 , weight 96±18 ,The mean value of their age were 51± antero-posterior fat thickness 19 ±7 for both gender the demographic values were compared between males and females , the males age were greater than females , but the weight and antero-posterior abdominal fat thickness were less comparing males with females with significant difference between the variables at PValue of 0.026 and 0.018 and 0.002 respectively ,these were presented in .tables 2 and 3

The liver fatty infiltration was evaluate including the 8 segment's of evaluation .this finding were significant to the study done by (Kakizaki e tal 2002) , that the relation between AP Abdominal distribution with the fatty

. component of liver

All segments were evaluated by measuring the CT number for all of them

And also the values were compared between the two genders , the difference between the males and females fatty component were found to be different significant between thems at PValue of 0.021 , 0.014 , 0.001 , 0.052 , 0.042 , 0.032 , 0.036 , 0.046 for CT number segement 1, 2 , 3 , 4, 5, 6, 7, 8 in respectively this was presented in . tables 4 and 5

The correlation between fatty infiltration which was evaluate by measuring the CT number for the 8 segements were studied with relation to sample weight , . sample age , AP abdominal fat thickness

The correlation was significant at PValue = 0.005 with all the variables of all the CT number of all segements , that mean the age and weight and AP abdominal fat thickness have an impact on the liver CT number values this was presented in table 6 , this finding were significant to the study done by (Kakizaki e tal 2002) , that the relation between AP Abdominal distribution with the fatty . component of liver

The data were correlated in form of figure and scatter . plottdiagram

Equation were established to describe the relation between the age and weight and AP abdominal fat .thickness

As The age increased The AP Fat thickness Decreased by 0.036 starting from 21.48 y=-0.036X+21.4

As The Weight increased The AP Fat thickness increased by 0.226 starting from y= 0.226X+2.115

The AP fat thickness has also an impact on the measured CT liver values at all segements , also equation were established to predict the CT number or density for patients with known AP abdominal fat thickness these : equation were

Segment1: As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.061 starting from CT number of Segment1=0.061AP diameter +52.40

Segment2: As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.159 starting fromCT number of Segment2=0.159AP diameter+47.89

Segment3: As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.103 starting from CT number of Segment3=0.103AP diameter+50.19

Segment4: As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.088 starting from CT number ofSegment4=0.088AP diameter+55.20

Segment5: As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by

0.108 starting fromCT number of Segment5=0.108AP diameter+54.16

Segment6 :As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.065 starting from CT number of Segment6=0.065AP diameter+53.06

Segment7: As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.002 starting fromCT number of Segment7=0.002AP diameter+52.10

Segment8: As The CT Number a linear relationship between the Antero-posterior abdominal fat thickness by 0.135 starting fromCT number of Segment8=0.135AP diameter+52.81

These were presented in the tables 4.4 , 4.5 , 4.6 , 4.7 , . 4.8 , 4.9 , 4.10 , 4.11

These equation are important to predict any changes .which may occur in the patients subjects liver CT number

:Conclusion-5-2

The current study aimed to study the liver of Sudanese
. patients by measuring the CT number

Correlations are Significant at P-Value= 0.005 for all of the values including segment's 1,2,3,4,5,6,7,8, with age ,
. weight and AP fat thickness

There were significant difference between both gender for
. the measured values

The equation were established to predict the CT number of the liver for the subjects with known AP abdominal fat
. thickness

:Recommendation 5-3

A. To use the Computer Tomography as noninvasive method to measure the changes in liver density and texture using houns field units.

B. To increase the sample size and select sample above 100 kg.

.References .

Appendices .

: References 5.4

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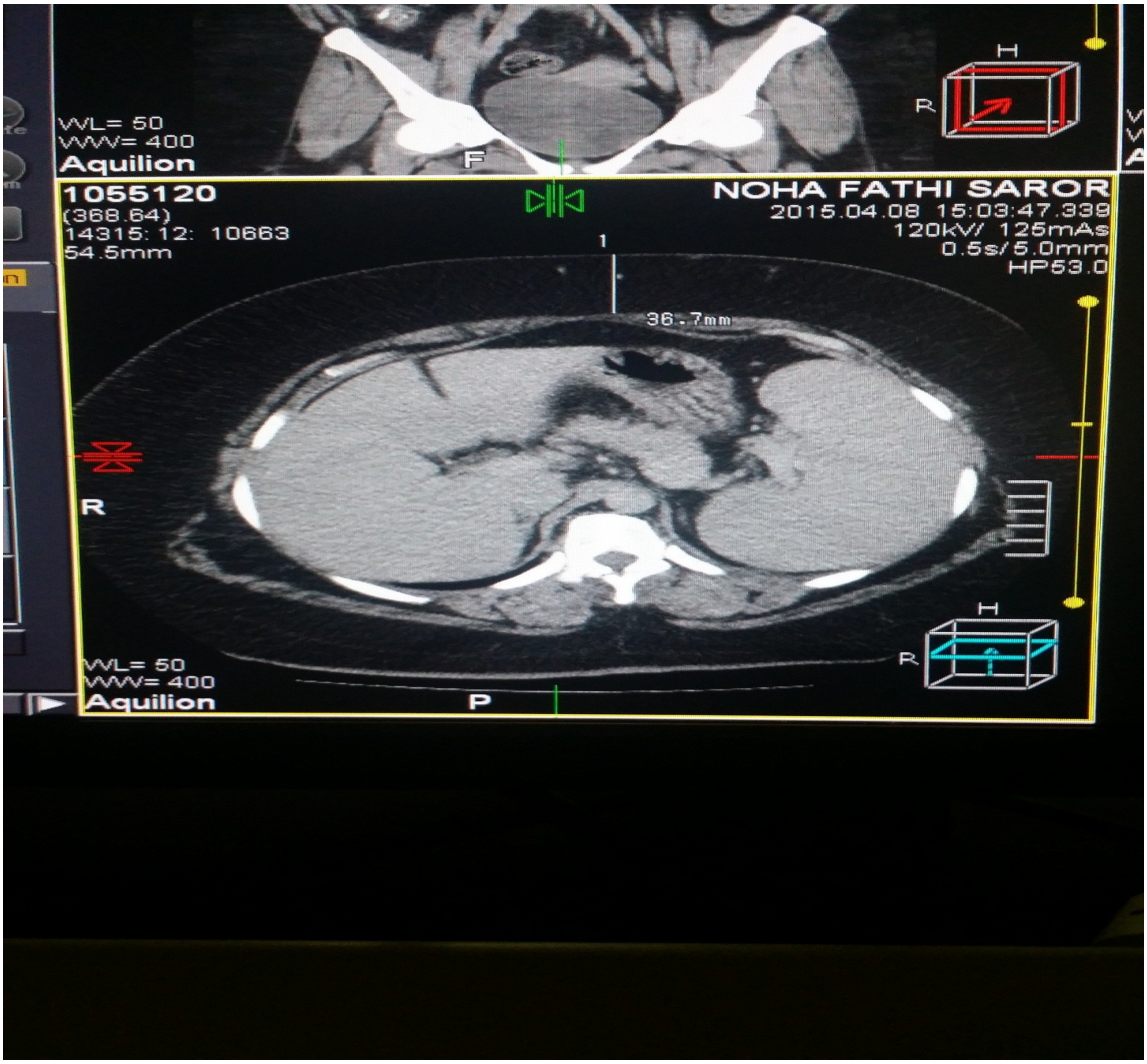
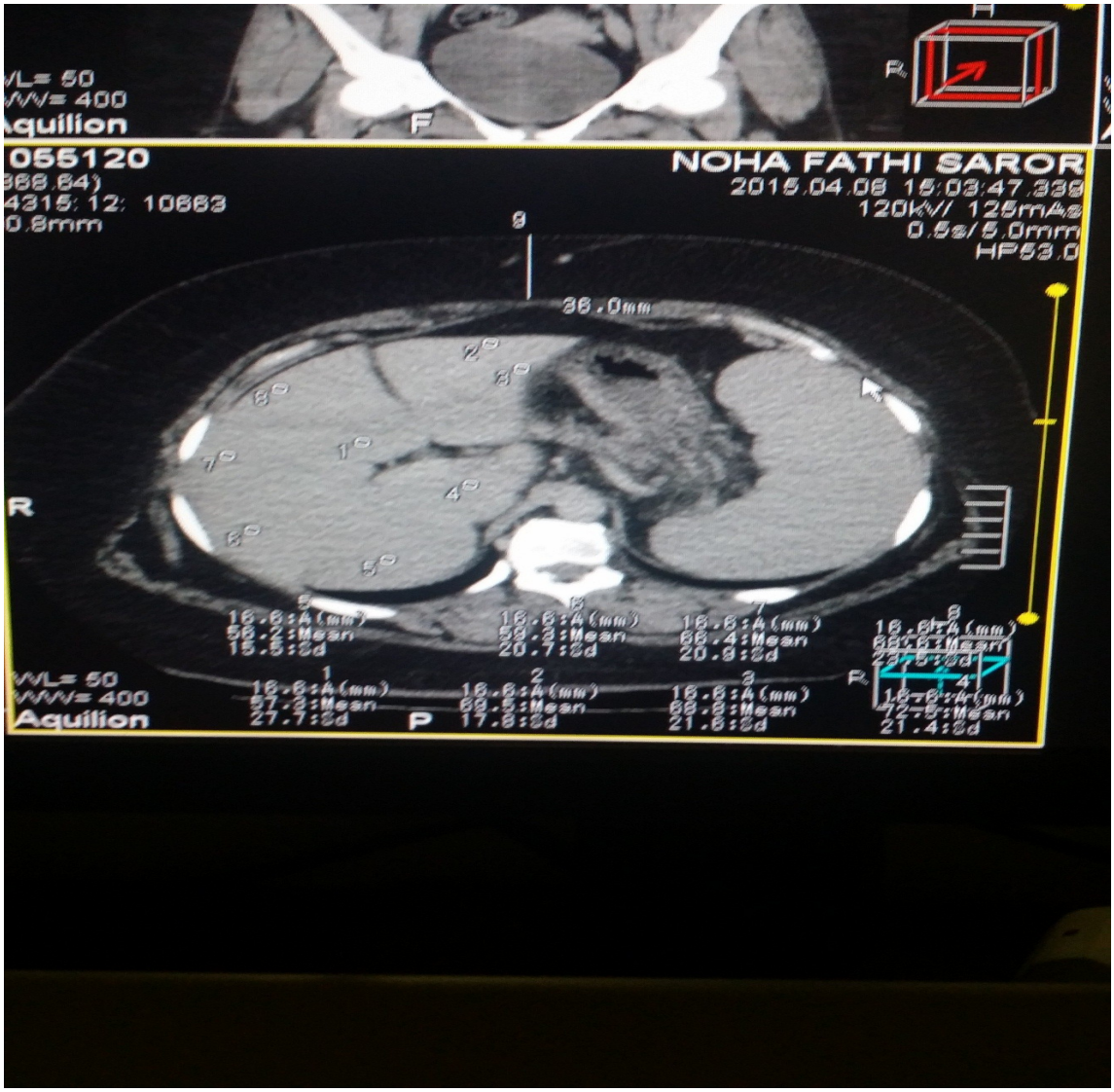
Appendices



Measuring AP fat value



Measuring CT number and AP fat value

(.Data sheet include (patient name, age, weight, gender

GENDER		WEIGHT	AGE	P/N	N/P
F	M				
					1
					2
					3
					4
					5
					6
					7
					8
					9
					10
					11

			12
			13
			14
			15
			16
			17
			18
			19
			20

Data sheet include (age , weight , gender , 8segements , (AP fat

	AP	8	7	6	5	4	3	2	1	Gender	Weight	Age	
													1
													2

3

4

5

6

7

8

9

10

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