Sudan University of science and technology

College of graduate studies

Study of Liver Diseases using Triphasic Computed Tomography Scan Protocol

دراسة أمراض الكبد باستخدام برتوكول الأشعة المقطعية ثلاثية الأطوار

A Thesis Submitted for Partial Fulfillment of M.Sc. Degree in

Diagnostic Medical Radiology

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الاية

(وَقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ وَرَسُولُهُ وَالْمُؤْمِنُونَ وَسَتُرَدُّونَ إِلَى عَالِمِ الْغَيْبِ وَالشَّهَادَةِ فَيُنَبِّئُكُمْ بِمَا كُنْتُمْ تَعْمَلُونَ)

صدق الله العظيم

سورة التوبة الآية (105)

Dedication

To My father

To My mother

To my sister

To my teacher and collogues

Acknowledgement

Firstly thank to Allah to give me health and strength to conduct this study.

For person who bring me to this life. For astrong and gentle soul with taught me to trust in Allah, believe in hard work and that so much could be done with little

For earning and honest living for us and for supporting and encouraging me to believe in myself.

I would like thanks to my supervisor and my teacher and colleague for help me in this work. There is no suitable word that I can express my feeling to my big family to support. Thanks for everyone assisted me to perform this research

Abstract

Background: this study was designed to study of liver diseases using triphasic computed tomographic scan protocol in Sudanese patient whom presents at computer tomography scan department in Kuwaiti specialized hospital when the liver is investigated using computed tomography machine (CT).

Methodology: 16 slice GE-Optima (2016) CT scanner was used to scan the 51 patient with liver disease, in period from April 2018 to august 2018 where the time and pattern of enhancement were assessed using stander triphsic protocols where the true angiographic phase was done using SMART prep option used. The data was initially summarization into mean. Stander deviation and percentage in a form comparison table and figure statically analysis was perform using Microsoft excel and stander statistical package for social sciences (SPSS).

Result: Out of 51 examined samples (mean age of 54 years male and female ratio (30) (86.8%) (21) (41.2%) were (16) (21.3%) of patients have hepatocellular carcinoma to liver between disease. the accurate time of three phases in exposure time was (8.13-19.6-8.2s) and delay time was (5.16-22.11-359s).

The Computed tomography enable detecting and characterization of liver diseases using the proper timing contrast and protocols.

الملخص

الخلفيه : تم تصميم هذه الدراسه بهدف دراسه امراض الكبد باستحدام الاشـــعه المقطعيـــه ثلاثيـــه الاطوار في المرضي السودانين في قسم الاشعه المقطعيه بمستشفى الكويتى التخصصي با ستخدام جهاز الاشعه المقطعيه

طريقه البحث : تم استحدام جنرال الكترلك بمعدل 16مقطع في الثانيه بمسح 51 مريض بامراض الكبد في الفتره بين ابريل 2018 الي اغسطس 2018 وتم تقييم الوقت وتحسين نمـــط باســـتخدام بورتوكول ثلاثي الاطوار حيث تم تصوير الاوعيه الحقيقيه باســـتخدام خيـــار الاعداديـــه الزكيـــه. المعلومات المتحصل عليها في هذه الدراسه تم تلخيصها فى شكل متوسطات انحرافـــات معياريـــه ونسب مئويه عرضت النتايج فى طاولات مقارنه وصور بيانيه والتحليـــل الاحصـــائى باســـتخدام برنامج الاكسل والحزم الاحصائيه القياسيه للعلوم الاجتماعي

النتايج : متوسط الاعمار فى المرضى هو 54سنه من جمله (51) مريض تم فحصه نسبه الرجـــال الى النساء (30)(86.8%) (21) (41.2%) . ونسبه المرضي المصابين بسرطان الكبد هـــو (16 21.3%) بين الامراض . والزمن المحدد فى ثلاثه اطوار فى زمن التعرض كانت (8.13 – 19.6–8.2 ثانيه) في زمن التاخير5.16 – 22.11 – 359).

الاشعه المقطعيه لفحص الكبد اظهرت قدرتها المتميزه فى تشخيص امراض الكبد باستخدام الوقـــت المحدد والبرتوكول.

List of content

List of figure

List of table

Chapter One

Chapter one

1-1 Introduction

CT offers the best spatial resolution and the ability to study the entire liver in a single breath-hold. It serves as an ideal screening examination for the entire abdomen and pelvis. Recent technological advances in CT technology, such as helical CT and multidetector row helical CT; have further improved the performance of CT scanners in terms of speed of acquisition, resolution, and the ability to image the liver during various phases of contrast enhancement more precisely than was possible previously. Advances in image post processing and reconstruction methods have enabled the acquisition of three-dimensional (3D) images of the liver vasculature (CT angiography) to map the liver vascular anatomy and to define the liver and tumor volume. Intravenous iodinated contrast media are routinely used in the imaging of the liver. They improve the contrast-to-noise ratio between focal liver lesions and normal liver and thus aid in the detection of focal liver lesions. They also help to characterize liver lesions, based on the enhancement patterns of liver lesions during various phases of contrast circulation in the liver. When performed properly, CT suffices for most clinical indications. Its limitations include the need for a high radiation dose and a low sensitivity for the detection and characterization of lesions smaller than 1 cm. Contrast-enhanced CT is contraindicated in patients with a history of anaphylaxis from contrast agents and renal failure. CT fluoroscopy is a new tool that assists in performing biopsies of liver lesions. Current multiline CT fluoroscopy systems allow real-time monitoring of the needle during biopsies and may increase the yield of biopsies and decrease the time required for performing a biopsy, with an acceptable radiation dose. (DushyantandShane2004.)

1-2 Problem of study

HCC is difficult to be detected using the ordinary phase, most of hospital using venous phase instead of Porto venous phase for routine abdominal scan rather than triphasicstudy, in which the contrast timing is important to assess and differentiate the different lesions. Incorrect time lead to miss some tumors to be detected, inaccuracy of conducting the proper scan also expose the patient to additional radiation without beneficial diagnostic accuracy.

1-3 Objective of the Study:

1-3-1General objective

The general objective of this study is to assess the liver disease by using Triphsic imaging protocol in accurate time

1-3-2Specific objective

- TO assess the enhancement characteristic in Triphsic CT scan performance in patient with suspect liver disease
- To show the time .volume and injection rate of contrast media
- To show the most of liver disease finding by using triphasic protocol
- To show the accurate time of exposure and delay time of contrast in three phases (arterial portovenouse and delay).
- To correlate between exposure time of arterial .portovenouse.delay and patient length and delay exposure time and portovenouse exposure time
- To correlate between contrast volume and patient weight
- To correlate between density of hepatic vein and number of hepatic vein

1-4 Significant of study

To facilitate for physiciandirect evolution and diagnostic tools will reaching quick and significant computed tomography of diagnostic hepatocellular carcinoma by using Triphsicprotocol.

1-5over View of Study

This thesis consist of five chapter .chapter one deals with introduction .objective.problem of study thesis out line .chapter two show the literature review .theory of study .previous of study .chapter three show methodology of study chapter four deals with this study chapter five including discussion .conclusion .recommendationreference appendix

Chapter Two

Chapter Two

2-1 Theoreticalbackground

2.1.1 Anatomy

The liver is 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 poster-inferior (or visceral) surface abuts against the abdominal esophagus, the stomach, duodenum; hepatic flexure of colon and the right kidney suprarenal, as well as carrying the gall-bladder. The liver is divided into a larger right and small left lobe, separated superiorly by the falciform ligament and poster-inferiorly by an H-shaped arrangement of fossae anteriorly and to the right the fossa for the gall-bladder; posteriorly and to the right the groove which the inferior vena cava lies embedded; anteriorly and to the left the fissure containing the ligament terse; posteriorly and to the left the fissure for the ligament venous. The cross-bar of the H is the portahepatis two subsidiary lobes are marked out on the visceral aspect of the liver between the limbs of this the quadrate lobe in front and the caudate lobe behind. The ligament tersest the obliterated remains of the left umbilical vein which, in uteri, brings blood from the placenta back into the fetus. The ligament Venuses the fibrous remnant of the fetal ducts venous 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 ligament terse, ligament venous and inferior vena cava, representing as they do the pathway of a fetal venous trunk, are continuous in the adult. See also fetal circulation page 38.Lying in the portahepatis (which is 2 in (5 cm) long)are: the common hepatic duct anteriorly; the hepatic artery in the middle; 3the portal vein posteriorly. As well as these, autonomic nerve fibers (sympathetic from the coeliac axis and parasympathetic from the vague), lymphatic vessels and lymph nodes are found there ,The liver is made up of lobules, each with a solitary central vein which is tributary of the hepatic vein which, in turn, drains into the

inferior vena cava. Inspaces between the lobules, termed portal canals, lie branches of the hepatic artery (bringing systemic blood) and the portal vein, both of which drain into the central vein by means of sinusoids traversing the lobule. Branches of the hepatic duct also lie in the portal canals and receive fine bile capillaries from the liver lobule (Harold ellis2006).

2-1-1-1 Segmental anatomy: The gross anatomical division of the liver into a right and left lobe, demarcated by a line passing from the attachment of the falciform ligament on the anterior surface to the fissures for the ligament terse and ligament venous on its posterior surface, is simply a gross anatomical descriptive term with no morphological significance. Studies of the distribution of the hepatic blood vessels and ducts have indicated that the true morphological and physiological division of the liver is into right and left lobes demarcated by a plane which passes through the fossa of the gall-bladder and the fossa of the inferior vena cava. Although these two lobes are not differentiated by any visible line on the dome of the liver, each has its own arterial and portal venous blood supply and separate biliary drainage. This morphological division lies to the right of the gross anatomical plane and in this the quadrate lobe comes to be part of the left morphological lobeof the liver while the caudate lobe divides partly to the left and partly to the right lob The right and left morphological lobes of the liver can be further subdivided into a number of segments, four for each lobe. The student need not learn the details of these, but of course to the hepatic surgeon, carrying out a partial resection of the liver, knowledge of these segments, with their individual blood supply and biliary drainage, is of great importance. At the hilum of the liver, the hepatic artery, portal vein and bile duct each divide into right and left branches and there is little or no anastomosis between the divisions on the two sides. From the region of the portalhepatic, the branches pass laterally and spread upwards and down (haroldellis 2006).

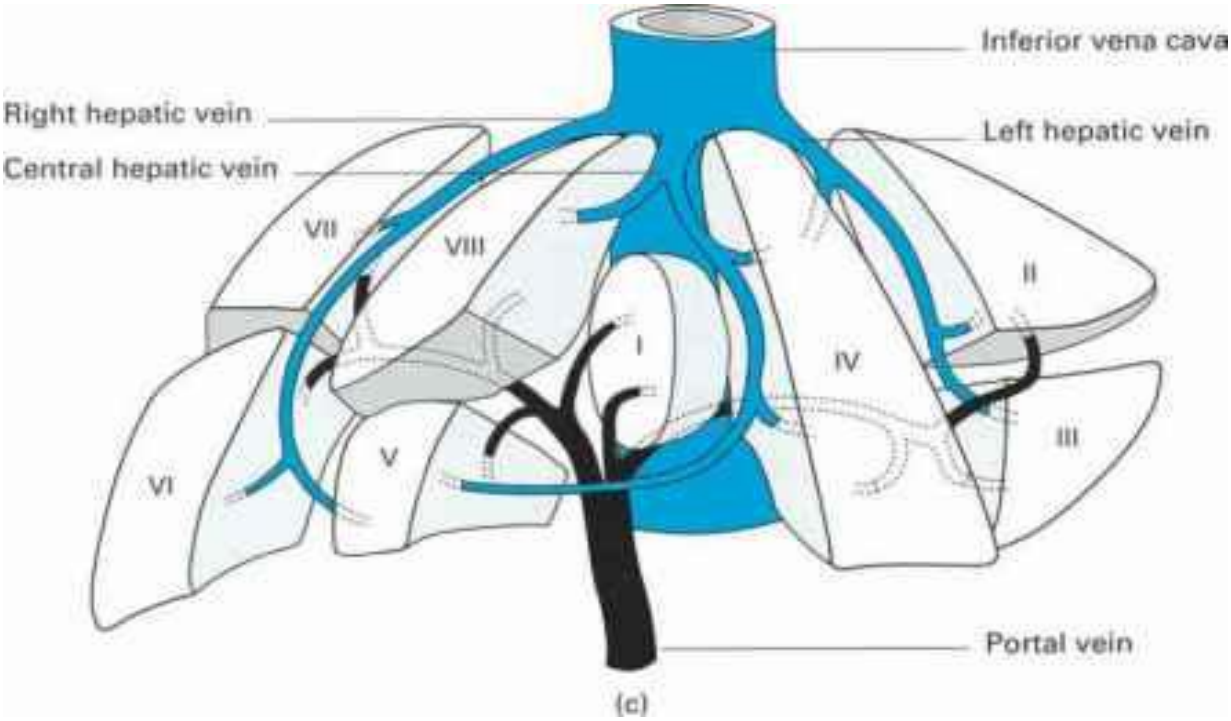

Fig (2.1) the morphological right and left lobes of the Liver shown separated by the dotted line: (a) anterior and (b) ventral aspect. Note that the quadrate lobe is morphologically a part of the left lobe while the caudate lobe belongs to both right and left lobes. (c) The further segmental divisions of the liver.(haroldellis 2006)

2-1-1-2PeritonealattachmentsThe 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 toform the right triangular ligamentthe falciform ligamentascends to the liver from the umbilicus, somewhatto the right of the midline and bear the ligament terse in its free border. The ligament terse 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 the upper end of the fissure for the ligament venous. The lesser omentum

arises from the fissures of the portalhepatic and the ligament venous and passes as a sheet to be attached along the lesser curvature of the stomach(haroldellis 2006).

2-1-1-3Hepatic veinsthese veins are massive and their distribution is somewhat different from that of the portal, hepatic arterial and bile duct systems already described. 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 lobotomy. 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 forth 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 (haroldellis 2006).

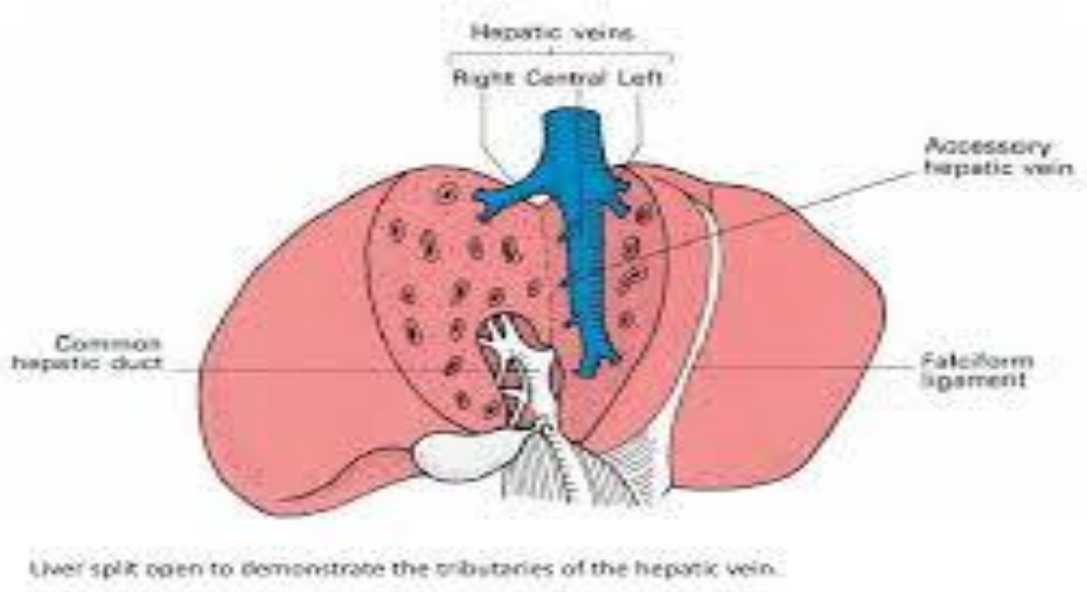

Fig (2.2) the morphological show the hepatic vein (haroldellis 2006)

2-1-1-4Portal hepatic veinThe portal venous system drains blood to the liver from the abdominal part of the alimentary canal (excluding the anal canal), the spleen, the pancreas and the gall-bladder and its ducts. The distal tributaries of this system correspond to, and accompany, the branches of the celiac and the superior and inferior mesenteric arteries enumerated above; only proximally does the arrangement differ the inferior mesenteric vein ascends above the point of origin of its artery to enter the splenic vein behind the pancreas. The superior mesenteric vein joins the splenic vein behind the neck of the pancreas in the Trans pyloric plane to form the portal vein which ascends behind the first part of the duodenum into the anterior wall of the foramen of Winslow and thence to the portahepatis. Here the portal vein divides into right and left branches and breaks up into capillaries running between the lobules of the liver. These capillaries drain into the radicals of the hepatic vein through which they empty into the inferior vena cava. (haroldellis 2006)

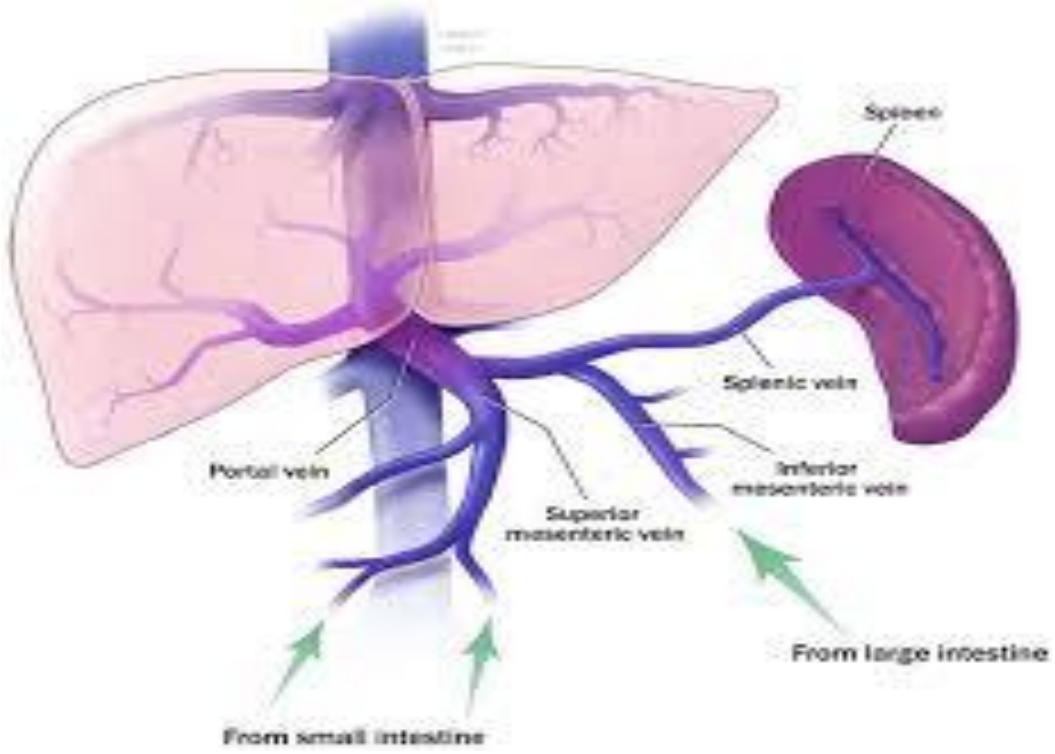

FIG (2.3) the morphological show the portal system(clinical liver disses 2013)

2-1-1-5 **Vasculature**The liver is unusual in that it has dual blood supply .receiving arterial blood (20_25%) from the common hepatic artery and nutrient rich venous blood (75-80%) from the portal vein **.**The common hepatic artery usually arises as one of the three branches off the celiac artery coursing to the right to enter the lesser omentum anterior to the portal vein .it branches into the gastric and gastro duodenal arteries just above the duodenum and continues in the hepatic duodenal ligament as the proper hepatic artery (hiatt 1994)

2-1-2 Physiology of the Liver:

2-1-2-1 ***Digestion:***The liver plays an active role in the process of digestion through the production of *bile*. Bile is a mixture of water, bile salts, cholesterol, and the pigment bilirubin. Hepatocytes in the liver produce bile, which then passes through the bile ducts to be stored in the gallbladder. When food containing fats reaches the duodenum, the cells of the duodenum release the hormone cholecystokinin to stimulate the gallbladder to release bile. Bile travels through the bile ducts and is released into the duodenum where it emulsifies large masses of fat. The emulsification of fats by bile turns the large clumps of fat into smaller pieces that have more surface area and are therefore easier for the body to digest. Bilirubin present in bile is a product of the liver's digestion of worn out red blood cells. Buffer cells in the liver catch and destroy old, worn out red blood cells and pass their components on to hepatocytes. Hepatocytes metabolize hemoglobin, the red oxygen-carrying pigment of red blood cells, into the components heme and goblin. Globin protein is further broken down and used as an energy source for the body. The iron-containing hemi group cannot be recycled by the body and is converted into the pigment bilirubin and added to bile to be excreted from the body. Bilirubin gives bile its distinctive greenish color. Intestinal bacteria further convert bilirubin into the brown pigment stercobilin, which gives feces their brown color. (human anatomy and physiology of liver 2013)

2-1-2-2*Metabolism:* The hepatocytes of the liver are tasked with many of the important metabolic jobs that support the cells of the body. Because all of the blood leaving the digestive system passes through the hepatic portal vein, the liver is responsible for metabolizing carbohydrate, lipids, and proteins into biologically useful materials. Our digestive system breaks down carbohydrates into the monosaccharide glucose, which cells use as a primary energy source. Blood entering the liver through the hepatic portal vein is extremely rich in glucose from digested food. Hepatocytes absorb much of this

glucose and store it as the macromolecule glycogen, a branched polysaccharide that allows the hepatocytes to pack away large amounts of glucose and quickly release glucose between meals. The absorption and release of glucose by the hepatocytes helps to maintain homeostasis and protects the rest of the body from dangerous spikes and drops in the blood glucose level. (See more about glucose in the body.) Fatty acids in the blood passing through the liver are absorbed by hepatocytes and metabolized to produce energy in the form of ATP. Glycerol, another lipid component, is converted into glucose by hepatocytes through the process of gluconeogenesis. Hepatocytes can also produce lipids like cholesterol, phospholipids, and lipoproteins that are used by other cells throughout the body. Much of the cholesterol produced by hepatocytes gets excreted from the body as a component of bile. Dietary proteins are broken down into their component amino acids by the digestive system before being passed on to the hepatic portal vein. Amino acids entering the liver require metabolic processing before they can be used as an energy source. Hepatocytes first remove the amine groups of the amino acids and convert them into ammonia and eventually urea. Urea is less toxic than ammonia and can be excreted in urine as a waste product of digestion. The remaining parts of the amino acids can be broken down into ATP or converted into new glucose molecules through the process of gluconeogenesis.(Human anatomy and physiology of liver 2013)

2-1-2 -3*Detoxification:* As blood from the digestive organs passes through the hepatic portal circulation, the hepatocytes of the liver monitor the contents of the blood and remove many potentially toxic substances before they can reach the rest of the body. Enzymes in hepatocytes metabolize many of these toxins such as alcohol and drugs into their inactive metabolites. And in order to keep hormone levels within homeostatic limits, the liver also metabolizes and removes from circulation hormones produced by the body's own glands.(human anatomy and physiology of liver 2013)

2-1-2-4*Storage*the liver provides storage of many essential nutrients, vitamins, and minerals obtained from blood passing through the hepatic portal system. Glucose is transported into hepatocytes under the influence of the hormone insulin and stored as the polysaccharide glycogen. Hepatocytes also absorb and store fatty acids from digested triglycerides. The storage of these nutrients allows the liver to maintain the homeostasis of blood glucose. Our liver also stores vitamins and minerals- such as vitamins A, D, E, K, and B12, and the minerals iron and copper - in order to provide a constant supply of these essential substances to the tissues of the body.(human anatomy and physiology of liver 2013)

2-1-2-5 *Production*: The liver is responsible for the production of several vital protein components of blood plasma: prothrombin, fibrinogen, and albumins. Prothrombin and fibrinogen proteins are coagulation factors involved in the formation of blood clots. Albumins are proteins that maintain the isotonic environment of the blood so that cells of the body do not gain or lose water in the presence of body fluids.(human anatomy and physiology of liver 2013)

2-1-2-6 *Immunity* The liver functions as an organ of the immune system through the function of the Buffer cells that line the sinusoids. Buffer cells are a type of fixed macrophage that form part of the mononuclear phagocyte system along with macrophages in the spleen andlymph nodes. Buffer cells play an important role by capturing and digesting bacteria, fungi, parasites, worn-out blood cells, and cellular debris. The large volume of blood passing through the hepatic portal system and the liver allows Buffer cells to clean large volumes of blood very quickly.(human anatomy and physiology of liver 2013).

2-1-3 CT liver appearance

The liver appears homogeneous on non-contrast computed tomography (CT) with attenuation values of 55–65 HU, approximately 8 HU greater than the spleen. The vascular structures of the liver, the common bile, common hepatic, and right and left hepatic ducts are easily identified on contrast-enhanced CT, while the peripheralintrahepatic ducts are not. Multiphase, multidetector (MDCT) scan is commonly used to assess the liver and characterize liver lesions. This technique typically includes an arterial-dominant phase at 10–30 s post contrast injection, a portal or venous phase at 60–90 spost contrast injection, and a delayed phase at 5–10 min post contrast injection. Anunenhancedscan is optional and not routinely performed at all centers. The minimum requirement is an arterial phase and a portal/venous phase; however, the delayed phase is of great value in the characterization some benign and malignant lesions (e.g., hemangioma and cholangiocarcinoma).Optimizing the protocols and timing of these phases are important to maximize lesion-to-liver contrast. For this purpose, method known as automatic bolus tracking issued to time the arterial phase; scanning is triggered the celiac axis or hepatic artery. This technique gives more consistent results and accounts for the variation in cardiac output and intravascular volumeCone beam CT is basically a CT scan performed with catheter injection into the hepatic artery in the angiography suite to detect subtle liver lesions or to guide treatment used mainly in oncology liver directed therapies such as trans arterial Chemoembolize(Ali A. Haydar2017)**.**

2-1-4 Pathology

2-1-4-1 ***Hepatocellular carcinoma (HCC)*** is the most common type of primary liver cancer. Hepatocellular carcinoma occurs most often in people with chronic liver diseases; such as cirrhosis caused by hepatitis B or hepatitis C infection Hepatocellular carcinoma (HCC) is the most common primary malignant neoplasm of the liver. Liver cirrhosis of any etiology is a major predisposing factor for development of HCC.HCC can be solitary, multifocal, or diffuse. The five-year survival of patients with HCC is approximately 30%. There are several types of liver cancer based on the type of cells that becomes cancerous. Hepatocellular carcinoma (HCC), also called hematoma, HCC is the most common type of liver cancer accounting for approximately 75 percent of all liver cancers. HCC starts in the main type of liver cells, called hepatocellular cells. Most cases of HCC are the result of infection with hepatitis B or C, or cirrhosis of the liver caused by alcoholism. Fibro lamellar HCC is a rare type of HCC that is typically more responsive to treatment than other types of liver cancer. Fibro lamellar carcinoma is a rare sub type of hepatocellular cancer (HCC). Fibro refers to fibrous tissue and lamellar refers to the plate like structure of the cells. Fibro lamellar carcinoma tends to develop in younger people, and is not usually linked with cirrhosis or infection with hepatitis B or C. The other main difference is that people with fibro lamellar carcinomas do not usually have higher levels of the protein alpha fetoprotein (AFP) in their blood. Like HCC, surgery is the main treatment. If it can be removed with surgery, fibro lamellar carcinoma may have a better outlook than HCC. Cholangiocarcinoma (bile duct cancer) occurs in the small, tube-like bile ducts within the liver that carry bile to the gallbladder. Cholangiocarcinoma account for 10-20 percent of all liver cancers. Intrahepatic bile duct cancer begins in ducts within the liver. Extra hepatic bile duct cancer develops in ducts outside of the liver.Angiosarcoma also called hemangiocarcinoma, accounts for about 1 percent of all liver cancers. Angiosarcoma begins in the blood vessels of the liver and grows quickly. They are

typically diagnosed at an advanced stage.Secondaryliver cancer, also known as a liver metastasis, develops when primary cancer from another part of the body spreads to the liver. Most liver metastases originate from colon or colorectal cancer. More than half of people diagnosed with colorectal cancer develop secondary liver cancer .(Liver cancer2017)

Hepatocellular carcinoma represents the fifth most common cancer worldwide and account for 90% of primary liver cancer .men have higher prevalence than women .the sex ratio varies between 2:1 and 4:1 gender difference in patient with hepatocellular.(hefaiedh 2013).

2-1-4-2 CT Hepatocellular Carcinoma appearance: HCC is the most common primary malignancy of the liver. HCC can be focal, multifocal, or diffuse. On unenhanced CT, HCCs are well defined and appear hypo dense to liver. In diffuse liver disease, the lesions may not be seen on unenhanced CT. These lesions are actively enhancing on arterial study and appear hypedense to liver. On portal venous phase images, they appear hypodense to liver. When a capsule is present, it is usually hypodense on hepatic arterial phase images, is of mixed density on portal venous phase images, and shows enhancement on delayed phase images. CT helps detect tumor extension into the portal vein or hepatic veins and the presence of biliary obstruction, regional nodes, and peritoneal implants .It is difficult to differentiate tumor thrombi from bland thrombi; however, enhancing thrombi favor tumor thrombi. CT is also useful in guiding percutaneous biopsy and follow-up after surgery or radiofrequency ablation for detecting recurrence. (DushyantandShane, 2004.)

2-1-5 ComputerTomographies:

2-1-5-1 Computed tomography uses a computer to process information collected from the passage of x-ray beams through an area of anatomy. The images created are cross-sectional. To visualize CT, the often-used loaf of bread analogy is useful. If the patient's body is imagined to be a loaf of bread, each CT slices correlates to a slice of the bread. The crust of the bread is analogous to the skin of the patient's body; the white portion of the bread, the patient's internal organs The word tomography has as its root tom meaning to cut, section, or layer from the Greek tomes(a cutting). In the case of CT, a sophisticated computerized method is used to obtain data and transform them into "cuts," or cross-sectional slices of the human body.In CT, we are better able to quantify the beam attenuation capability of a given object Measurements are expressed in Hounsfield units (HU), named after Godfrey Hounsfield, one of the pioneers in the development of CT. These units are also referred to as CT numbers, or density Value **(** lois.e.romans.2011).

2-1-5-2ct system operation Scanners vary widely in their mechanical makeup, and the ideal configuration and composition of detectors and tube are hotly debated topics within the industry. Each manufacturer claims that its scanner design is the best. Unfortunately, it is impossible to state unequivocally which set of design factors produces the best overall CT scanner. Fortunately, it is not essential that a technologist understand the precise makeup of each type of scanner available to perform high-quality studies. This section provides basic understandings of how a CT image is created-ray photons are created when fast-moving electrons slam into a metal target. The kinetic energy (the energy of motion) of the electrons is transformed into electromagnetic X-rays are produced when a substance is bombarded by fast-moving electrons. In a CT system, the components that produce x-ray beams are housed in the gantry. The x-ray tube contains fi laments that provide the electrons that create x-ray photons. This is

accomplished by heating the filament until electrons start to boil off, hovering around the filament in what is known as a space cloud. The generator produces high voltage (or kV) and transmits it to the x-ray tube. This high voltage propels the electrons from the x-ray tube fi lament to the anode. The area of the anode where the electrons strike and the x-ray beam is produced is the focal spot. The quantity of electrons propelled is controlled by the tube current and is measured in thousandths of an ampere, mill amperes (mA). The electrons then strike the rotating anode target and disarrange the electrons in the target material. The result is the production of heat and x-ray photons. The vast majority (generally more than 99%) of the kinetic energy of the projectile electrons is converted to thermal energy. To spread the heat over a larger area, the target rotates. Increasing the voltage increases the energy with which the electrons strike the target and, hence, increases the intensity of the x-ray beam. The intensity of the x-ray beam is controlled by the KVp setting.(lois.e.romans.2011).

2-1-5-3 Dataacquisitions scanners are complex, with many different components involved in the process of creating an image (lois.e.romans.2011).

2-1-5-4Gantry The gantry is the ring-shaped part of the CT scanner. It houses many of the components necessary to produce and detect x-rays. Components are mounted on a rotating scan frame. Gantries vary in total size as well as in the diameter of the opening, or aperture. The range of aperture size is typically 70 to 90 cm. The CT gantry can be tilted either forward or backward as needed to accommodate variety of patients and examination protocols. The degree of tilt varies among systems, but ±15° to ±30° is usual. The gantry also includes a laser light that is used to position the patient within the scanner. Control panels located on either side of the gantry opening allow the technologist to control the alignment lights, gantry tilt, and table movement. In most scanners, these functions may also be controlled via the operator's console. A

microphone is embedded in the gantry to allow communication between the patient and the technologist throughout the scan procedure.(lois.e.romans.2011).

2-1-5-5 Filtration Compensating filters are used to shape the x-ray beam. They reduce the radiation dose to the patient and help to minimize image artifact (lois.e.romans.2011).

2-1-5-6 Generator High-frequency generators are currently used in CT. They are small enough so that they can be located within the gantry. Highly stable three-phase generators have also been used, but because these are stand-alone units located near the gantry and require cables, they have become obsolete.(lois.e.romans.2011).

2-1-5-7 Collimation Collimators restrict the x-ray beam to a specific area, thereby reducing scatter radiation. Scatter radiation reduces image quality and increases the radiation dose to the patient. Reducing the scatter improves contrast resolution and decreases patient dose. Collimators control the slice thickness by narrowing or widening the x-ray beam(lois.e.romans.2011).

2-1-5-8 X-ray SourceX-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. This is because the intensity of x-ray production is approximately proportional to the atomic number of the target material. CT tubes often contain more than one size of focal spot; 0.5 and 1.0 mm are common sizes.(lois.e.romans.2011).

2-1-5-9 Detectors 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 conventional radiography we used a fi lm-screen system to record the attenuation information. In CT, we use detectors to collect the information. The term detector refers to a single element or a single type of

detector used in a CT system. The term detector array is used to describe the entire collection of detectors included in a CT system.(lois.e.romans.2011).

2-1-5-10Image displayafter the CT images has been reconstructed it exits the computer in digit form this must be converted to form that's suitable for viewing and meaningful to the observer. In CT the digital reconstructed rage is converted into a gray scale image for interpretation by the radiologist (lois.e.romans.2011).

2-1-6 other modalities Image of Liver

2-1-6-1 Ultrasound Ultrasound is safe and painless, and produces pictures of the inside of the body using sound waves. Ultrasound imaging, also called ultrasound scanning or Sonographer, involves the use of a small transducer (probe) and ultrasound gel placed directly on the skin. High-frequency sound waves are transmitted from the probe through the gel into the body. The transducer collects the sounds that bounce back and a computer then uses those sound waves to create an image. Ultrasound examinations do not use ionizing radiation (as used in x-rays), thus there is no radiation exposure to the patient. Because ultrasound images are captured in real-time, they can show the structure and movement of the body's internal organs, as well as blood flowing through blood vessels. Ultrasound imaging is a noninvasive medical test that helps physicians diagnose and treat medical conditions. An abdominal ultrasound produces a picture of the organs and other structures in the upper abdomen. A Doppler ultrasound study may be part of an abdominal ultrasound examination.Doppler, also called color Doppler ultrasonography, is a special ultrasound technique that allows the physician to see and evaluate blood flow through arteries and veins in the abdomen, arms, legs, neck and/or brain (in infants and children) or within various body organs such as the liver or kidneys(radiological society of north American 2018)

2-1-6-2 Magnetic Resonance ImagingMRI has emerged as the best imaging test for liver lesion detection and characterization, because this modality provides high lesion-to-liver contrast and does not use ionizing radiation. Recent advances in MRI, including breath-hold 3D imaging and rapid half-Fourier acquisition, help image the liver in a single breath-hold with a high spatial resolution. In addition, chemical shift imaging is very useful to differentiate pseudo lesions, such as focal fatty infiltrations and focal fatty springs, from pathologic liver lesions Various contrast agents are available to image the liver Gadolinium diethylenetramlinepentacetic acid (DTPA), On T1-weighted MRI, these lesions usually appear hypo intense to liver and are moderately hyper intense on T2-weighted images; however, their appearances may be variable(Dushyant and Shane2004.)

2-1-6-3 Nuclear medicine a liver scan is a type of nuclear medicineprocedure. This means that a tiny amount of a radioactive substance is used during the procedure to assist in the examination of the liver. The radioactive substance, called a radiopharmaceutical or radioactive tracer, is formed by the addition of a radioactive atom (radionuclide) to a molecule absorbed by normal liver tissue. The remainder of the radioactive substance is absorbed by the spleen and bone marrow. The radionuclide used in liver scans is usually a form of 99mTechnetium-sulfur colloid. Once absorbed into the liver tissue, the radionuclide emits a type of radiation, called gamma radiation. The gamma radiation is detected by a scanner, which processes the information into a picture of the liver.(Johns Hopkins 2011)

Hepatic imaging is usually undertaken to search for primary or metastatic liver disease. CT is the initial diagnostic test for most indications due to its versatility, availability, high sensitivity and specificity, and the fact that it surveys the entire abdomen for potential metastatic disease in the lymph nodes and peritoneum. MRI is superior to CT in lesion detection and characterization and should be used in cases in which CT is equivocal or noncontributory. PET is useful in evaluating the entire body for potential metastatic

spread; however, its high cost and lack of availability make it a poor choice.(Dushyant and Shane2004.

2-1-9 previous studies

(Lee et al. (2004)) his main purpose of his study was to describe the appearances of hepatocellular carcinoma including intraregional contrast washout using a triple-phase liver protocol on an MDCT scanner. Fifty-one patients with newly diagnosed hepatocellular carcinoma underwent standardized triple-phase CT using a multidetector scanner..the result of Correlation between tumor size and appearance was analyzed. The most common enhancement pattern for hepatocellular carcinoma was hypervascularity on hepatic arterial phase images with a mosaic pattern on both arterial and portal venous images; this finding was seen in 86% and 78% of lesions by the two observers, respectively. A hypervascularcomponent was seen in 96% of lesions by both observers, and the observers recorded 86% and 63% of lesions as showing washout, the conclusion the prevalence of hypervascular hepatocellular carcinoma on MDCTimages is higher than previously described on single-detector helical images and most lesionsshowed washout on portal venous MDCT images.

(Kagawa Y[1], Okada M, Yogi Y, Kumano S, Kanematsu M, Kudos M, Murakami T 2013) his main purpose to his study to describeOptimal scan timing of hepatic arterial-phase imaging of hypervascular hepatocellular carcinoma determined by multiphasic fast CT imaging technique. One hundred and one hypervascular HCCs in 50 patients were prospectively studied by 64-channel multidetector-row computed tomography (MDCT) with multiphasic fast imaging technique. By injected contrast media containing 600 mg iodine per kg body weight intravenously for 30 s. Six seconds after the contrast arrival in the abdominal aorta detected with bolus tracking, By placing regions of interest in the abdominal aorta, portal vein, liver parenchyma, and hyper vascular Timing of maximum

tumor-to-liver contrast after the contrast arrival in the abdominal aorta was determined. The result mean time and value of maximum tumor-to-liver contrast after the contrast arrival were 21 s and 38.0 HU, respectively. The conclude Optimal delay time for the hepatic arterial-phase imaging maximizing the contrast enhancement of hypervascular HCCs was 21 s after arrival of contrast medium in the abdominal aorta.

(AJR Am J Roentgen. 2008 Sep) his main purpose to his study to describeOptimal arterial phase imaging for detection of hypervascular hepatocellular carcinoma determined by continuous image capture on 16-MDCT. to estimate the optimal time delay before the initiation of arterial phase scanning for detection ofhyper vascular hepatocellular carcinoma (HCC) on 16-MDCT when a rapid bolus injection of contrast medium is administered25 patients with pathologically confirmed HCC were included. 16-MDCT imaging was performed in using 70 mL of nonionic iodinated contrast medium (300 mg I/mL) at an injection rate of 7 mL/s. 5-mm-thick slices at the maximum diameter of the HCC were selected as the region of interest. Time-attenuation curves were generated by region of interest drawn on the aorta, tumor, and liver. Qualitative assessments of conspicuity for contrast medium wash-in, peak, and wash-out of aorta and tumor were performed. The conclusion: When using 70 mL of 300 mg I/mL of contrast medium with an injection rate of 7 mL/s in 16-MDCT scanning, the optimal time to initiate scanning for HCC is 26.3 +/- 2.9 seconds (range, 24.0-34.5 seconds) after contrast medium administration

(Kanematsu M, Goshima S, Kondo H, Nishibori H, Kato H, Yokoyama R, Miyoshi T, Hoshi H, Onozuka M, Moriyama N.r. 2005).His main purpose to his study to describeOptimizing scan delays of fixed duration contrast injection in contrast-enhanced biphasic multidetector-row CT for the liver and the detection of hypervascular hepatocellular carcinoma**.** To determine the optimal scan delay required for fixed duration contrast injection in contrast-enhanced biphasic multidetector-row CT for the

liver and the detection of hypervascular hepatocellular carcinoma (HCC). CT images (2.5-mm collimation, 5-mm thickness with no intersectional gap) were obtained after an intravenous bolus injection of 2 mL/kg of nonionic iodine contrast material (300 mg I/mL) for a fixed 30-second injection in 206 patientsTheconclutionFor the detection of hypervascular HCCs, the optimal scan delay after a 30-second contrast injection of the hepatic arterial phase, was found to range from 5 to 10 seconds, and that of the portal venous phase was 35 seconds or somewhat long

--Almutasim 2001 (role of u/s vsctin diagnostic hepatic focal lesion)He found that the most common type of focal liver lesion is hepatic cellular carcinoma and showed in arterial phase inhomogeneous enhancing mass with focal area of necrosis and recommended that it's important to use high injection rates and appropriate bolus timing .spirals scan should be delayed 30-50 sec after injection of contrast media for great enhancement of liver for the coming studies should increase sample size and correlate focal liver lesion with age .habits and pt condition .future studies should compare the amount of contrast and rate of injection with degree of enhancement of lesion

-jihad hammedgadAlmoula 2016 (evolution of liver tumor using triphasic spiral computed tomography)

She found that the triphsic spiral computed tomography is the golden stander examination used to evaluated the liver tumor (malignant _benign)that's because it gives us pathology at different phases (arterial .port venous .delay)appearance enhancement by time (homogenous and heterogeneous)and the vascularity of tumor (speed wash in and wash out)reconstruction imaged should be 2 mm interval. Recommended that Spiral ct scan used with stander protocol for evolution tumor because it gives clearly image of normal liver parenchyma and any pathology effect it contrast media should given by its significant doses .scan delay should be 35 sec after injection for more enhancement .for better result ministry of health must provider better and update edct scan

Chapter Three

Chapter three

3-1 (Materials and method)

3-1 Materials

3-1-1 PATIENT The data has been collected from Kuwaiti specialist hospital in period from April 2018 to august 2018 .the study include Sudanese population .50 patient female and male their ages between (30 – 90)year all patient done triphsic scan protocol

3-1-1Machine All patients were scanned using a16-detector row CT machine (general electoral (GE) using same scanning parameters as follows: tube voltage, 120 kV; tube current, 250 MAS As; rotation time, 0.358 s; field of view, 400 mm; reconstruction interval,3 mm; slice thickness, 5 mm.and automatic injector .control console

3-2Method

3-2-1patient preparation Asses the clinical problem and medical history includes the indication of the study .contrast allergies .renal impairment etc

3--2-2CONTARST MEDIA we use the oral contrast negative (neutral) and positive contrast .and nonionic intravenous contrast media the injection rate was 5cc/sec through an 18 gauge the Total amount of contrast iswhich automatically calculates the contrast medium dose based on the weight of each patient by using weight factor dosing method calculated from the following formula: Contrast volume (ml) =patient weight *1.5

3--2-3 technique Scan area from the lower border of diaphragm to symphysis pubic .patient lays supine .feet first .rise hands above head. Scan is performed during normal inspiration .gantry angle zero .10 mm slice thickness are selected through the entire abdomen. All patients underwent both unenhanced and enhanced CT scans during hepatic arterial phase (HAP) and portal venous phase (PVP). According touring HAP and PVP in the present study started at 35 s and65 s, respectively, after the contrast injection, from the level of diaphragm to inferior hepatic edge. The patients receive the same contrast medium with omnipaque concentration of 300 mgI / mL injected at a flow rate of 5 mL.

3--2-4 PHASE arterial phase conducted at (30_35sec) after contrast injection and port venous(late arterial after (50_60 sec) after bolus tracking and delayafter (5 _10min) after contrast inject using SMART PREP to get the optimum HU from the ROI the arterial phase is taken after 5.2s after 100HU then the mean exposure time used to scan the liver from lower chest to the iliac crest, is 8.13s and the mean for PV phase to scan the whole abdomen and pelvis is 19.6s where the optimization of the time to reach the 55 sec (optimum time for PV) is achieved when adding the delay time for arterial phase to the exposure time of arterial phase to the exposure time of the PV phase minus 55s, showing the mean delayed time of PV equal to 22.11s then adding all the above mentioned time to the exposure time of delayed phase together to 350s in order to obtain the time of 6-10 min after contrast injection.

3--2-5 interpretation All cases of abdomen Triphsic are reported by Dr /hozifaHassanbairam M.D RADIOLOGST

3--2-6 Data presentation Data will be presented in table and figure while include gender (male .female) .age, weight.Length. Contrast volume. Type of oral contrast .arterial exposure time, port venous exposure time .delay exposure time .Arterial delay time .Porto venous delay time .delay delay time .number of hepatic and port venous branches .density of hepatic and port venous branches .finding of diseases

3--2-7data analysis Finally this data was tabulated described and analyzed using spss to manage the accurate timing of contrast

Chapter Four

Chapter four

RESULT

Table(4.1)show statistical parameters for the age .weight. Length to all patients

Variables	Min	Max	Mean	Std. D
Age	30.0	86.0	54.098	12.9325
Weight	18.0	98.0	65.922	13.2964
Length	140.0	198.0	163.627	12.8109

Table(4.2)show statistical parameters for the(arterial. port venous. delay) exposure time and contrast volume to all patient

Variables	Min	Max	Mean	Std. D
Arterial exposure time	5.5	10.9	8.13	1.2
Portal venous exposure time	12	24.5	19.6	2.6
Delay exposure time	4.8	12.3	8.2	1.3
Contrast volume	75.0	144.0	92.7	12.9

Table(4.3)show statistical parameters for the(arterial .Porto venous .delay) delay time and density of portal and hepatic vein to all patient

Variables	Min	Max	Mean	Std. D
DART	4.3	6.7	5.165	0.4655
DPVT	14.0	24.0	22.11	2.3309
DTD	330.0	370.0	359.412	10.6605
DPV	0.0	411.0	164.353	57.2635
D h vien	0.0	396.0	136.686	81.0381

Table (4-4) show frequency distribution for sex

Sex	Frequency	Percent
Male	30	58.8
Female	21	41.2
Total	51	100.0

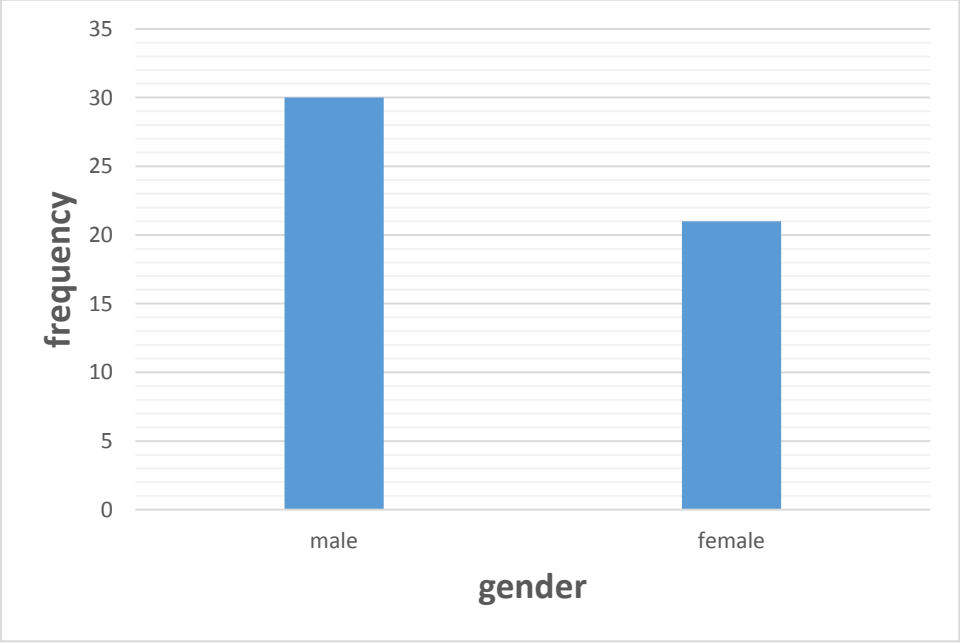

Fig (4.4) show frequency distribution for sex

Table (4.5)show frequency distribution for type of contrast

Type of oral Contrast	Frequency	Percent
Negative(neutral)	49	96.1
positive	2	3.9
Total	51	100.0

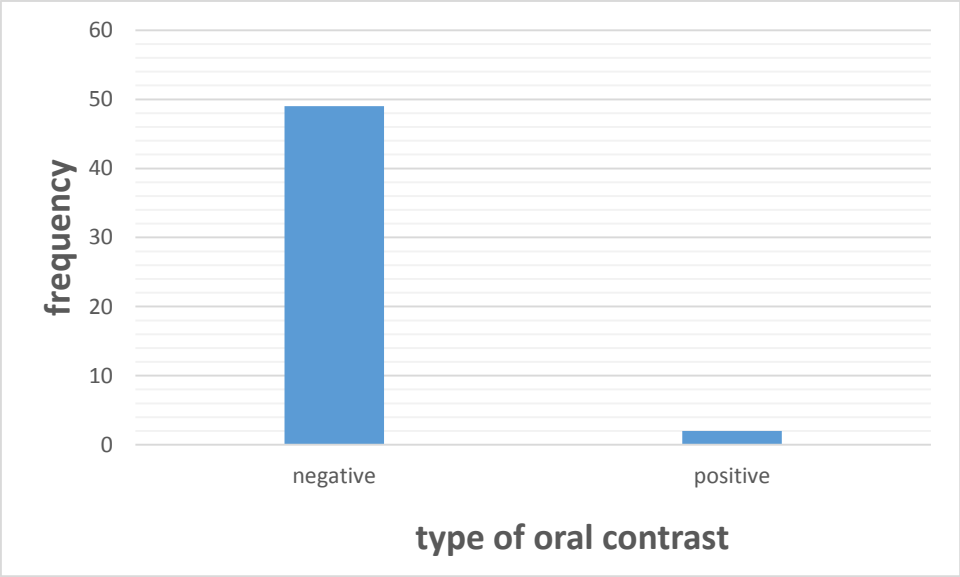

Figure (4.5) show frequency distribution for type of oral contrast

Table (4.6) show frequency distribution for number of hepatic vein

Number of hepatic vein	Frequency	Percent
Not seen	6	11.8
1.0	6	11.8
2.0	11	21.6
3.0	25	49.0
4.0	3	5.9
Total	51	100.0

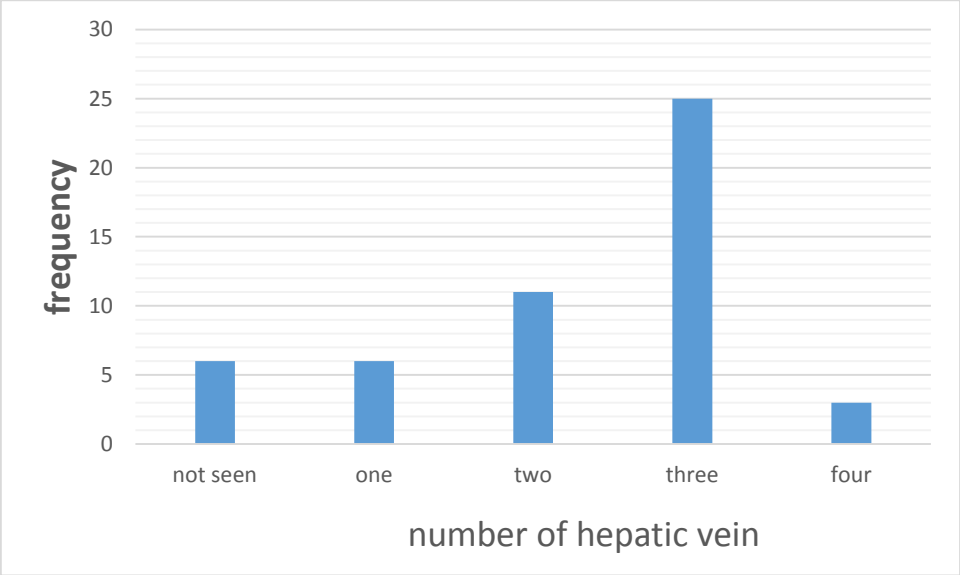

Figure (4.6) show frequency distribution for number of hepatic vein

(4.7) show frequency distribution for number of portal vein

No. of portal vein	Frequency	Percent
Not seen	1	2.0
1.0	2	3.9
2.0	24	47.1
3.0	22	43.1
4.0	2	3.9
Total	51	100.0

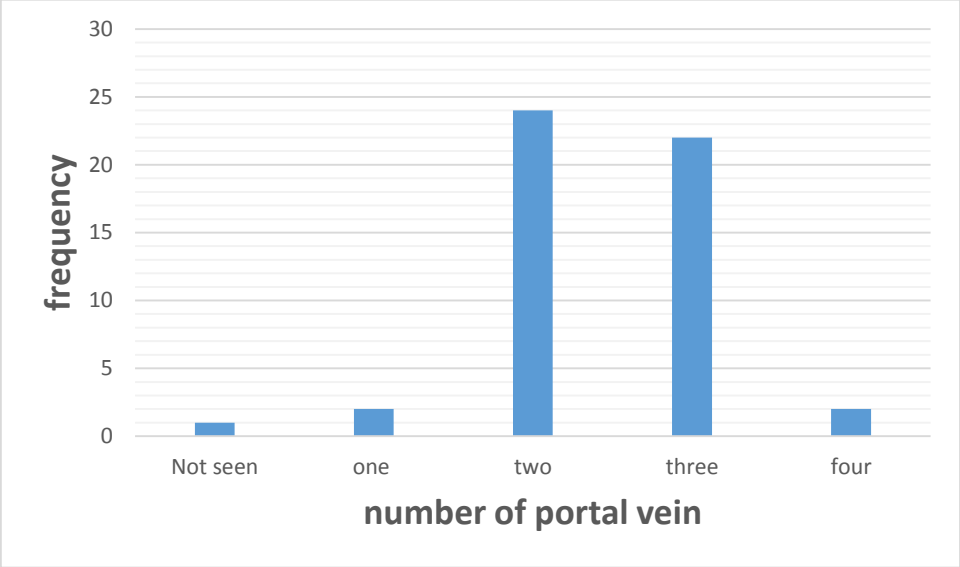

Figure (4.7) show frequency distribution for number of portal vein

Table (4.8) show frequency distribution of pathology finding

Finding	Frequency	Percent
ca prostate	7	13.7
liver lesion	3	5.9
GB stone	3	5.9
pancreatic cyst	1	2.0
ampullary mass	1	2.0
HCC	16	21.3
hemangioma	3	5.9
liver cirrhosis	1	2.0
renal cyst	1	2.0
Obstruction	3	5.9
Colorectal ca	2	3.9
portal polyp	1	2.0
Metastasis	1	2.0
liver transplants	1	2.0
normal	4	7.8
HB	1	2.0
jaundice	1	2.0
pancreatitis	1	2.0
Total	51	100.0

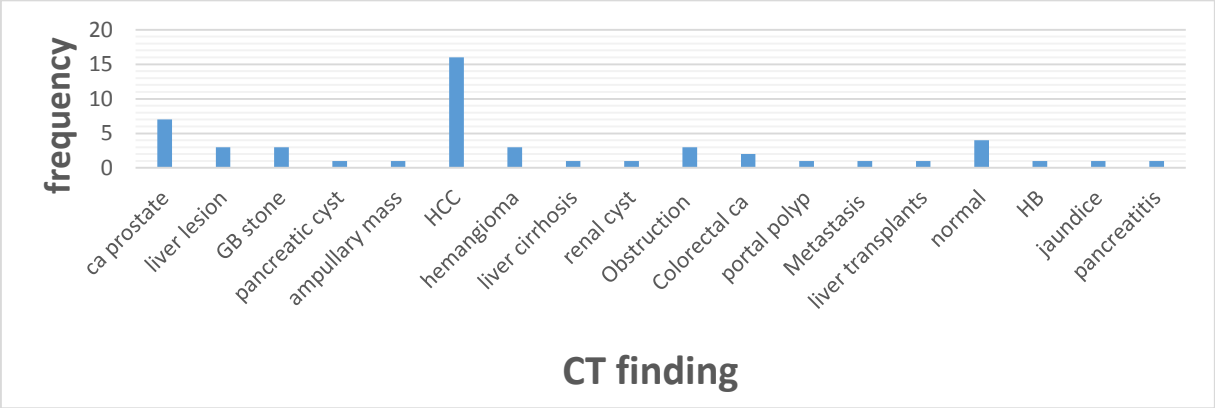

Figure (4.8) show frequency distribution of of pathology finding

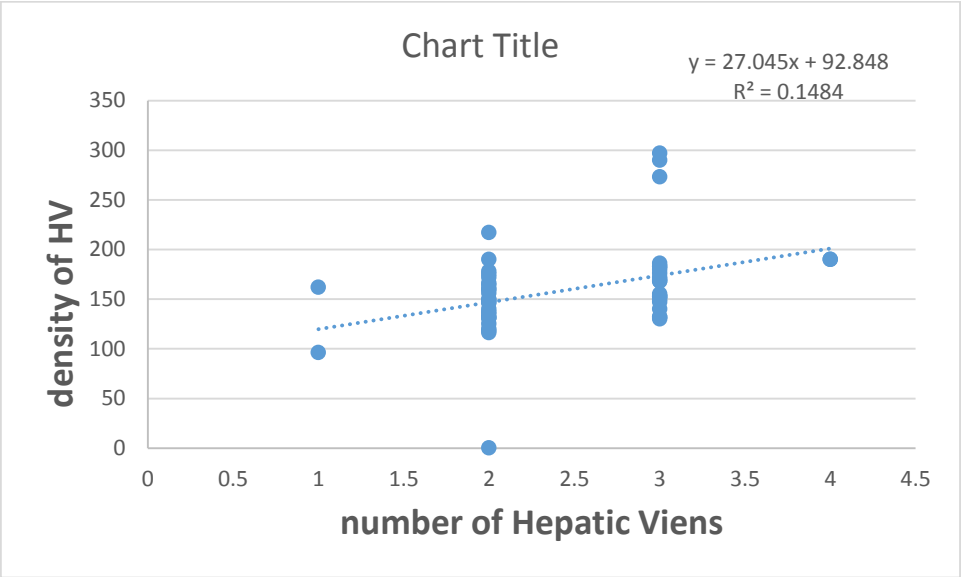

figure (4.9) show a correlation between density of hepatic vein and number of hepatic vein

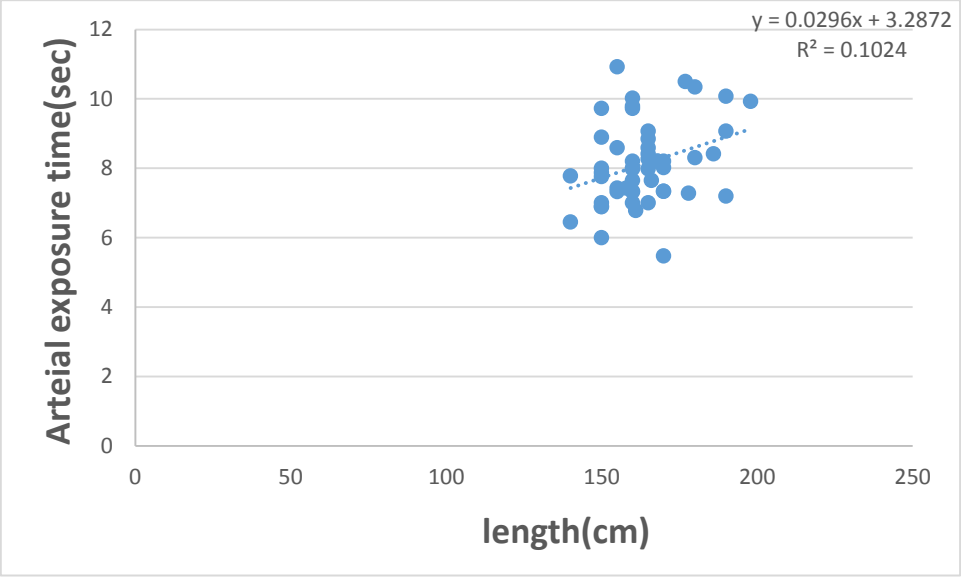

Figure (4.10) show correlation between density of arterial exposure time and patient length

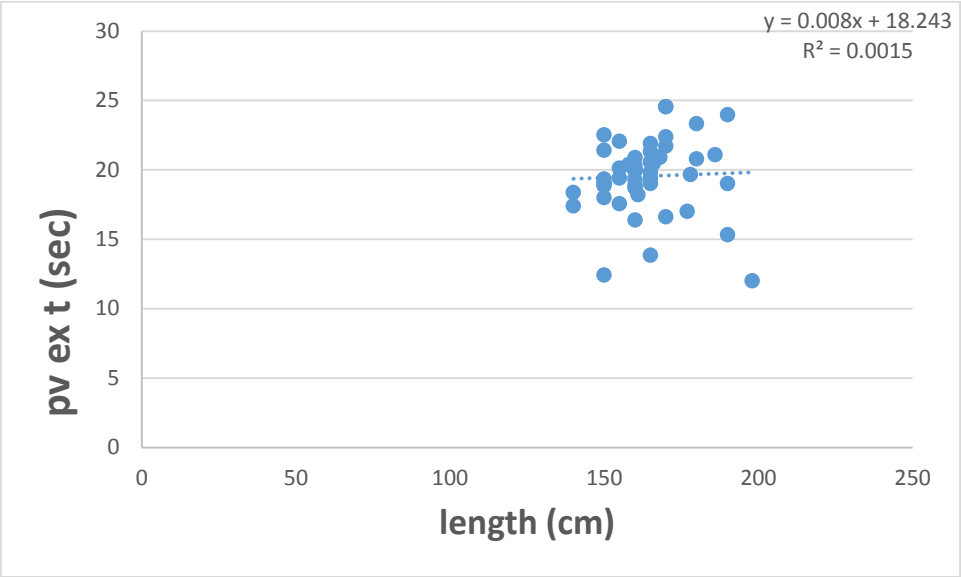

Figure (4.11) show correlation between patient length and Porto venous exposure time

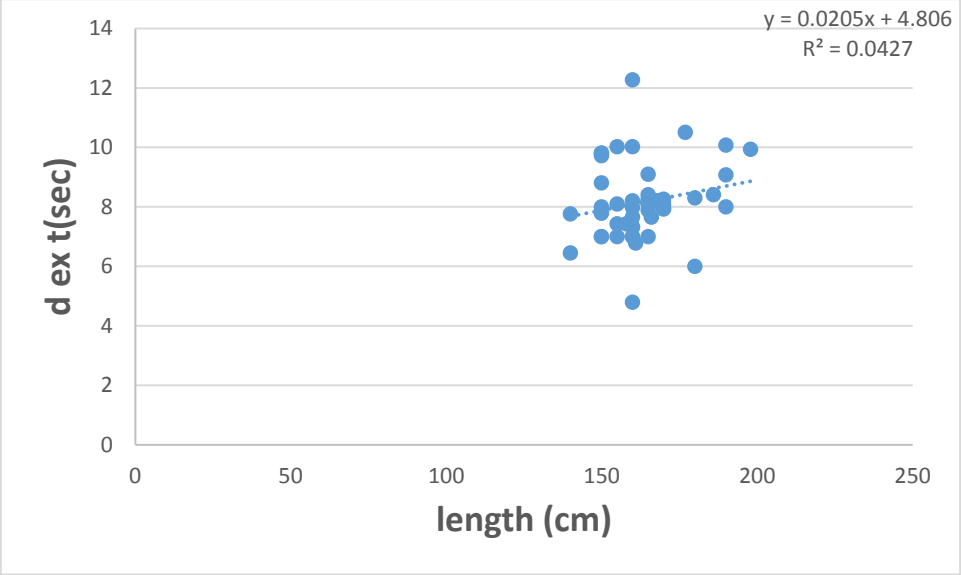

Figure (4.12) show correlation between delay exposure time and patient length

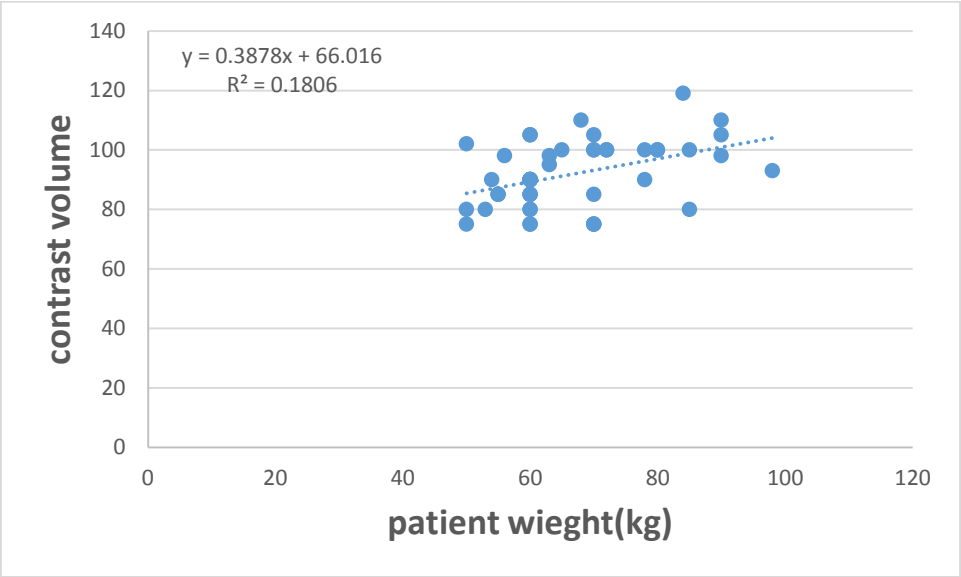

Figure (4.13) show correlation between contrast volume and patient weight

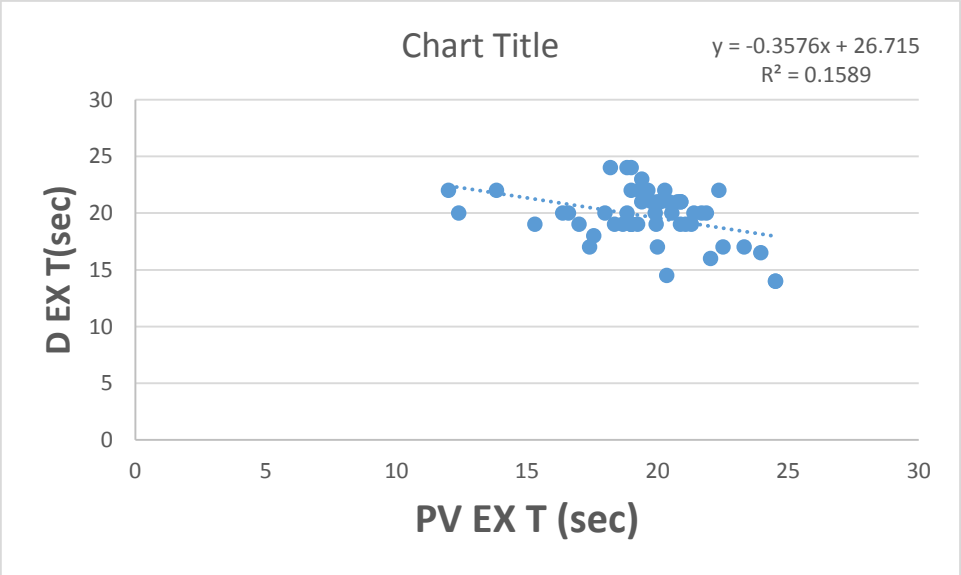

Figure (4.14) show correlation between delay exposure time and Porto venous exposure time

Chapter Five

Chapter five

5-1 Discussion

This was analytical study conducted to assess the Triphsic protocol for abdomen (liver) in order to manage the accurate timing for contrast study. This can lead to misdiagnosis of lesions assess by the uptake of contrast..The most important factor that affect the contrast enhancement of abdominal organs is the timing of contrast injection through the different phase of contrast, triphsic CT abdomen is the protocol used for scanning of the liver and its related pathology mostly include (arterial phase, portal venous phase in addition to the delayed phase) this procedure aimed to demonstrate the liver parenchyma where the portal vein, hepatic veins and its branches totally well Opacified by the contrast in addition liver tissue in all phase of contrast the first phase aimed to identify the liver vasculature and relative organs vasculature and the PV phase used to perfuse the abdominal organs totally with contrast (negative).

Most of data population was male accounting for (30) (58.8%) and female accounting (21) (41.2%), table (4-4) where most of published articles stated that the male predominance in live tumor and disease is higher than female as stated by (FATIMA ALI .HCC IN SUDAN (2005).

while CT study revealed that most of the finding was include CA prostate (7) (13.7 %) liver lesion (3) (5.9%) .GB stone (3) (5.9%) .Pancreatic cyst (1) (2%.)Ampulla mass (1) (2%).Hepatocellularcarcinoma (16) (21.3%).

Hemangioma (3)(5.9%). Liver cirrhosis (1) (2%)Renal cyst (1) (2%). Obstruction (3) (5.9%). Collaterals (2) (3.9%).portalpylus (1) (2%).Metastasis (1) (2%) .Liver transplant (1) (2%).Hepatitis (1) (2%). Jaundice (1) (2%). Pancreatitis (1)Normalcase (4)

(7.8%) .Table (4-11). According to Omer RE, Bakker (2001),Marwan .M bawdyAlshima. A .Mohamed (2017)) most of the CT study of the liver suggested that hepaticellurcarcinoma have high incidence of Sudan .Most common finding was hepatocellular carcinoma (16)(21.3%) according to literature review problem effect male than female (hepatocellular carcinoma represents the fifth most common cancer worldwide and account for 90% of primary liver cancer .men have higher prevalence than women .the sex ratio varies between 2:1 and 4:1(gender difference in patient with(hefaiedhr.etal..tunismed2013)

Most patients take the oral contrast negative (neutral) (49)(96.1 %) . positive contrast (2)(3.9%) .table (4-5) Oral contrast is one of the most important type of contrast used to study the abdomen where the GIT relative to other abdominal versa can be evaluated and assessed, there was many type can be used in CT triphsic protocol while it depend on the relative patient condition need to assess in which have two type (positive and negative contrast).By Negative contrast mean (neutral)contrast which is also two type: oral water or Manitoul oral water is given on table for assessment of stomach wall and its disease and the other type is used for assessment of small bowel lesion and the water can be given rectally to assess the large bowel or depending on time of oral contrast the we have to Waite for more than for hour to reach the large bowel.(Chau Hung, Lee, Tan Tock Sen(2016)).

Finding of study showed the number of hepatic vein in patient I vein (6) (11.8%) _ 2vein (11) (21.6%)_3 vein (25) (49%)_4 vein (3) (5.9%) and no seen or observed (6)(11.8%) due to disease or not accurate time of contrast inject or volume table(4-6). most of branches number seen 3 vein (25) (49%).and the number of Porto venous branches 1 vein (2) (3%) .2 vein (24) (47.1 %) .3 vein (22) (43.1%) .4 vein (2) (3.9%).not seen (1)(2%) table (4-7). Most of branches number seen 2 veins (24) (47.1%)

ACCORELATION was investigate the relationship between the patient length and portovenouse exposure time because the length of exposure time is significant according to patient length at (R2 =0.0015) WHERE DIRECT CORLATION .indicate that exposure time at portovenouse phase increase by 0.008 second for every one centimeter increase in pt length y=0.008x+18.243 table (4_11).

A correlation was investigate the relationship between the patient length and delay exposure time .because the length of exposure time is significant according to pt length that R2=0.0427 WHERE DIRECT CORLATION .indicate that the exposure time at delay phase increase by 0.0205 seen for every one centimeter increase in patient length y=0.0205x+4.806 table (4-12).

A correlation was investigate the relationship between the patient length and arterial exposure time .because the length of exposure time is significant according to pt length that R2=0.1024 WHERE DIRECT CORLATION .indicate that the exposure time at delay phase increase by 0.0296 seen for every one centimeter increase in patient length y=0.0296x+3 .2872 table (4-10).

A correlations was investigate the relationship between the contrast volume and patient weight .because the weight of patient is significant according to contrast volume R2=0.1806 WHERE DIRECT CORLATION. Indicate that the contrast volume increase by 0.3878 for every one kg in patient weight y=0.3878x+66.016 table (4-13).

A correlation was investigate the relationship between the density of Hepatic vein and number of hepatic vein .because the number of hepatic vein is significant according to number of hepatic vein R2=0.1484 WHERE DIRECT CORLATION. Indicate that the increase by 27.045 for every one kg in patient weight y=27.045x+92.484 table (4-9)

A correlation was investigate the relationship between the port venous exposure time and delay exposure time .because the port venous exposure time is significant according to R2=0.1589 WHERE REVERS CORLATION. Indicate that the increase of exposure time by 0.3576 lead to decrees delay exposure time y=0.3576x+26.715 table (4-14)

5-2 Conclusion

The computer tomography is important modalities in detecting liver pathology. Fifty one patient include this study was age between 30_86year (68.8%) male and (21.2%)female found had higher incident of hepatic cellular carcinomain in the liver is (16) (21.3%) effected in male than female .this study demonstrate the accurate time in the three phase the optimum HU from the ROI placed at the descending thoracic aorta,100 HU the arterial phase is taken after 5.2s then the mean exposure time in arterial Porto venous. delay (8.13. 19.6 and 8.2s)and mean delay time in arterial Porto venous and delay (5.16,22.11,and359s) and the optimum time of contrast to reach is 55sec for PV. and show the most appearance of hepatic vein number was 3 vein (25)(49%) .2 portal vein (24)(47.1%).the correlation between the patient length and p.v exposure time. delay exposure time . arterial exposure time and correlation between contrast volume and patient weight and correlation between density and number of heptic vein is direct correlation but the correlation between porovenouse and delay exposure time is revers correlation .

5-3 recommendation

Early detection of HCC by close follows up of risk groups.

Timing of CT-series is important in order to grab the right moment of maximal contrast differences between a lesion and the normal parenchyma

Adapt the protocol to the type of scanner, the speed of contrast injection and to the kind of patient that you are examining.

must be use the correct contrast volume formula.

Use the neutral oral contrast (water) in patient preparation.

Training of medical staff (technologist) to improve health care

Recommend to increase sample size which help in gaining accurate time

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Appendices

Appendices

Data collection sheet

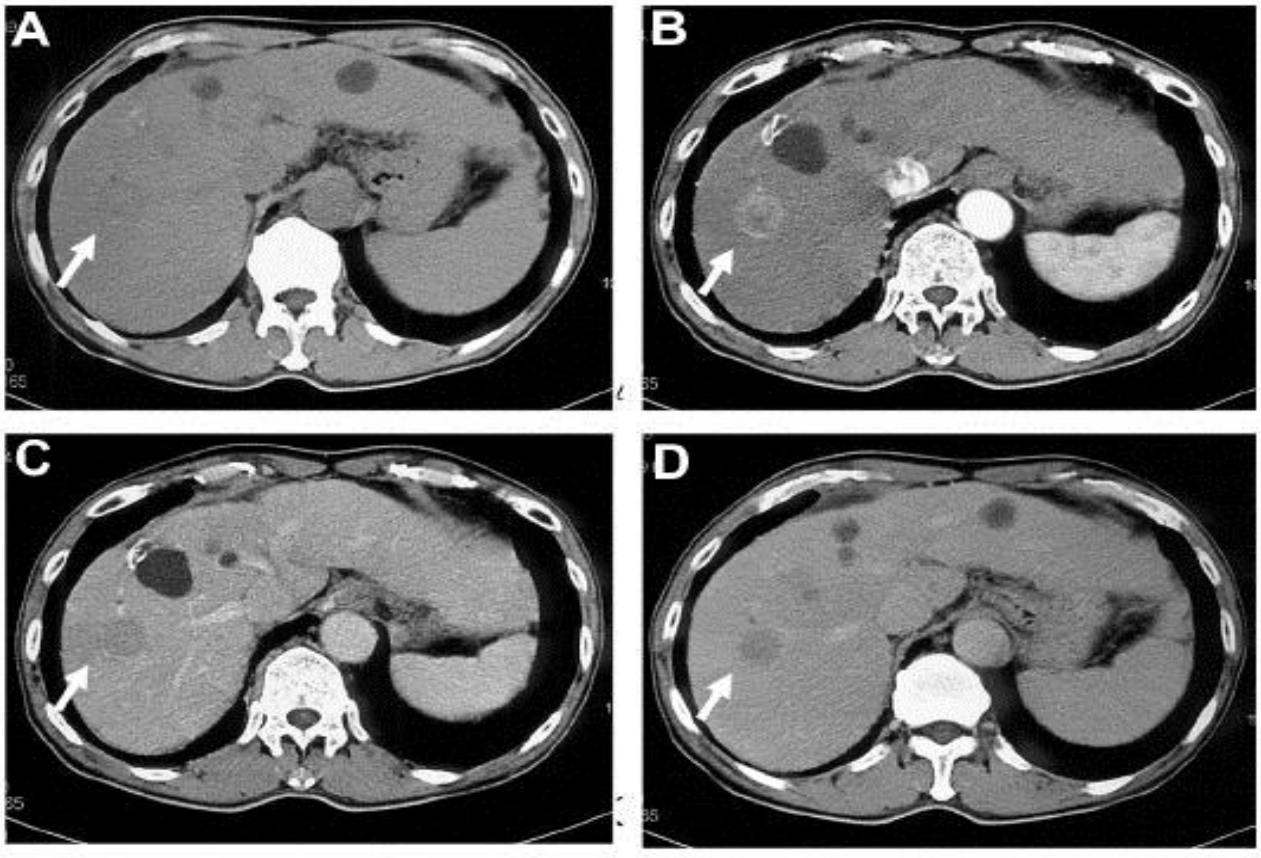
Gender (male. Female)	age (years)
Weight(kg)	length (cm)
Contrast volume	type of oral contrast
Arterial exposure time	port venous exposure time
Delay exposure time	arterial delay time
Port venousdelay time	delay delay time
Number of hepatic veins branches	number of port venous branches
density of hepatic branches	density of port venous branches

Finding of disease

Appendices (1) scans parameters of multislicect scanner

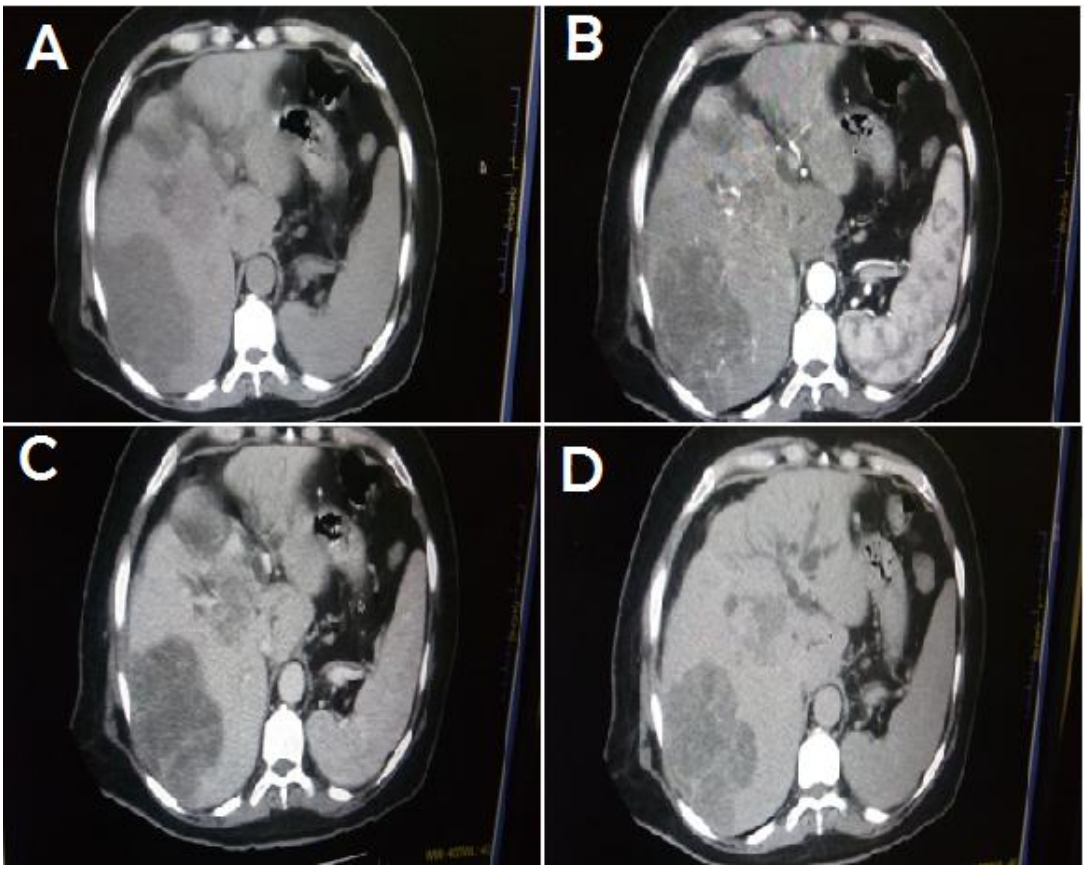
Parameter	4-8slice	10-16slice	16 slice
Scanning setting			
Tube voltage (k v)	120	120	120
Rotation time (s)	0.5	0.5	0.5
Time current time product(Mas)	124-300	124-300	124-300
Pitch corrected tube current time product(MAs)	155_250	155_250	155_250
Collimation(mm)	2.5	1.25/1.5	0.6_0.62
Norm. Pitch	0.8_1.2	0.8_1.2	0.8_1.2
Reconstruct increment(mm)	4_6	5-6	5-6
Reconstra_slice thickness(mm)	4_6	5_6for recon 1	5_6for recon 0.6
Convolution kernel	Standard	Standard	Standard
Specials			
Scan rang	Diaphragm to caudal hepatic surface	Diaphragm to caudal hepatic surface	Diaphragm to caudal hepatic surface
Scan direction	Cranio caudal	Cranio caudal	Cranio caudal
Contrast media application			
Concentration(mg iodine/ml)	300/370	300/370	300/370
Mono/biphasic	Biphasic	Biphasic	Biphasic
Volume (ml)	100-150	100-150	100-150
Injection rate (ml/s)	4_5	4_5	4.0_5.0
Saline chasel	Optional	Optional	Optional
Delay(s)	20 and 50	25 and 60	25 and 60

Appendx (2)



Images (1) A 68-year-old man with a hepatocellular carcinoma in segment 8. Notes: (A) A noncontract CT image cannot clearly depict a liver nodule (arrow). (B) Arterial-phase CT image (performed with an iodine concentration of 300 mg I/mL) shows a hyper attenuating nodular lesion in segment 8 (arrow). (C) On portal-phase CT imaging, the lesion is depicted as hypo attenuating nodule (arrow). (D) An equilibrium-phase CT image shows a discrete hypo attenuating nodule (arrow). On combination of four-phase image sets, the lesion is definitely diagnosed as typical hyper vascular hepatocellular

Appendices (3)



Images (2) A 68-year-old man with two focal hepatic lesion representing hepatocellularcarcinoma showing early enhancement and early washout with delay enhancement Notes: (A) A noncontract CT image cannot clearly depict a liver nodule). (B) Arterial-phase CT image (performed with omnipaque contrast concentration of 300 mg /mL) shows a hyper attenuating nodular lesion. (C) On portal-phase CT imaging, the lesion is depicted as a fairly discrete hypo attenuating nodule. (D) An equilibrium-phase CT image shows a discrete hypo attenuating nodule. On combination of four-phase image sets, the lesion is definitely diagnosed as typical hyper vascular hepatocellular