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Enhancement Pattern of liver Lesions: AComputerized Tomography Based Study

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Abstract

The Objectives of this study were to evaluate the enhancement pattern of liver lesions in the triphasic spiral computerized tomography (CT), as well as to validate the most suitable protocol for lesion detection correlated with the final CT opinion/diagnosis, in addition to find textural changes of liver and spleen, highlighting the most common associated findings in those cases. A sample of 100 patients was used, their ages were from (24 – 88) years old, both genders were included. All were diagnosed to have liver lesions. This study was conducted in Radiology Department Wad Medani Hospital and ELsoni Clinic Center- Wad Medani-Sudan, during the period from January 2015 up to January 2018.The sample included 26 cases of simple cyst ,2 with both cysts and abcess,19 of heamangioma,27hepatocelluler carcinoma(HCC)and 26 with metastases. Results showed that the most common liver enhancement pattern was heterogeneous in the hepatic arterial phase and in the portal venous phase. This finding was seen in 23% and 19% of lesions including (HCC) and metastases causing the liver texture to be heterogeneous. Other patterns of enhancement were not common sending-off homogeneous pattern in the cases of the cysts 21% and heamangioma 15%.The mean attenuation measurement of the cysts in the hepatic arterial phase was 35HU±69.98, and it increased in the portal venous phase to a mean of 39.92HU±72.40.Cysts and abscess showed HUof -705.00±134.35 in the arterial phase then showed an increasing at the venous phase to be -550.00±70.71 then reduced at the equilibrium phase to be-805.00HU±134.35.Haemangiomas was 44.42HU ±17.38in the arterial phase and increased in the venous phase 48.19HU±25.73 then decreased in the equilibrium phase 47.27HU±22.78.On average, the HCCwas 52.3 HU±25.90 less than the adjacent liver parenchyma in the arterial phase,57.31HU±26.44in the venous phase and 54.15HU±24.06 at the equilibrium phase. Metastases also showed an increasing in the attenuation pattern after contrast enhancement from 73.54HU±63.62in arterial phase to be increased in the venous phase80.94HU±67.50then it decreased to be 75.31 HU±57.30at the equilibrium phase .The study showed that there is a significant difference of the HU between all the detected liver lesions in all scanning phase at p= 0.000.The presence of liver enhancing lesions were in association with liver and spleen texture changes. Ascites was found in most of the cases constituting 47(47%) of the cases. The study concluded that triphasic CT Scan is an acknowledged imaging tool in

characterizing liver lesions and evaluation of liver and spleen textural changes and detection of the associated findings

Keywords: Liver lesions, Triphasic-CT scan, HU, Ascitis

المستخلص

هدفت الدراسة إلى تقييم نمط التعزيزلآفات الكبدفي التصويرالمقطعي المحوسب الحلزوني ثلاثي الطور،بالإضافة للتحقق من صحة البروتوكول الأكثرملاءمة لاكتشاف الآفة الكبدية ومعامل الارتباط مع التشخيص النهائي، بالإضافة إلى العثورعلى تغييرات تركيب الكبدوالطحال، وتسليط الضوءعلى النتائج الأكثر شيوعاً المرتبطة في تلك الحالات . تم إستخدام عينة من 100مريض،تتراوحأعمارهم بين(24–88)عاًما،وتمتضمن كلا الجنسين .تم تشخيص جميع الحالات بأن لديهم آفات الكبد . أجريت هذه الدراسة في قسم الأشعة بمستشفى ودمدني ومركزعيادات السني – ودمدني بالسودان، خلال الفترة من يناير 2015 إلى يناير 2018 شملت العينة 26 حالة كيس بسيط، 2 كل من الخراجات والأكياس معاً، 19 ورم وعائي كبدي، 27 سرطان خلايا الكبد و 26من نقائل الاورام.أظهرت النتائج أن نمط تعزيز الكبدا لأكثر شيوعا كان غير متجانسة في المرحلة الشريانية الكبدية وفي المرحلة الوريدية.23 ٪و 19 ٪ من الآفات التي تشمل سرطان خلايا الكبد و نقائل الأورام تسببت في تغييرنسيج الكبد فاصبحت غيرمتجانسة. لم يكن أنماطا التعزيزمتجانسة في حالات الأكياس بنسبة 21 ٪ والورم العضلي الوعائي 15 ٪ وكان متوسط قياس التوهين للاكياس في المرحلة الشريانية69.98±35HU ،وزاد في المرحلة الوريدية للبوابة إلى متوسط 72.40±39.92HUأظهرت الأكياس والخراجات معا متوسط 134.35 ±705.00HU–في المرحلة الشريانية ثم أظهرت زيادة في الطور الوريدي إلى 70.71±550.00HU– ثم خفضت في مرحلة التوازن الي 134.35±805.00HU– . كان المتوسط في الأورام الوعائية17.3844±42HU. في المرحلة الشريانية وزاد في المرحلة الوريدية 25.73± 48.19HU ثم انخفض في مرحلة التوازن إلى 22.78±47.27HUكان المتوسط في سرطان خلايا الكبد (HCC) 25.90±52.3HU أقل من أنسجة الكبد المجاورة في المرحلة الشريانية الي 26.44±57.31HU في الطور الوريدي و24.06±54.15 HU في مرحلة التوازن. أظهرت النقائل أيضاً زياده في نمط التوهين بعد تعزيز التباين من 63.62±73.54 HU في الطور الشرياني إلى زيادتها في الطورالوريدي 67.50±80.94 HUثم انخفض إلى57.30±75.31HU في مرحلة التوازن . وأظهرت الدراسة أن هناك فرق كبيربين HU في جميع آفات الكبد المكتشفة في جميع طورالمسح p=0.000. في وجود تعزيزالكبد كانت الآفات في ارتباط مع تغييرات نسيج الكبد والطحال. تم العثورعلى مرض الاستسقاء في معظم الحالات التي تشكل47 (47 ٪). خلصت الدراسة الي ان التصوير الطبقي ثلاثي الطور يعتبر أداة تصوير مثالية في توصيف آفات الكبد وتقييم التغيرات النسيجية في الكبد والطحال والكشف عن النتائج المرتبطة بها.

الكلمات المفتاحية: أفات الكبد، التصوير الطبقي ثلاثي الطور،هاونس فيلد(HU)، الإستسقاء

Introduction

The pattern of the liver texture on various phases of imaging is thought to be related to the liver's dual blood supply. The normal liver receives about 70% of its blood flow from the portal vein and 30% from the hepatic artery (Schenk *et al.,* 1962).A variety of benign and malignant liver lesions can be characterized using contrast-enhanced Computed tomography (CT). The times for imaging the liver differs as late-arterial phase, the portal venous phase and the equilibrium phase where the non-

enhanced phase provides minimal additional diagnostic information for liver lesions. (Iannaccone *et al.,* 2005 and Doyle *et al.,* 2007)

It is difficult to characterize hepatic lesions with various imaging studies. Although histopathology is the gold standard, biopsy is always not possible as it is an invasive technique. CT is the imaging modality most often used to evaluate liver lesions, however, the complex blood supply of the liver disturb the optimal contrast-enhanced CT protocol for the detection and characterization of focal hepatic lesions. Therefore the triphasic spiral CT technique was developed to image the entire liver in arterial, portal, and equilibrium phases. (Bonaldi *et al* .,1995; Francis *et al.,* 2003)

The Objectives of this study were to evaluate the enhancement pattern of liver lesions in the triphasic spiral computerized tomography (CT), as well as to validate the most suitable protocol for lesion detection correlated with the final CT opinion/diagnosis, in addition to find textural changes of liver and spleen giving a highlighting for the most common associated findings in those cases.

Materials and Methods

This descriptive study a sample of 100 patients was used, their ages were from (24 – 88) years old and both genders were included. All were diagnosed to have focal liver lesions and associated findings. This study was conducted in Radiology Department Wad Medani hospital and ELsoni Clinics Center :Wad Medani, Sudan, during the period from January 2015 up to January 2018.The sample included 26 cases of simple cyst, 2 with both cysts and abcess,19 of heamangioma,27 HCC and 26 with metastases .

Equipment used:

Equipment (CT Machine) Wad Medani hospital :TOSHIBA Model: CGGT-015A SN :1EC10Z4776, Manufacture date : 12/2010 , 120 Kv – 300mA , 135Kv – 260mA

ELsoni Clinics Center : TOSHIBA Model CXXG-012A , SN : 1AA09242256 ,Manufacture date 11/2009 , 120Kv-600mA , 135Kv-530mA

Method of data collection and analysis:

Examination Technique: **Position & imaging procedure:**

A triphasic liver CT protocol was developed in which the spiral CT scanner was used. With the triphasic liver CT protocol, the entire liver was scanned successively in arterial, portal, and equilibrium phases. After obtaining a scout view, an unenhanced scan of the liver was acquired with 10 mm/sec table speed, 10-mm collimation. On the unenhanced scan, the craniocaudal extent of the liver was measured. 5-mm collimation and 5 mm/sec table speed were used acquisition in arterial and portal phases together were 50 rotations. The craniocaudal extent of the liver determined the number of required rotations in portal phase. The remaining number of rotations was used for the arterial phase, and table speed and collimation were adjusted to cover the entire liver. Depending on the craniocaudal extent of the liver, 5-mm collimation with 10 mm/sec table speed and 10-mm collimation with 20 mm/sec table speed were used in the arterial phase. Patients were positioned in supine with head first, center between xiphoid process to iliac creast. The longitudinal alignment light in the midline and the horizontal one passes just below the lower costal margin .A total of 50 mL of nonionic contrast material [Omnipaque], was injected with a power injector (into an antecubital vein) the concentration was 350 mg/ml. Flow rate 3.5 contrast, the entire

liver was scanned in arterial phase. After the end of the arterial phase, the liver was scanned in portal phase, the patient was asked to breathe in and to reposition the scan plane cephalad to the liver. The scan obtained in the equilibrium phase, was 15 min after injection of contrast material. The Venus time is 60-90 second after injection the contrast material and the delay time is 15-20 minutes after the contrast injection.

Method Image Interpretation

Each study was interpreted by one radiologist after that CT images were stored in computer disk were viewed by the Radiant, Ant. DICOM in computer to selected the section of image. The enhancement characteristics of each phase were assessed by grading the attenuation of the arterial and portal venous system in comparison to liver parenchyma. The arterial, portal, and equilibrium phase images were reviewed for the presence of liver lesions. The appearance of each lesion in each phase was described on the basis of the homogeneity of the lesion in comparison to surrounding parenchyma in that phase. Additional features, defined by typical location, and CT number (Hounsfield unit) (HU) of the lesion were used in each phase .The criteria for lesion diagnosis was depended on the diagnostic criteria of (Weissleder *et al.,* 2007)

Data analysis:

The data in the study were documented and analyzed using SPSS program version16. Descriptive statistics, including mean ± standard deviation, were calculated. ANOVA test was applied to test the significance of differences, *p*-value of less than 0.05 was considered to be statistically significant.

Ethical approval:

The researcher granted an ethical approval from the hospital and the radiology department. No identification or individual details were published. No information or patient details were disclosed or used for other than the study. The collected data were used for scientific research only and the ID of the patient or their personality weren't being disclosed under any circumstances.

Results

Table(1) Descriptive statistics of patients age and liver lesions CT number(Hounsfield),p- value at all CT phases of scanning for different liver lesions

Descriptive							
		N	***Mean***	***Std. Deviation***	***Minimum***	***Maximum***	***P-value***
lesion CT number at precontrasts canning	Cyst	26	35.06	73.95	-30.00	292.00	.000
	Cyst & abscess	2	-445.00	77.78	-500.00	-390.00	
	Haemangiomas	19	40.43	23.45	16.30	122.50	
	HCC	27	54.61	102.77	-35.00	557.00	
	Metastases	26	69.20	67.31	15.00	250.50	
	Total	100	40.63	102.47	-500.00	557.00	
lesion CT number at arterial phase	Cyst	26	35.40	69.98	-17.00	272.00	.000
	Cyst & abscess	2	-705.00	134.35	-800.00	-610.00	
	Haemangiomas	19	44.42	17.38	18.50	83.60	
	HCC	27	52.03	25.90	-18.00	136.00	
	Metastases	26	73.54	63.62	1.00	236.50	
	Total	100	36.71	119.24	-800.00	272.00	
lesion CT number at	Cyst	26	39.92	72.40	-7.00	283.00	.000
	Cyst & abscess	2	-550.00	70.71	-600.00	-500.00	
	Haemangiomas	19	48.19	25.73	8.50	100.00	

venous phase	HCC	27	57.31	26.44	-11.00	112.00	
	Metastases	26	80.94	67.50	2.00	243.00	
	Total	100	45.05	101.83	-600.00	283.00	
lesion CT number at equilibrium phase	Cyst	26	38.70	69.39	-12.00	269.00	.000
	Cyst & abscess	2	-805.00	134.35	-900.00	-710.00	
	Haemangiomas	19	47.27	22.78	15.50	99.00	
	HCC	27	54.15	24.06	-9.00	102.00	
	Metastases	26	75.31	57.30	7.00	229.00	
	Total	100	37.15	131.46	-900.00	269.00	

Table (2) Cross tabulation between final diagnosis, Liver texture and p-value

P-value=0.000		***Liver texture***			Total
		Homogenous	***Mixed***	***Heterogeneous***	
Final Diagnosis	Cyst	21(21.0%)	0(0.0%)	5(5.0%)	26(26.0%)
	Cyst & abscess	0(0.0%)	0(0.0%)	2(2.0%)	2(2.0%)
	Haemangiomas	15(15.0%)	0(0.0%)	4(4.0%)	19(19.0%)
	HCC	3(3.0%)	1(1.0%)	23(23.0%)	27(27.0%)
	Metastases	6(6.0%)	1(1.0%)	19(19.0%)	26(26.0%)
Total		45(45.0%)	2(2.0%)	53(53.0%)	100(100.0%)

Table (3) Cross tabulation between final diagnosis in the liver s, Spleen texture and p-value

P-value=0.000		***Spleen texture***		Total
		Homogenous	***Heterogeneous***	
Final Diagnosis in the liver	Cyst	23(23.0%)	3(3.0%)	26(26.0%)
	Cyst & abscess	0(0.0%)	2(2.0%)	2(2.0%)
	Haemangiomas	17(17.0%)	2(2.0%)	19(19.0%)
	HCC	4(4.0%)	23(23.0%)	27(27.0%)
	Metastases	5(5.0%)	21(21.0%)	26(26.0%)
Total		49(49.0%)	51(51.0%)	100(100.0%)

Table (4) Cross tabulation between final Diagnosis, liver lobe and p-value

P-value=0.019		**Site**			Total
		LT lobe	***RT lobe***	***both lobes***	
Final Diagnosis	Cyst	4(4.0%)	12(12.0%)	10(10.0%)	26(26.0%)
	Cyst & abscess	0(0.0%)	2(2.0%)	0(0.0%)	2(2.0%)
	Haemangiomas	2(2.0%)	16(16.0%)	1(1.0%)	19(19.0%)
	HCC	3(3.0%)	17(17.0%)	7(7.0%)	27(27.0%)
	Metastases	3(3.0%)	9(9.0%)	14(14.0%)	26(26.0%)
Total		12(12.0%)	56(56.0%)	32(32.0%)	100(100.0%)

Table (5) Cross tabulation between final diagnosis, Liver segment and p-value

P-value=0.000		*Segment*				Total
		Lower	***Mid***	***Upper+ Lower***	***Upper***	
Final Diagnosis	Cyst	3(3.0%)	0(0.0%)	5(5.0%)	18(18.0%)	26(26.0%)
	Cyst & abscess	0(0.0%)	0(0.0%)	2(2.0%)	0(0.0%)	2(2.0%)
	Haemangiomas	7(7.0%)	2(2.0%)	1(1.0%)	9(9.0%)	19(19.0%)
	HCC	6(6.0%)	0(0.0%)	9(9.0%)	12(12.0%)	27(27.0%)
	Metastases	2(2.0%)	0(0.0%)	17(17.0%)	7(7.0%)	26(26.0%)
Total		18(18.0%)	2(2.0%)	34(34.0%)	46(46.0%)	100(100.0%)

Table (6) cross tabulation between the final diagnosis and lesion texture at different scanning CT phases : Homogenous(HM) and Heterogeneous(HT)

Final Diagnosis	***Plane Texture***		***Arterial Phase Texture***		***Venus Phase Texture***		***Equilibrium Phase Texture***	
	HM	HT	HM	HT	HM	HT	HM	HT
Cyst	20(20.0%)	6(6.0%)	20(20.0%)	6(6.0%)	20(20.0%)	6(6.0%)	20(20.0%)	6(6.0%)
Total	**26(26.0%)**		**26(26.0%)**		**26(26.0%)**		**26(26.0%)**	
Cyst & abscess	0(0.0%)	2(2.0%)	0(0.0%)	2(2.0%)	0(0.0%)	2(2.0%)	0(0.0%)	2(2.0%)
Total	**2(2.0%)**		**2(2.0%)**		**2(2.0%)**		**2(2.0%)**	
Haemangiomas	16(16.0%)	3(3.0%)	15(15.0%)	4(4.0%)	15(15.0%)	4(4.0%)	16(16.0%)	3(3.0%)
Total	**19(19.0%)**		**19(19.0%)**		**19(19.0%)**		**19(19.0%)**	
HCC	5(5.0%)	22(22.0%)	4(4.0%)	23(23.0%)	3(3.0%)	24(4.0%)	3(3.0%)	24(24.0%)
Total	**27(27.0%)**		**27(27.0%)**		**27(27.0%)**		**27(27.0%)**	
Metastases	2(7.0%)	16(16.0%)	2(2.0%)	24(24.0%)	2(2.0%)	24(2.0%)	3(3.0%)	23(23.0%
Total	**18(23.0%)**		**26(26.0%)**		**26(26.0%)**		**26(26.0%)**	
***p*-value**	**0.000**		**0.000**		**0.000**		**0.000**	

***Diagnostic Criteria**{The cysts appears as hypo dense with no enhancement, heamangioma appears hypodense, well-circumscribed lesion on precontrast scan with highly peripheral enhanced during dynamic bolus phase with good bolus fill-in occurs within minutes after administration of contrast and also occurs in metastases. HCC appears as hypodense mass lesion showed excellent early arterial enhancement .Metastases is best seen on portal venous *phase* images. Abscess appears as hypo dense mass with peripheral enhancement, no fill-in was detected}

Table (7) Cross tabulation between the Final Diagnosis and associated findings at CT scanning

Associated findings	Final Diagnosis					Total
	Cyst	***Cyst & abscess***	***Haemangiomas***	***HCC***	***Mets***	
Ascites	18(18.0%)	1(1.0%)	10(10.0%)	13(13.0%)	5(5.0%)	47(47.0%)
Ascites+LungMets	0(0.0%)	0(0.0%)	0(0.0%)	2(2.0%)	0(0.0%)	2(2.0%)
Breast cyst	2(2.0%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	2(2.0%)
Ca colon	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	2(2.0%)	2(2.0%)
Ca pancreas	0(0.0%)	0(0.0%)	0(0.0%)	3(3.0%)	7(7.0%)	10(10.0%)
Ca stomach	0(0.0%)	0(0.0%)	0(0.0%)	1(1.0%)	0(0.0%)	1(1.0%)
Gallbladder mass	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	2(2.0%)	2(2.0%)
Hepatomegaly	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	1(1.0%)	1(1.0%)
Large bowel mass	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	1(1.0%)	1(1.0%)
Lung mass	0(0.0%)	0(0.0%)	0(0.0%)	3(3.0%)	3(3.0%)	6(6.0%)
RCC	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	1(1.0%)	1(1.0%)
RCC+Lung Mets	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	1(1.0%)	1(1.0%)
Renal cyst	5(5.0%)	0(0.0%)	2(2.0%)	0(0.0%)	0(0.0%)	7(7.0%)
Spleen Mets	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	3(3.0%)	3(3.0%)
Splenomegaly	1(1.0%)	1(1.0%)	0(0.0%	5(5.0%)	0(0.0%)	7(7.0%)
Uterine mass	0(0.0%)	0(0.0%)	7(7.0%)	0(0.0%)	0(0.0%)	7(7.0%)
p value	***0.000***					

Ca=Cancer, RCC= Renal cell carcinoma, Mets= metastases

Discussion

The current study used spiral computed tomography (CT) multiphase technique for liver, spleen and lesions evaluation as it provides images at peak enhancement of the liver parenchyma as well successive scanning of the entire liver at different instant after injection of contrast. It was stated that the liver receives approximately 30% of its blood supply from the hepatic artery and 70% from the portal vein; most primary and secondary liver neoplasms receive 80-95%of their blood supply from the hepatic artery and because of the high frequency of focal liver lesions characterization of these lesions is essential(Craig *et al.*, 1989; Karhunen *et al.*, 1986;Karhunen *et al.*,1986;Jones *et al.*, 1992)Therefore, the multiphasic liver CT technique was applied for lesion characterization and differentiation, these protocols was applied to image the entire liver in all phases.

The different vascular phases of the liver that are the precontrast, arterial, equilibrium and venous phases have been studied Table (1).The Hepatic arterial phase occurs at 20–30 seconds post injection with contrast medium, which showed optimum contrast to the hepatic artery. Most of the liver lesions were noticeable on hepatic arterial phase images. Hepatic venous phase at approximately 60 seconds post- contrast medium injection, when the contrast material has arrived at the hepatic veins, and hepatic delayed phase 15 min post- contrast medium injection when contrast material equilibrium of the intravascular and extra-vascular components occurs

Table(1) showed the descriptive statistics of patients liver lesions CT number (Hounsfield), at all CT phases of scanning for different liver lesions detected during the

scan. In all CT phases metastases scored the highest value of enhancement followed by the hepatocellular carcinomas(HCC)on the other hand the abscess and cysts have the lowest values ranged between (-805.0 to-445.00HU).Also the enhancement characteristics and patterns of the liver lesions are summarized. The most common liver enhancement pattern was heterogeneous in the hepatic arterial phase and in the portal venous phase. This finding was seen in 23% and 19% of lesions including (HCC) and metastases casing the liver texture to be heterogeneous. Other patterns of enhancement were not common. Sending-off homogeneous pattern in the cases of the cysts21% and heamangioma 15%.The mean attenuation measurement of the cysts in the hepatic arterial phase was 35 HU±69.98(range, -17–272 HU), and it increased in the portal venous phase to a mean of 39.92HU±72.40(range,-7–283 HU). Cysts and abscess showed HU of -705.00±134.35 in the arterial phase then showed an increasing at the venous phase to be -550.00±70.71 then reduction at the equilibrium phase to be-805.00HU±134.35.Haemangiomas was 44.42H ±17.38(range ,18.50 to83.60HU) in the arterial phase and increased in the venous phase 48.19HU±25.73 then decreased in the equilibrium phase 47.27HU±22.78.On average, the HCC measured 52.3 HU±25.90 (range, –18 to136 HU) less than the adjacent liver parenchyma in the arterial phase57.31HU±26.44(range,-11.0to112.00HU) in the venous phase 54.15HU±24.06(range, -9.00 to102.00HU) at the equilibrium phase.Metastases also showed an increasing the attenuation pattern after contrast enhancement from 73.54HU±63.62(range,1.00 to 236.50HU) in arterial phase then increased in venous phase80.94HU±67.50(range ,2.00 to 243HU) then it decreased to be 75.31 HU±57.30(range7.00-229.0HU) at the equilibrium phase .The study showed that there was a significant difference of the HU between all the detected liver lesions in all scanning phase at p= 0.000.Current literature search showed that the short scanning time made CT an acknowledged imaging technique for these enhancement criteria (Ichikawa *et al.,* 2010;Hammerstingl *et al.,* 2008; Soyer *et al.*,2010).Recent studies have also reported an improvement in lesion detection if arterial phase imaging is performed in addition to portal venous imaging especially inthe presence of hyper vascular neoplasms, such as(HCC). (Van Leeuven *et al.,* 1996, Szklaruk *et al.*,2003; Iannaccone *et al.*,2007)

Tables (2, 3) showed the cross tabulation between final diagnosis of the liver included cysts, cysts with abscess, heamangioma, HCC and metastases correlated with Liver and spleen texture changes with their differences in the enhancement pattern as homogenous, heterogeneous or both textures .The results showed a significant difference in the enhancement pattern for liver lesions both with liver and spleen texture changes at p=0.000.

Both lobes of the liver were affected with lesions as well the lesions might affected any segment of the liver as noticed in Tables (4and 5).All liver sites and segments can be affected with lesions , this was considered a complex function, this were analyzed in that the contrast enhancement of the liver showed also a compound function due to the presence of the sinusoids instead of the capillary, the sinusoidal endothelium without basement membrane instead of the capillary endothelium, the presence of per sinusoidal space instead of the extra vascular extracellular compartment, two blood inflow components including the hepatic artery and the portal vein. (Wang *et al.,* 2010)

Table (6)showed that the cysts appears as hypo dense with no enhancement, while the

heamangioma appears hypodense, well-circumscribed lesion on precontrast scan with highly peripheral enhanced during dynamic bolus phase, most characteristic findings on good bolus fill-in occurs within minutes after administration of contrast and also occurs in metastases. HCC appears as hypodense mass lesion showed excellent early arterial enhancement because arterial supply, prominent Arterio-venous shunting causes early enhancement. Metastases are best seen on portal venous phase images. Abscess appears as hypo dense mass with peripheral enhancement, no fill-in was detected. The spleen texture was affected when there are findings in the liver especially in the cases of HCC and metastases it became heterogeneous due to combined hepatic portal circulation. Also showed that 20(20%) of the cases with cysts appears homogenous in all the CT scanning phase where the cases with both cyst and abscess were found to be heterogeneous in all phases. Most of the cases which are diagnosed as heamangioma were found to be homogenous at all phases, while the HCC and metastases were found to be heterogeneous in arterial, venous and equilibrium compared with the plane phase. This differences were found to be significant at p=0.000. The study revealed that any lesion has its own texture and character in all CT enhancement phases, this was justified as that the vascular hemodynamics is the answer in the characterization of lesions. Several studies have been done worldwide on the role of triphasic CT scan in characterizing and differentiating hepatic lesions.(Hafeez *et al.,* 2011).In the current study, we evaluated a triphasic spiral CT technique that allowed imaging of the entire liver in arterial, portal and equilibrium phases. It showed that the portal phase is the most sensitive phase for lesion detection, whereas the arterial and equilibrium phases provide extra information on the vascularity of the lesion which may help to identify the nature of lesion.This was found also in other several previous studies (Ichikawa *et al* 2010;Hammerstingl *et al* .,2008;Soyer ,2010;Van Leeuven ,1996, Szklaruk ,2003; Iannaccone .,2007)

The presence of ascites, ascites with lung metastases, breast cyst, Ca colon, Ca pancreas, Ca stomach ,gallbladder mass, hepatomegaly, large bowel mass, lung mass, renal cell carcinoma (RCC),RCC with lung metastases, renal cyst, spleen metastases, Splenomegaly and uterine mass were the associated findings with the liver lesions as presented in table (7)Ascitis was found in most of the cases constituting 47(47%) of the cases .

Conclusion: The presence of liver lesions and its enhancement pattern in all the scanning phase had been detected and characterized. Any lesion has its own texture and character showing that most of the liver lesions were noticeable on hepatic arterial phase images. It showed that the portal phase is the insightful phase for lesion detection, whereas the arterial and equilibrium phases provide extra information on the vascularity of the lesion which may help to identify the nature of lesion this was noticeable in the increasing of the HU values in the HCC and Metastases. liver and spleen texture changes was detected in the presence of hepatic lesions Triphasic CT Scan is an acknowledged imaging tool in characterizing liver lesions and evaluation of liver and spleen textural changes and detection of the associated findings

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