ROLE OF COMPUTED TOMOGRAPHY IN THE EVALUATION OF SPACE OCCUPYING LESIONS IN THE LIVER WITH CYTOPATHOLOGICAL CORRELATION

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Abstract

Background: The widespread availability of non-invasive radiological and diagnostic imaging techniques significantly contributes to detect space occupying lesions in the liver. So the objective of the present study is to establish diagnostic usefulness of computed tomography in the evaluation of space occupying lesions in the liver.

Materials and methods: It is a cross sectional study done in the Department of Radiology and Imaging, Chittagong Medical College Hospital, Chattogram, during a six months periods. Patients having suspected hepatic space occupying lesions (Clinical / on ultrasonography / High serum α-fetoprotein level) attending Department of Radiology and Imaging, were the study patients. A total of 70 patients of space occupying lesions in the liver were recruited. All CT scans were performed with a 16 slice multidetector Philips MX whole body scanner using standard technical parameters. Age, sex, clinical presentation, physical examination, CT evaluation and cytopathological findings were noted.

Results: It was observed that majority (42.9%) patients had belonged to age ≤ 40 years. The mean age was 45.7 ± 11.6 years. Almost two third 42(60.0%) patients were male. Two third (62.9%) patients came from middle class. It was observed that 44(62.9%) patients had enlarged liver, 36(51.4%) patients had multiple number of lesions, the mean size of lesion had 5.0±3.2 cm, 36(51.4%) patients had lesions in both lobe of liver, 38(54.3%) patients had well defined margin of mass, 44(62.8%) patients had hypodense lesion in pre contrast CT, 28(40.0%) patients had marked enhancement in post contrast CT, 55(78.6%) patients had lesion enhancement in arterial phase of contrast, 32(45.7%) patients had rim enhancement, 2(2.9%) patients had calcification, 28(40.0%) patients had necrosis, 22(31.4%) patients had lymphadenopathy, 2(2.9%) patients had portal vein invasion. It was observed that, 10(14.3%) patients had cyst and 20(28.6%) patients had abscess in benign cases. In malignant cases 14(20.0%) patients had HCC and 26(37.1%) patients had metastasis. Comparison of CT scan with cytopathology report of space occupying lesions in the liver shows true positive 40 cases, false positive 4 cases, false negative none and true negative 26 cases.. It was observed that, sensitivity 100.0%, specificity 86.7%, accuracy 94.3%, positive predictive value 90.9% and negative predictive value 100.0%.

Conclusion: In this study the cytopathological diagnosis of space occupying lesion in the liver significantly correlated with Computed Tomography (CT). Considering the high validity parameter it can be concluded that CT scan is a useful diagnostic modality for the diagnosis of space occupying lesions in the liver.

Key words : Hepatic space occupying lesions; CT Scan; Hepatocellular carcinoma.

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Introduction

The liver is the largest and one of the most complex organs in the human body with a multitude of functions that range from a synthetic and secretory nature to detoxification and surveillance. There is dual blood supply from the portal vein and hepatic artery. The liver is also part of the monocyte–macrophage system. Hence, it is affected not only by primary hepatic pathologies but by extrahepatic or systemic diseases as well.

A space occupying lesion can be defined as a discrete abnormality within the liver. It can be classified into developmental, neoplastic, inflammatory and miscellaneous. Although in some cases, it is difficult to differentiate these lesions with imaging criteria alone, certain focal liver lesions have classic ultrasonic, computed tomographic and magnetic resonance imaging features.

Common focal liver lesions may be malignant or benign in nature like metastatic tumors, hepatocellular carcinoma and cholangiocarcinoma. Benign focal liver lesions are cysts, hemangiomas, focal nodular hyperplasia, hepatic adenomas and abscesses. Once a mass is found in the liver, its number, location, characteristics and extension into the surrounding structures should be determined by using means that are both precise and economic.

For the detection and characterization of focal liver lesion, ultrasonography, Computed Tomography (CT) Magnetic Resonance Imaging (MRI) hepatic artery angiography and radionuclide scan are available. Ultrasonography and computed tomography play a primary role. For further characterization, magnetic resonance imaging provides valuable information.

Whereas un-enhanced ultrasound and color Doppler ultrasonographic examination are widely used to screen liver lesions, these techniques have limited performance in the characterization of solid focal tumors.[1-3] Thus contrast enhanced Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) is required to assess the nature of the tumors as basis for therapy decisions. The characterization of lesions with contrast enhanced CT or MRI is based on the vascularity and enhancement pattern within the lesion.[4,5]

Multiphase contrast-enhanced Computed Tomography (CT) has been widely used for the characterization of focal liver lesions, such as Hepatocellular Carcinoma (HCC) metastases and hemangioma etc, due to its various advantages.[6] A multiphase CT study can be acquired in four phases: non contrast phase, arterial phase, portal venous phase and delayed phase. The visual characteristics of focal liver lesions and their evolutions over the four phases carry important diagnostic information. Generally focal liver lesions similar in image appearance correspond to the same disease category hence radiologists can, to a certain extent, characterize the lesions based on their radiological appearances.[7] Multi-phase hepatic CT is the current standard that effectively diagnoses 63%–87% of focal changes in the liver. In diagnosis of hepatic metastases, the sensitivity of 18F-FDG-PET/CT scans reaches up to 96% and their specificity is estimated at 75%.[8]

Materials and methods

It was a cross sectional type of study done in Chittagong Medical College Hospital (CMCH) Chattogram during a six months from June 2016 to November 2016. This study was carried out on patients, having suspected hepatic lesions (Clinical / on ultrasonography / High serum α-fetoprotein level). Among of 70 patients where purposive sampling technique was applied. Un-cooperative patients, when follow up is not possible, cytopathology report not available in hand, patients with diffuse liver disease, cardiac disease and pregnant women with suspected liver disease, patients who have iodinated contrast administration in the previous 48 hours, lithotripsy in the previous 72 hours and liver biopsy in the previous 24 hours and patients with hypersensitivity to CT contrast agents and patients in whom CT or FNAC is contraindicated due to any other reason were excluded. All CT scans was performed with a multidetector Philips MX whole body scanner using standard technical parameters. CT protocol was maintained. Both pre and post contrast scans were performed. At first a non contrast scan was taken. Before giving IV contrast, the patient was given water soluble oral contrast medium (Iodinated contrast medium of 370 strength).Then 1mg/kg body weight of nonionic water soluble contrast medium (Inj iopamiro, 370 strength) was injected in anticubital vein by automated injector at 3 ml/sec for a total of 100 ml. The arterial phase of scanning was taken 18 secs after the start of bolus, second phase (Portal venous phase) 35 secs after the start of bolus & the last phase (Hepatic venous) was taken at 60 secs (Delayed images can be taken upto 10-15 mins). 5-7 mm contiguous slices were obtained through the upper abdomen in craniocaudal direction during single breath hold. CT scan images were interpreted by specialist radiologist. On precontrast images, size of liver along with number and location of lesion was seen. Density of lesion was noticed in precontrast images. In postcontrast scan, each lesion was judged according to enhancement pattern. On hepatic arterial phase images, the presence or absence of hypervascular components within the lesion was recorded. A hypervascular component was defined as an area of enhancement greater than the surrounding liver parenchyma. Each lesion was evaluated for the presence or absence of contrast material washout on the portal venous phase images. The wall of lesions was carefully observed, either ill or well defined. Presence of vascular invasion and abdominal lymphadenopathy was noted, if any. Statistical analyses of the results were obtained by using window based computer software devise with Statistical Packages for Social Sciences (SPSS-20). The results were presented in tables, figures, diagrams. For the validity of study outcome, sensitivity, specificity, accuracy, positive

predictive value and negative predictive value of Computed Tomography (CT) in the evaluation of hepatic space occupying lesion was calculated.

Ethical implications

Participation in this research was fully voluntary. Written informed consent was taken from each patient. Prior to consent they were explained the aims and purpose of the research. The respondents were entirely free to withdraw their participation at any stage or at any time of the study confidentiality was assured and anonymity was maintained, no participant was identified in any report or publication under this study.

Results

Table I : Baseline Characteristics of the Study Population (n=70).

Particulars of the patients	Number of patients	Percentage
Age (In years)		
≤40	30	42.9
41-50	22	31.4
51-60	14	20.0
>60	4	5.7
Mean ± SD	45.7±11.6	
Range (Min, max)	25, 85	
Sex		
Male	42	60.0
Female	28	40.0
Socioeconomic condition		
Low	26	37.1
Middle	44	62.9
High	0	0.0

From Table-I it was observed that majority (42.9%) patients had belonged to age ≤ 40 years. The mean age was 45.7 ± 11.6 years with ranged from 25 to 85 years. Almost two third 42(60.0%) patients were male. In socioeconomic condition almost two third (62.9%) patients came from middle class.

Table II : Distribution of the study patients by CT scan Findings (n=70).

CT findings	Number of patients	Percentage
Liver size		
Normal	26	37.1
Enlarged	44	62.9
Number of lesion		
Single	34	48.6
Multiple	36	51.4
Size of lesion (cm)		
<5.0	46	65.7
>5.0	24	34.3
Mean ± SD	5.0 ± 3.2	
Range (Min, max)	1.2, 13.0	
Consistency of lesion		
Solid	30	42.9
Cystic	10	14.2
Mixed	30	42.9
Location of mass		
Right	24	34.3
Left	10	14.3
Both lobe	36	51.4
Margin of mass		
Well defined	38	54.3
Ill defined	32	45.7
Pre contrast appearance		
Isodense	6	8.6
Hyperdense	2	2.9
Hypodense	44	62.8
Mixed density	18	25.7
Post contrast enhancement		
No enhancement	12	17.1
Mild	4	5.7
Moderate	26	37.1
Marked enhancement	28	40.0
Phase of contrast		
Arterial	55	78.6
Venous	9	12.9
Delayed	6	8.6
Enhancement pattern		
Homogenous	10	14.3
Heterogenous	28	40.0
Rim enhancement	32	45.7
Calcification		
Present	2	2.9
Absent	68	97.1
Necrosis		
Present	28	40.0
Absent	42	60.0
Lymphadenopathy		
Present	22	31.4
Absent	48	68.6
Portal vein invasion		
Present	2	2.9
Absent	68	97.1

Table II showed almost two third 44(62.9%) patients had enlarged liver, 36(51.4%) patients had multiple number of lesions, the mean size of lesion had 5.0 ± 3.2 cm with ranged from 1.2 to 13.0 cm, 36(51.4%) patients had lesions in both lobe of liver, 38 (54.3%) patients had well defined margin of mass, 44 (62.8%) patients had hypodense lesion in pre contrast CT, 28 (40.0%) patients had marked enhancement in post contrast CT, 55 (78.6%) patients had lesion enhancement

in arterial phase of contrast, 32 (45.7%) patients had rim enhancement, 2 (2.9%) patients had calcification, 28 (40.0%) patients had necrosis, 22(31.4%) patients had lymphadenopathy, 2 (2.9%) patients had portal vein invasion.

Table III : Cytopathology of space occupying lesions in the liver (n=70).

Cytopathology report	Number of patients	Percentage
Benign	30	42.9
Cyst	10	14.3
Abscess	20	28.6
Malignant	40	57.1
HCC	14	20.0
Metastasis	26	37.1

It was observed that, 10(14.3%) patients had cyst and 20(28.6%) patients had abscess in benign cases. In malignant cases 14(20.0%) patients had HCC and 26(37.1%) patients had metastasis (Table III.

Table IV : CT scan diagnosis of space occupying lesions in the liver (n=70).

CT diagnosis	Number of patients	Percentage
Benign	26	37.1
Cyst	8	11.4
Abscess	18	25.7
Malignant	44	62.9
HCC	10	14.3
Metastasis	34	48.6

From Table IV it was observed that, 8(11.4%) patients had cyst and 18(25.7%) patients had abscess in benign cases. In malignant cases 10 (14.3%) patients had HCC and 34 (48.6%) patients had metastasis.

Table V : Comparison of CT scan with cytopathology report of space occupying lesions in the liver (n=70).

CT diagnosis	Cytopathology report		Total
	+ve for Malignant	-ve for Malignant	
+ve for Malignant	40 (True positive)	4 (False positive)	44
-ve for Malignant	0 (False negative)	26 (True negative)	26
Total	40	30	70

Table V, shows true positive 40 cases, false positive 4 cases, false negative none and true negative 26 cases.

Table VI : Validity of CT scan in diagnosis of space occupying lesions in the liver.

Validity test	Percentage (%)
Sensitivity	100.0
Specificity	86.7
Accuracy	94.3
Positive predictive value	90.9
Negative predictive value	100.0

It was observed that, sensitivity 100.0%, specificity 86.7%, accuracy 94.3%, positive predictive value 90.9% and negative predictive value 100.0% (Table VI).

Discussion

This cross sectional study was carried out with an aim to establish diagnostic usefulness of CT scan in evaluation of space occupying lesion in the liver and to assess the enhancement pattern of the lesion in CT scan. This study also correlate the CT diagnosis of hepatic space occupying lesion with cytopathology report as well as to determine and validate the diagnostic accuracy, sensitivity, specificity, Positive Predictive Value (PPV) and Negative Predictive Value (NPV) of CT in the evaluation of hepatic space occupying lesion.

In this present study, it was observed that majority (42.9%) patients had belonged to age ≤ 40 years. The mean age was 45.7±11.6 years with ranged from 25 to 85 years. Hafeez et al observed the mean age was 46.5 ± 13.4 years and all the patients of age over 18 years.[9] Similarly, Ibrahim et al found the mean age was 41.4 ± 10.5 years.[10] On the other hand Jeon et al found the age range varied from 29–78 years with mean age 58 years.[11] The higher mean age and age range maybe due to geographical variations, racial, ethnic differences, genetic causes, different lifestyle and increased life expectancy may have significant influence on hepatic space occupying lesions.

In this present study, it was observed that almost two third (60.0%) patients were male and 40.0% female and male to female ratio was 1.5:1, which is closely resembled with Jeon et al study, where they found male to female ratio was 1.4:1.[11] Similarly, Hafeez et al and Ibrahim et al were also found male predominance in their respective studies.[9,10] Regarding the socioeconomic condition in this present study, it was observed that almost two third (62.9%) patients came from middle class family.

According to CT findings, it was observed that almost two third 44 (62.9%) patients had enlarged liver size, 36 (51.4%) patients had multiple number of lesions, the mean size of lesion was 5.0 ± 3.2 cm with ranged from 1.2 to 13.0 cm, 36 (51.4%) patients had lesions in both lobe of liver, 38 (54.3%) patients had well defined margin of mass, 44 (62.8%) patients had hypodense lesion, 28 (40.0%) patients had marked enhancement in post contrast CT, 55 (78.6%) patients had arterial enhancement, 32 (45.7%) patients had rim enhancement, 2 (2.9%) patients had calcification, 28 (40.0%) patients had necrosis, 22(31.4%) patients had lymphadenopathy, 2 (2.9%) patients had portal vein invasion. In our country a study done by Parveen found enlarged liver in 66.7% cases, 13.3% contracted and 20.0% normal at USG.[12] At CT findings, liver size was found 77.3% enlarged, 20.0% contracted and 6.7% normal. Lee et al in their study reported that most were isodense or hypodense in unenhanced scan with mostly hyperdense or isodense in arterial phase and mostly iso or hypodense in delayed portal venous phase.[2] In another study Yaqoob et al found 81.0% hyperattenuating, 15.0% isoattenuating and 3.5% hypoattenuating in arterial phase.[13] The portal venous phase images showed hyperattenuation 2.3%, isoattenuation 49.0% and hypoattenuation 48.0%. The above study findings closely resemble with the current study. In BIRDEM a study done by Parveen found margin of lesions were well defined in 40.0% cases, ill defined in 36.7% cases and irregular in 23.3% cases at CT scan.[12] Hafeez et al found the mean lesion size was 3.4± 2.6 cm ranging from 0.9 to 13 cm, which are comparable with the current study.[9]

According to cytopathology, in this present study, it was observed that, 14.3% patients had cyst and 28.6% patients had abscess in benign cases. 20.0% patients had HCC and 37.1% patients had metastases in malignant cases. The gold standard for detection of focal lesions in liver is enhanced MRI or triple phase dynamic spiral CT.[14] Conventionally a triple phase CT scan includes unenhanced, arterial and venous phases. This is only required for small lesions thought to be HCC or cysts and hemangiomas. A single imaging modality can be sufficient in cases such as metastasis which show interval development or progression. CT Porto angiography is one of the most sensitive imaging for metastasis but it is an examination that is performed in high selected cases, in few institutions and not for all types of liver lesions.[15] FDG PET CT scan is not very useful for HCC and therefore is not the best imaging modality to distinguish benign from malignant lesions.[15] Ultrasound contrast agents and MRI using iron or gadolinium contrast better detect smaller lesions, satellite lesions or distant metastasis.[16] Radiographic characteristics favouring hepatocellular carcinoma include the presence of a lesion with different densities, arterial hyper vascularisation and venous wash-out.

According to CT diagnosis, in this present study, it was observed that, among malignant cases 14.3% patients had HCC and 48.6% patients had metastases. Among benign cases 11.4% patients had cyst and 25.7% patients had abscess. Accidentally detected benign tumors occur in around 15% of the healthy population and focal changes are malignant in persons without cancer history does not exceed 1.0%.[17] It is estimated that around 20% of focal liver lesions (Which are not simple cysts) observed in patients with malignancies are benign, but such changes are regarded as metastases until they are ruled out. Metastatic tumors account for 95% of all hepatic malignancies, while primary tumors for only 5%. Hepatocellular Carcinoma (HCC) is a common tumor with an incidence of 1 - 6 % among cirrhotic patients. Risk factors include cirrhosis, alcohol, HBV, HCV, metabolic liver diseases, environmental carcinogens, hormonal treatments and smoking[18]. About 90% - 95% of HCC arise in cirrhotic livers. New abdominal pain, recent hepatomegaly, hemoperitoneum, persistent fever or weight loss should raise suspicion for HCC.

Comparison of CT scan with cytopathology report of hepatic space occupying lesions showed that true positive 40 cases, false positive 4 cases, false negative none and true negative 26 cases. Hafeez et al found 35 true positive, 2 false positive, 8 true negative and 0 false negative results reported on CT based assessment of liver lesions.[9] Parveen observed true positive 23 cases, false positive 4 cases, false negative 2 cases and true negative 3 cases of HCC.[14] Similar findings obtained by Snow et al, where they found false positive 12.0% and false negative 8.0%, which are comparable with the current study.[18]

In this present study the validity test of CT scan in evaluation of hepatic space occupying lesion showed 100.0% sensitivity, 86.7% specificity, 94.3% accuracy, 90.9% positive predictive values and 100.0% negative predictive values. The sensitivity of CT (85%) can be augmented by CT arterial portography.[19] The most promising imaging modality is PET CT with FDG that accumulates in cells with hyper metabolism. Colon, lung, and breast cancer can be staged with PET CT with sensitivity 92 - 100% and specificity 85 - 100%.[20] Multi-phase hepatic CT is the current standard that effectively diagnoses 63%–87% of focal changes in the liver. In diagnosis of hepatic metastases, the sensitivity of 18F-FDG-PET/CT scans reaches up to 96% and their specificity is estimated at 75%.[8]

Assy et al found that the diagnostic accuracy of Computed Tomography (CT) was 74.0%, sensitivity 70.0%, specificity 86.0%, positive predictive value 95.0%, negative predictive value 43.0% in the diagnosis of liver mass.[21] Hafeez et al assessed that CT scan has a sensitivity of 100%, specificity of 80%, positive predictive value of 94.5%, negative predictive value of 100% and diagnostic accuracy of 95.5% in differentiating benign from malignant liver lesions.[9] A study using high-resolution ultrasonography in patients confirmed with biopsy or laparoscopy found a sensitivity and specificity of 91.1 and 93.5 percent respectively, positive and negative predictive values of 93.2 and 91.5 percent respectively.[22] The above findings are comparable with the current study.

Limitation

- The study population was selected from one selected hospital in Chattogram City, so that the results of the study may not reflect the exact picture of the country.
- The present study was conducted at a very short period of time.
- Sample size is small. Therefore, in future further study may be undertaken with large sample size.
- In cases of multifocal lesions, FNAC of largest and most approachable lesion was performed.

Conclusion

CT scan has some additional advantages. All the upper abdominal anatomy is displayed on the CT image, providing information about extra hepatic lesion that may be important to interpret the image. Characterization of various hepatic tumors is of great therapeutic and prognostic relevance and has thus been one of the focuses of multiple imaging research studies. Characterization of focal liver lesions depends on their enhancement pattern and the vascular architecture, because they clearly differ between various types of tumors. This study was undertaken to establish diagnostic usefulness of Computed Tomography (CT) in evaluation of space occupying lesion in the liver. Cytopathological diagnosis of hepatic space occupying lesions in this study significantly correlated with Computed Tomography (CT). It can be concluded that CT scan is useful diagnostic modality in pre-operative discrimination of space occupying lesions in the liver and it should be worthy to note here that Computed Tomography (CT) scan can be used as a reliable tool with which we can assess space occupying lesions in the liver and it can facilitate the subsequent appropriate management in majority of cases.

Recommendations

Further studies can be undertaken by including large number of patients.

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Contributions of authors

SS-Conception, design, acquisition of data, drafting & final approval.

SM-Design, data analysis, interpretation of data, critical revision & final approval.

AKR-Data analysis, critical revision &final approval.

Disclosure

All authors declared no competing interest.

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