Original Research Paper

Volume - 11 | Issue - 02 | February - 2021 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Radiology

ROLE OF TRIPLE PHASE CONTRAST ENHANCED COMPUTED TOMOGRAPHY IN HEPATIC LESIONS AND THEIR CYTOPATHOLOGICAL CORRELATION

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ABSTRACT **AIMS:** To evaluate the enhancement patterns of hepatic lesions on triple phase contrast enhanced computed tomography and to correlate the CT findings of hepatic lesions with cytological findings on fine needle aspiration cytology (FNAC).

Settings and Design: This prospective observational study was carried out at Department of Radiodiagnosis, Gobind Singh Medical College and Hospital, Faridkot. The study was approved by the Institutional Ethics Committee. Source of Data: A total of 75 patients who had hepatic lesions on ultrasonography and clinical suspicion of focal hepatic lesions were referred for CECT abdomen. Findings of Triple phase CT for hepatic lesions were correlated with cytopathological findings.

Methods and Material: A Triphasic CECT abdomen was performed on Siemens Somatom Perspective 128 slice scanner in the Department of Radiodiagnosis, Guru Gobind Singh Medical College and Hospital, Faridkot. The entire liver was scanned successively, in arterial, portovenous and delayed phases. A 5mm collimation and 5mm/sec table speed were used. After obtaining a digital scout view, unenhanced scan of the liver was obtained.1.5ml/kg body weight of 300mgI/ml iodinated contrast material was administered by using a pressure injector at a rate of 3.0 mL/s using a pressure injector.USG/CT guided FNAC was done. CT imaging findings were classified as benign or malignant by correlating them with cytopathological findings.

Results: The present study inferred that Triple phase CECT is a highly sensitive and specific imaging modality for detection and characterization of hepatic lesions with an overall sensitivity and specificity of 100.00 % (95% C.I. 92.45% to 100%) and 92.86% (95% C.I. 76.50% to 99.12%)respectively when correlated with cytopathological findings.

Conclusions: It is inferred from our study that triple phase CECT is highly sensitive and specific imaging modality for detection and characterization of hepatic lesions with wide availability in the present scenario.

KEYWORDS : CT,Triple phase Contrast Enhanced,Hepatic Lesions

INTRODUCTION

The liver is the largest solid organ, the largest gland and one of the most vital organs in human body that functions as a centre for metabolism of nutrients and excretion of waste metabolites. Its primary function is to control the flow and safety of substances absorbed from the digestive system before distribution of these substances to the systemic circulatory system. A total loss of liver function could leads to death within minutes, demonstrating the liver's great importance[1] Cancers of the liver are one of the commonest cancers that occur in the world, the commonest of which is the hepatocellular carcinoma (HCC). It is considered to be the 5th commonest cancer in the world.[2] HCC is very common in India with two peaks, one at a young age between 40 to 55 years and another above 60 years. Eighty per cent of all HCCs occurring in India occur with cirrhosis of liver in the background and 60% of all these cases are hepatitis B positive carriers. Symptoms are reflective of late presentation with advanced disease.[3] An annual Report by National Centre for Diseases Informatics and Research, India in which the data collected from all over India. The data from Punjab showing five districts (Bathinda, Mohali, Ludhiana, Faridkot and Mansa) that had high incidence rates of cancer. The PBCR (Population Based Cancer Registry) of the above said 5 districts were comparable with that of other PBCRs in the Metro cities of India.[4] Liver has dual source of blood supply, nearly 75-80% from portal vein and 20- 25% from hepatic artery. As the normal liver receives predominant blood supply from the portal vein, most primary and secondary liver neoplasms receive 80-95% of their blood supply from the hepatic artery. This difference in pattern of blood flow forms the basis of triple phase studies of liver. This technique has helped to elucidate the imaging features of primary and metastatic liver tumors.[5] Liver, probably as a consequence of its anatomic location, size, dual blood supply and favorable nutritional elements, is the site of neoplastic lesions, which are greater in number and diversity than those seen in any other organ. Liver is prone to various diseases including benign and malignant because of its major function of digestion, detoxification and rich blood supply by hepatic artery and portal vein.[6] Liver masses present a relatively common clinical dilemma, particularly with the increasing use of various imaging modalities in the diagnosis of abdominal and other symptoms. The accurate and reliable determination of the nature of the liver mass is critical, not only to reassure individuals with benign lesions but also, and perhaps more importantly, to ensure that malignant lesions are diagnosed correctly. Appropriate interpretation of the clinical history and physical examination and with the judicious use of laboratory and imaging studies, the majority of liver masses can be characterized noninvasively.[7] Malignant focal lesions of liver can broadly be classified as primary and secondary. The most common primary malignancy of liver is hepatocellular carcinoma. Differentiation of various liver lesions is considered to be critical for determining the treatment options. The differential diagnosis (malignant and non malignant lesions) in patients presenting with a focal liver lesion is broad.[8] Hepatic lesions are being identified increasingly because of the widespread use of imaging modalities such as ultrasonography, Radionuclide scanning, triple phase contrast enhanced computed tomography (CECT) and Magnetic Resonance Imaging (MRI). Liver lesions are not visible on conventional radiography unless calcified. Ultrasonography (USG) is most often used as the initial imaging modality of investigation for screening liver lesions due to its relatively low cost, safety and wide availability, but the differentiation between benign and malignant lesions is difficult in many cases with this technique. However, often the definitive diagnosis is not based on gray-scale information alone and a lesion detected on ultrasound is generally evaluated further with contrast-enhanced computed tomography (CECT). Triple phase CECT has become the primary imaging modality for detection and characterization of focal liver lesions. It is an effective aid in determining the number, location, and nature of such lesions and monitoring their size over time. Despite increased competition from MRI over the last decade, role of CT diagnosis of diseases of liver has not been significantly affected. The dominance of CT in hepatic imaging is primarily due to its excellent visualization of anatomic relationship and of liver position relative to adjacent organs. A triple phase CECT has a crucial role in distinguishing a benign lesion from malignant and thus avoids

unnecessary invasive procedures especially in benign lesions like hemangiomas.[9] Magnetic Rasonance Imaging (MRI) is slightly better in the diagnosis of HCC when compared with CT due to improved detection of small lesions 1–2 cm. However, MRI remains relatively insensitive for the detection of small HCC nodules ,in tumors larger than 2 cm, MRI is reported to have accuracy 90%, however, in tumors less than 2 cm, this level is reduced to 33%.[10,11] CT offers the advantages of characterization of lesion and provides important preoperative information. Although current literature shows that MRI has a comparable rate in detection and classification of focal liver lesions, however, wide availability and short scanning time has made CT an ideal imaging technique.[9] Fine needle aspiration cytology (FNAC) is useful in diagnosis of hepatic lesions and can be performed under guidance of ultrasound or computed tomography (CT) scan with low risk of complications. It is used for diagnosing primary or metastatic lesions in liver but occasionally it may be used to diagnose inflammatory lesions or diffuse liver diseases which may appear as inhomogeneous regions in imaging mimicking mass like lesions. Nuclear medicine imaging techniques have unique role in the evaluation of hepatic masses. Hepatic blood-pool scintigraphy is extremely useful for the confirmation or exclusion of benign hepatic hemangiomas.

AIMS:

To evaluate the enhancement patterns of hepatic lesions on triple phase contrast enhanced computed tomography and to correlate the CT findings of hepatic lesions with cytological findings on fine needle aspiration cytology (FNAC).

MATERIALS AND METHODS -

This prospective observational study was carried out at Department of Radiodiagnosis, Gobind Singh Medical College and Hospital, Faridkot. The study was approved by the institutional ethics committee. Source of Data: A total of 75 patients who had hepatic lesions on ultrasonography and clinical suspicion of focal hepatic lesions were referred for CECT abdomen. Sample Size: 75 cases Duration of Study: 12 months

INCLUSION CRITERIA:

1. Age-18 to 70 years. 2. All patients with clinical suspicion of focal liver lesions. 3. Patients with liver lesions detected on ultrasound or conventional CT.

EXCLUSION CRITERIA:

1. All pregnant women with suspected liver disease. 2. All patients with hypersensitivity to contrast agents. 3. Patients with deranged renal function tests. 4. Patients not willing to participate. 5. Patient with history of abdominal trauma

METHODOLOGY :

Detailed history and clinical examination of the patients were recorded. Routine investigations like CBC, LFTs, RFTs, ESR were done. Relevant serological tests were performed wherever required. Tumor markers like AFP, CA-19-9, CA-125 etc. were done wherever required. A Triphasic CECT abdomen was performed on Siemens Somatom Perspective 128 slice scanner in the Department of Radiodiagnosis, Guru Gobind Singh Medical College and Hospital, Faridkot. The entire liver was scanned successively, in arterial, portovenous and delayed phases. A 5mm collimation and 5mm/sec table speed were used. After obtaining a digital scout view, unenhanced scan of the liver was obtained.1.5ml/kg body weight of 300mgI/ml iodinated contrast material was administered by using a pressure injector at a rate of 3.0 mL/s using a pressure injector with 20-G catheter. After 13 or 15 seconds of contrast administration, the entire liver was scanned in early arterial phase followed by late arterial phase scan which was done at 35-40 seconds of contrast injection. Then, liver was scanned in portovenous phase at 70-80 seconds after contrast injection. At the end, delayed phase scan of liver was done after 8-10 min post contrast administration. The images acquired in different phases were evaluated in detail to identify lesions, classify according to age, clinical background and other imaging findings. USG/CT guided FNAC was done. Imaging findings were classified as benign or malignant by correlating them with cytopathological findings.

Sample Size- Based on previous data it is assumed that prevalence rate of hepatic lesion in our hospital is 5.1%

Assumptions: Confidence Level = 95% Precision (d) = ± 5%

For estimation of sample size, the following formula was used n = (Z2 α X P X (1-P))/d2 Where; Zα = Value of standard normal variate corresponding to α level of significance P = Likely value of parameter Q = 1 – P d = Margin of errors which is a measure of precision, with these assumptions the sample size works out as 75.

OBSERVATIONS AND RESULTS

The present study was conducted at Guru Gobind Singh Medical College and Hospital, Faridkot(Punjab) with a total of 75 cases on which Triple phase CECT study was done.The CECT findings were correlated with cytopathological findings.The patients were categorized according to age(Table1),Gender(Table2),chief complaints (Table 3),Findings on Unenhanced CT(Table 4,5), Enhancement pattern of the lesions in Early Arterial,Late Arterial, Portovenous and Delayed Phases(Tables 6,7,8,9). Radiological Diagnosis was made based on CT findings and lesions were characterized as Benign and Malignant(Tables10,11,12).Pathological Diagnosis was made based on cytopathological findings and lesions were characterized as benign and Malignant.(Table 13,14) The sensitivity, specificity, Positive and Negative predictive value of CT in characterizing lesions as benign and malignant were calculated(Table 15,16).

DISCUSSION

In present study 75 cases were enrolled as per the inclusion and exclusion criteria. Hemangioma was the most common benign lesion (10 cases, 13.3%) followed by simple hepatic cyst (6 cases 8.0%). Hydatid cyst (3 cases 4.0%) and amebic abscess 2 cases (2.7%), 1 case (1.3%) of hepatic adenoma and granulomatous disease each. In the present study Radiological Diagnosis of hemangioma was made in 9 cases (12.0%) on triple phase CECT(Figure 1). All cases were confirmed on cytopathological correlation. A case of giant hemangioma more than 10 cm in size was involving entire right lobe and segment IV of left lobe showed inhomogeneous enhancement on early arterial and late arterial phase images 78 with gradual washout on portovenous and delayed phases of triple phase CECT and suspected to be as hepatocellular carcinoma however it was confirmed as giant hemangioma on 99mTcRBC scintigraphy. In our study, out of 10 (13.3%) cases 9 cases (12%) showed hypodense lesion and 1 case(1.3%) showed heterogeneously hyperdense lesion on unenhanced scan. 9 cases (12%) showed early discontinuous peripheral enhancement in early and late arterial phase images with progressive centripetal filling in portovenous and delayed phases. In the present study 5 cases (7.9%) of pyogenic abscess and 2 cases (2.7%) of amoebic abscess were diagnosed on triple phase CECT. Cytopathological correlation was done in all cases of pyogenic abscess and in 1 case of amebic abscess. However, 1 case of amoebic abscess had multiple lesions on triple phase CECT with peripheral enhancement on portovenous phase and diagnosed as pyogenic abscess but later on confirmed as amoebic abscess on cytopathology. 1 case of pyogenic abscess which showed a single lesion with peripheral enhancement on CECT was radiologically diagnosed as amebic abscess was later confirmed as pyogenic abscess on cytopathology. Out of 2 cases of amebic abscesses 1 case was confirmed on serological diagnosis. Double target sign consisting of a hypodense central cavity formation which is surrounded by a high attenuation rim corresponding to enhancing wall of abscess (inner rim) and low attenuation rim 79 corresponding to perilesional edema (outer rim) was seen in 2 cases of pyogenic abscess and 1 case of amoebic abscess (3 out of 7 cases, 42.8 %) as compared to study by Toshifunie Gabata et al.[12] 42% cases of hepatic abscess were having double target sign. Pyogenic abscess were mainly multiple (4 cases, 80 %) and 1 case (20%) was single. This is also a feature to differentiate pyogenic abscess for amebic abscess otherwise no definite distinguishing features were delineated in our study. In our study hepatic abscess were noted only in male with no case in female. These observations corroborated well with study done by Abbas MT et al.[13] (Male to Female ratio was 10:1). In our study, 3 cases were diagnosed as hydatid cyst on triple phase CECT(Figure 2). Out of them, were confirmed on cytopathological correlation and 1 case showed well defined calcified lesion with no enhancement on triple phase CECT which was not confirmed on cytopathology. These were detected only in males. 2 cases were seen in 31-40 years of age group and 1 (33.3%) was in 41-50 years of age group. 1 case had well defined fluid attenuating lesion with tiny cystic areas within while another case showed well defined hypodense lesion with peripheral enhancement and enhancing septa within ,was confirmed on serology as well as on cytopathology. A 30 year female patient diagnosed as hepatic adenoma on triple phase CECT which was later confirmed on cytopathological correlation. The

lesion was well defined inhomogeneous with low attenuation areas with presence of fat. On arterial and portovenous phases, peripheral enhancement with a prominent feeding vessel was seen. No wash out was seen on delayed phase images. In view of risks of haemorrhage, rupture and malignant transformation associated with hepatic adenoma, it must be distinguished from other hyper vascular lesions occuring in young patients (E.g. Focal Nodular Hyperplasia). Well defined single or multiple lesions with areas of fat and hemorrhage on plain scan are characteristic of adenoma. On contrast study adenoma moderately hyper attenuating on arterial phase and nearly iso attenuating on porto-venous and delayed phases , whereas Focal Nodular hyperplasia appear homogeneous on unenhanced scan and show enhancement on arterial phase with central non enhancing scar which may enhance on delayed phase images. In our study 49 (65.3%) malignant cases were diagnosed on triple phase CECT .On cytopathological correlaton, 47 cases (62.7%) were malignant and 2 cases (2.7 %) were benign. One case of them was diagnosed as metastasis on triple phase CECT due to peripheral enhancement in the lesion and patient was a known case of ovarian carcinoma but later on found to be hepatic granulomatous disease on cytopathological correlation. Another case was diagnosed as hepatocellular carcinoma, which was later on proved to be giant hemangioma on 99mTcRBC scintigraphy. In the present study metastasis were diagnosed in 27 cases (36%) on triple phase CECT and on cytopathological correlation 26 cases (34.7%) of metastasis were detected. Triple phase CECT appearance of majority of the metastatic lesions ,in our study were multiple ill defined hypodense lesions scattered in both lobes of liver wih inhomogeneous enhancement in early arterial, late arterial and portovenous phases with washout of contrast on delayed phases(Figure 3). Metastases from several tumors (e.g. renal cell carcinoma, neuroendocrine tumor, choriocarcinoma, melanoma and thyroid carcinoma) have relatively greater hepatic arterial blood supply due to enhancement is seen only in arterial phase. In our study 5 cases showed hypervascular lesion on arterial phase images with washout of contrast on portovenous phase images. In our study, the second most common malignant case was hepatocellular carcinoma (HCC) 20 cases (26%). HCC was diagnosed in 21 cases (28%) on triple phase CECT(Figure 4). On unenhanced scan 10 cases of HCC were hypodense, 5 cases were nearly isodense and 6 cases were hyperdense compared to normal liver parenchyma. All cases showed enhancement on late arterial and portovenous phases and washout on delayed phase. Multiple lesions were noted 14 cases and a single lesion were noted in 6 cases. 16 cases of HCC were male and 4 cases were female. In our study, 5 cases (6.7%) of HCC were hepatitis C positive and 4 cases (5.3%) were having increased AFP levels. Chronic liver disease found is 13 cases (65%) and portal vein thrombosis was seen in 12 cases (60%). Findings of our study regarding portal vein thrombosis were similar to those reported by Fujiyama S et al. (71.0%).[14] In our study cholangiocarcinoma was radiologically diagnosed in 1 case (1.3%) on triple phase CECT. on triple phase CECT bilobar intrahepatic biliary radicles dilatation was noted and heterogeneous enhancement was noted on delayed scan with no enhancement on arterial and portovenous phases .The diagnosis was confirmed on cytopathological correlation. In our study, 47 cases (65.3%) were malignant and 26 cases (34.7%) were benign. Finding of our study were similar to a study done by Gupta et al [15] in which 64% patients were benign and 36% were malignant.Findings of our study did not corroborate with a study done by Hanninen et al[16] in which the incidence of malignant and benign lesion was 83.3% and 16.7% cases respectively. In our study 26 cases (34.7%) had metastatic lesions which was corroborated well with a study by Hafeez S et al.[17], who found 37.5% metastatic lesions in their entire sample. The result of our study did not corroborate with study done by Chauhan U et al.[18] who found that only 26.7% cases of metastases and Goel S et al.[19] , who had 42.1% metastatic lesions in their study. This disparity may be reflective of regional differences in the distribution of the disease. The overall sensitivity , specificity ,Positive predictive value and Negative predictive value of triple CECT scan in evaluation of hepatic lesions in our study was 100.00 % (95% C.I. 92.45% to 100%) , 92.86% (95% C.I. 76.50% to 99.12%), 95.9% and 100.00% respectively. Findings of our study corroborated well with the study done by Ahirwar CP et al.[20] in which sensitivity, specificity, positive predictive value and negative predictive value of triple phase CECT for detection of hepatic lesions were 91.3%, 97.8%, 91.3% and 97.8% respectively.

CONCLUSION

The Present study was conducted on 75 patients at Guru Gobind Singh Medical College and Hospital, Faridkot with the objective to evaluate the enhancement patterns of hepatic lesions on triple phase contrast enhanced computed tomography and to correlate the CT findings with cytolopathological findings. It is inferred from our study that triple phase CECT is highly sensitive and specific imaging modality for detection and characterization of hepatic lesions with wide availability in the present scenario.

Table-1(Age wise distribution of cases)

Age group	No. of cases	Percentage
18-30 years	5	6.7%
31-40 years	8	10.7%
41-50 years	21	28.0%
51-60 years	22	29.3%
61-70 years	19	25.3%
TOTAL	75	100.0%

Table-2(Gender wise distribution of cases)

Sex	No. of cases	Percentage
Female	22	29.3%
Male	53	70.7%
TOTAL	75	100.0%

Table 3: Distribution of cases according to complaints.

History	No. of cases	Percentage
Pain In Abdomen	33	44.0%
Weight Loss	13	17.3%
Lump In Abdomen	12	16.0%
Abdominal Distension	8	10.7%
Loss Of Appetite	7	9.3%
Fever	6	8.0%
Anorexia	5	6.7%
Jaundice	8	10.7%
Alcoholism	4	5.3%
Nausea & Vomiting	2	2.7%
Generalised Weakness	2	2.7%

Table 4: Unenhanced CT findings (Heterogeneous or homogeneous)

Unenhanced CT findings	No. of cases	Percentage
Heterogeneous	35	46.7%
Homogeneous	40	53.3%

Table 5: Unenhanced CT findings based on density

Unenhanced CT finding	No. of cases	Percentage
Hypodense	35	46.7%
Hyperdense	24	32.0%
Nearly Isodense	16	21.3%
TOTAL	75	100.0%

Table 6: Enhancement on early arterial phase

Enhancement on early arterial phase	No. of cases	Percentage
Enhancement	40	53.3%
No Enhancement	35	46.7%
TOTAL	75	100.0%

Table 7: Enhancement on late arterial phase

Enhancement on late arterial phase	No. of cases	Percentage
Enhancement	66	88.0%
No Enhancement	9	12.0%
Total	75	100.0%

Table 8: Enhancement on portovenous phase

Portovenous phase	No. of cases	Percentage
Washout Present	30	40.0%
Washout Absent	38	50.7%
No Enhancement	7	9.3%
Total	75	100.0%

Table 9: Enhancement on delayed phase

Enhancement on delayed phase	No. of cases	Percentage
Washout	18	24.0%
Persistent Enhancement	14	18.7%
No Enhancement	16	21.3%

Table 10: Distribution of Benign /malignant cases according to CT findings

Benign/Malignant	No. of cases	Percentage
Malignant	49	65.3%
Benign	26	34.7%
Total	75	100.0%

Table 11: Radiological diagnosis on basis of CT findings

CT diagnosis	No. of cases	Percentage
METASTASES	27	36.0%
HCC	21	28.0%
HEMANGIOMA	9	12.0%
HEPATIC CYST	6	8.0%
PYOGENIC ABSCESS	5	6.7%
HYDATID CYST	3	4.0%
AMEBIC ABSCESS	2	2.7%
HEPATIC ADENOMA	1	1.3%
CHOLANGIOCARCINOMA	1	1.3%
Total	75	100.0%

Table 12: Additional CT findings

Additional CT findings	No. of cases	Percentage
Chronic liver disease	13	17.3%
Portal vein thrombosis	12	16.0%
Lymphadenopathy	9	12.0%
Calcification	8	10.7%
Air within lesion	6	8.0%
Intralesional fat	5	6.7%
Capsular enhancement	3	4.0%
Central scar	2	2.7%
Arterioportal shunting	2	2.7%
Dilated IHBRs	1	1.3%

Table 13: Distribution of cases according to Pathological Diagnosis

Final Diagnosis	No. Of Cases	Percentage
Metastases	26	34.7%
HCC	20	26.7%
Hemangioma	10	13.3%
Hepatic Cyst	6	8.0%
Pyogenic Abscess	5	6.7%
Hydatid Cyst	3	4.0%
Amebic Abscess	2	2.7%
Hepatic Adenoma	1	1.3%
Cholangiocarcinoma	1	1.3%
Granulomatous	1	1.3%
Total	75	100.0%

Table 14: Distribution of benign and malignant cases according to Pathological findings.

	Pathological diagnosis		Percentage
Benign/Malignant	BENIGN	MALIGNANT	
BENIGN	26	0	37%
MALIGNANT	2	47	62.0%
Total	28	47	100%

Table 15: Sensitivity,Specificity,Predictive values and Accuracy of triple phase CECT for detection of benign cases

	Value	95% CI
Sensitivity	92.86%	76.50% to 99.12%
Specificity	100.00%	92.45% to 100.00%
Positive Likelihood Ratio		
Negative Likelihood Ratio	0.07	0.02 to 0.27
Disease prevalence (*)	37.33%	26.43% to 49.27%
Positive Predictive Value (*)	100.00%	
Negative Predictive Value (*)	95.92%	86.07% to 98.89%
Accuracy (*)	97.33%	90.70% to 99.68%

Table 16: Sensitivity,Specificity,Predictive values and Accuracy of triple phase CECT for detection of Malignant cases

Statistic	Value	95% CI
Sensitivity	100.00%	92.45% to 100.00%
Specificity	92.86%	76.50% to 99.12%
Positive Likelihood Ratio	14	3.68 to 53.23
Negative Likelihood Ratio	0	
Disease prevalence (*)	62.67%	50.73% to 73.57%
Positive Predictive Value (*)	95.92%	86.07% to 98.89%
Negative Predictive Value (*)	100.00%	
Accuracy (*)	97.33%	90.70% to 99.68%

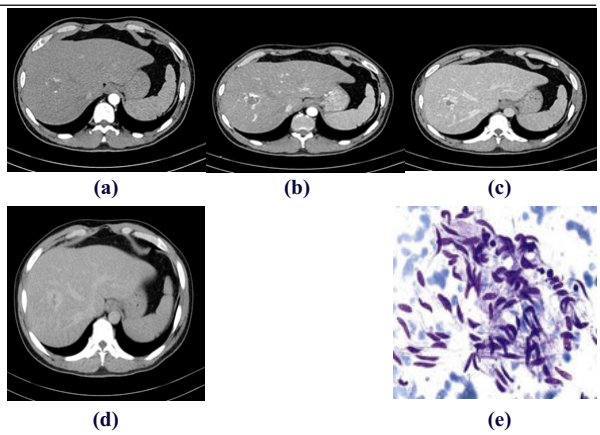

Figure 1: (a) Early arterial phase (b) Late arterial phase (c) Portovenous phase and (d) Delayed phase (f) Fine needle aspiration (May Grunwald Giemsa (MGG) strain) showing a well defined nearly isodense lesion in segment 8 of right lobe of liver with discontinuous peripheral nodular enhancement on arterial phase and progressive centripetal enhancement on portovenous and delayed phases-Hemangioma

Figure e) Fine needle aspiration cytology shows cluster spindle shaped endothelial cells on background of blood.

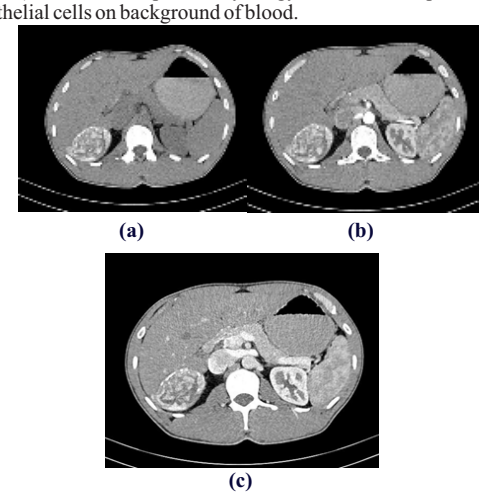

Figure 2: (a) Unenhanced (b) Arterial phase (c) Portovenous phase showing a well defined homogeneous calcified lesion in right lobe of liver with no contrast enhancement-Hydatid cyst.

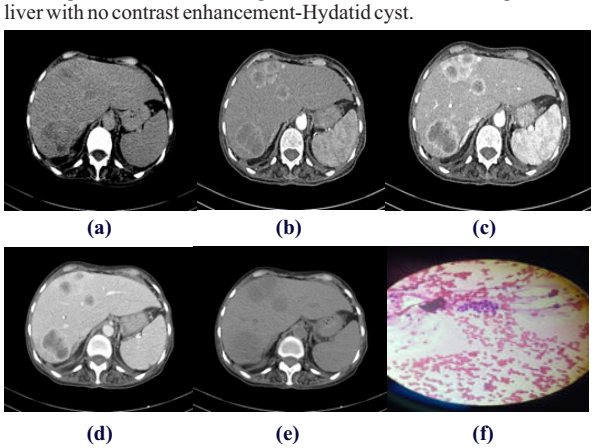

Figure 3: a) Enhancement (b) Early arterial phase (c) Late arterial phase (d) Portovenous phase and (e) Delayed phase (f) Fine needle aspiration cytology (H & E strain) of a A 45 years patient with history carcinoma colon showing multiple identified hypodense lesions in both lobes of the liver with inhomogeneous enhancement on arterial and portovenous phases with wash out of contrast on delayed phase.Fine needle aspiration cytology (H&E stain) showing metastases.

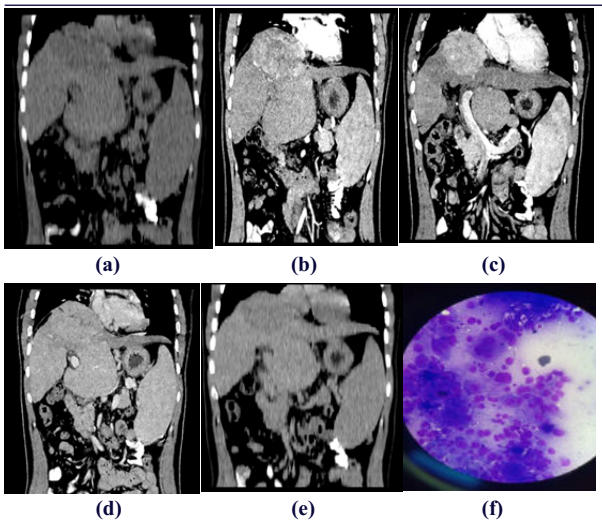

Figure 4: Hepatocellular carcinoma in a patient with chronic liver disease ,history of hepatitis C and increased AFP levels.

Figure a) Unenhanced (b) Early arterial phase (c) Late arterial phase (d) Portovenous phase (e) Delayed phase (f) Fine needle Aspiration cytology (May Grunwald Giemsa (MGG) stain) , A well defined hypodense lesion is seen in segment IV of liver with inhomogeneous enhancement on arterial and portovenous phases and washout of contrast on delayed phase images. Fine needle Aspiration cytology showing cells with prominent nucleoli, increased nuclear:cytoplasmic ratio and intranuclear inclusions.

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