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# Evaluation of Liver masses with 16 Slice Multi-detector Computed Tomography with Pathological Correlation

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**Abstract**
**Background-** *For the detection and characterization of focal hepatic mass lesions, ultrasonography and multi-detector computed tomography (CT) play a primary role. With the widespread of cross-sectional imaging, a growth of incidentally detected focal liver lesions (FLL) has been observed. A reliable detection and characterization of Focal liver lesions is critical for optimal patient management. Maximizing accuracy of imaging in the context of focal liver lesion is paramount in avoiding unnecessary biopsies, which may result in post-procedural complications.*
*So the vast spectrum of the focal liver lesions and their corresponding contrast enhancement characteristics were observed and tabulated to look for specificity of contrast patterns and tabulate a organised approach towards the diagnosis.*
**Materials-** *Sixty non-consecutive patients belonging to all ages and both sexes admitted into the various clinical departments of Krishna institute of medical sciences, Karad were examined with a triphasic liver CT protocol and histopathology/FNAC.Equipments Used USG :Siemens (Accuson x 300). 3.5 MHz frequency transducer and Siemens Emotion system 16 slice MDCT*
**Results Conclusions-** *Out of 60 the spectrum of lesions seen were Hepatocellular carcinoma (20%) (Out of which 9 cases were in cirrhotic livers and 3 in non-cirrhotic livers), Metastasis (33.3%), Hydatid cyst (2%), Abscess (5%), Haemangioma (13.3%), GB carcinoma, Cholangiocarcinoma and other (5% each) and simple liver cysts (10%).*
**Keywords-** *MDCT, Liver Lesions, Focal Liver masses, HCC, Cholangiocarcinoma, Giant Hemangioma, VMCs.*

## INTRODUCTION

The liver is the largest solid organ of the body. Its functions are remarkably diverse and anatomy correspondingly complex. Primary hepatic malignant neoplasms are less common than metastatic liver neoplasms. Between 40-50% of all primary cancers in the body are noted at death to have metastasis within the liver. The liver is second only to lymph nodes as the most frequent site of metastasis with exception of brain tumors virtually. In last two decades dynamic CT and grey scale ultrasound have been the main imaging modalities for focal lesions of liver; with both techniques many clinical questions can be answered, if no conclusive diagnosis can be made with a single technique, a combination of both is often helpful. For many liver lesions, each imaging technique provides a piece of the puzzle. It may consist of pathological characteristics of the tumor. Appreciation of pathological features of the tumor must be combined with imaging findings as well as clinical information to achieve a diagnosis.

A prospective study was performed in 60 patients with liver lesions who had undergone both abdominal ultrasonography and computed tomography and correlation was done with histopathology (FNAC/FNAB) for confirmation.

## MATERIALS AND METHODS

### Patients

Sixty non-consecutive patients belonging to all ages and both sexes admitted into the various clinical departments of Krishna institute of medical sciences, Karad were examined with a triphasic liver CT protocol and histopathology/FNAC.

### Methodology

Patients were included if focal liver disease was suspected clinically (positive symptoms/ altered LFT) or if previous imaging studies depicted hepatic lesions and normal patients with abnormal hepatic imaging/biochemical profile. Uncooperative Patients and failed FNAC/ Biopsy patients were excluded in this study.

### Equipments Used

Ultrasonography:

- Siemens (Accuson x 300). 3.5 MHz frequency transducer.
- Siemens Emotion system 16 slice MDCT.

### MDCT Evaluation:

Once unenhanced helical CT had been performed through the entire abdomen, 100 ml of Iohexol (Omnipaque) was injected intravenously through an 18/20-gauge cannula at a rate of 3-4 mL/sec with an automated pressure injector. The arterial-dominant phase, the delay between the start of contrast material administration and helical scanning was 20 seconds.

For the portal-dominant phase, the delay between the start of contrast material administration and helical scanning was 50 seconds and for the delayed phase, the delay between the start of contrast material administration and helical scanning was 180 seconds.

Spectrum of liver lesions and their enhancement characteristics were studied and tabulated.

### Histopathology & Statistical Correlation:

In the present study FNAC/BIOPSY was done in all the cases possible. In hydatid cyst cases post-operative specimen was sent for cytological interpretation. Hemangiomas have risk of haemorrhage on FNAB so only giant hemangiomas were evaluated by biopsy and rest were followed up by imaging.

FNAC/FNAB of liver involves two steps 1) accurate localization of the lesion 2) aspiration/ biopsy itself.

FNAC / biopsy specimens were obtained and processed by 10 ml syringe, 22 gauge spinal needle with stylet/ 18 G true cut biopsy needle, slides, alcohol bottle, formalin, IV line and sterile gloves. The procedures were done under local anaesthesia with image guidance.

Sensitivity, specificity were calculated using the formulas -

Sensitivity - SN = TP/ (TP + FN)

Specificity - SP= TN/ (TN + FP).

The pathology result was considered as the final

diagnosis.

## RESULTS

Total of 60 patients were selected for the study.

Out of 60 the spectrum of lesions seen (Table no. 1) were Hepatocellular carcinoma (20%) (Out of which 9 cases were in cirrhotic livers and 3 in non-cirrhotic livers), Metastasis (33.3%), Hydatid cyst (2%), Abscess (5%), Haemangioma (13.3%), GB carcinoma, Cholangiocarcinoma and other (5% each) and simple liver cysts (10%).

Metastases observed (Table No. 6) in the liver: 20% cases were from colorectal malignancies, 20% from lung, 15% from breast, 15% from ovary and 15% from oesophagus and 15% from stomach

**Diagnostic accuracy of CT features of Liver lesions :**

Three arterial phase enhancement patterns were associated with PPVs that exceeded 90%for particular diagnoses Table no. 4, including the abnormal internal vessels or variegated pattern as suggestive of HCC, the peripheral puddles pattern as suggestive of hemangioma, and the complete ring pattern as suggestive of metastases. Accordingly, these arterial phase enhancement patterns can be considered suggestive of these diagnoses.

**Correlation of CT and Pathological Findings**

Our study showed an accuracy of 98% (Table no. 8) in diagnosing various lesions by confirming these diagnosis using image guided FNAC/FNAB. This shows excellent correlation between radiological diagnosis and histological diagnosis of various liver lesions.

**Table No. 1:** Final Diagnosis of Liver Lesions seen in the study

| | No. Of Cases | Percentages |
|---|---|---|
| Liver Abscess | 3 | 5 |
| Hemangioma | 6 | 10 |
| Cysts | 6 | 10 |
| Hydatid | 2 | 3.3 |
| Metastasis | 20 | 33.3 |
| Primary Malignancy | 12 | 20 |
| GB Carcinoma | 3 | 5 |
| Cholangiocarcinoma | 3 | 5 |
| Others | 3 | 5 |
| Giant Hemangioma | 2 | 3.3 |
| Total | 60 | 100 |

Caption : Maximum number of the patients encountered were of Metastatic lesions (33.3%). Out of the 12 cases of the HCC (Primary Malignancy), 9 cases were seen in Cirrhotic Liver and 3 cases were seen in Non-cirrhotic Liver.'

Others: Von Meyerberg's Complexes, Focal Fatty Sparing and Focal fatty infiltration.

**Table No. 2 :** Computed Tomography Findings in General :

| CT findings | Number of Patients (n= 60) | Percentage (%) |
|---|---|---|
| **Number** | | |
| - Single | 32 | 53 |
| - Two | 2 | 3.3 |
| - Multiple | 26 | 43.3 |
| **Plain** | | |
| - Heterogeneous | 8 | 13.3 |
| - Hypodense | 51 | 85 |
| - Isodense | 1 | 1.6 |
| **CONTRAST** | | |
| **Arterial** | | |
| - Enhancing | 45 | 75 |
| - Non-enhancing | 15 | 25 |
| **Portal** | | |
| - Absent | 12 | 20 |
| - Present | 48 | 80 |
| 1. Enhancing | 47 | 78.3 |
| 2. Non-enhancing | 12 | 20 |
| 3. Equilibrium | 1 | 1.6 |
| **Delayed** | | |
| - Enhancing | 6 | 10 |
| - Non-enhancing | 12 | 20 |
| - Equilibrium | 27 | 45 |
| - Washout | 15 | 25 |

**Table No. 3:** Computed Tomography Findings in all cases :

| CT findings | Total | SLC | Hem | Hyd | HCC | Met | VmC | FFS | Fat | GB | Cho | Abs | GH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number** | | | | | | | | | | | | | |
| - Single | 32 | 5 | 4 | 2 | 10 | - | - | 1 | 1 | 3 | 3 | 1 | |
| - Two | 2 | - | 1 | | - | - | - | - | - | - | - | 1 | |
| - Multiple | 26 | 1 | 1 | | 2 | 20 | 1 | - | - | - | - | 1 | |
| **Plain** | | | | | | | | | | | | | |
| - Heterogeneous | 8 | - | - | 1 | 6 | - | - | - | - | - | - | 1 | - |
| - Hypodense | 51 | 6 | 6 | 1 | 6 | 20 | 1 | - | 1 | 3 | 3 | 2 | 2 |
| - Isodense | 1 | - | - | - | - | - | - | 1 | - | - | - | - | - |
| **CONTRAST** | | | | | | | | | | | | | |
| **Arterial** | | | | | | | | | | | | | |
| - Enhancing | 45 | - | 6 | - | 12 | 19 | - | 1 | - | - | 3 | 2 | 2 |
| - Non-enhancing | 15 | 6 | - | 2 | - | 1 | 1 | - | 1 | 3 | - | 1 | - |
| **Portal** | | | | | | | | | | | | | |
| - Absent | 12 | 6 | - | 2 | - | 1 | 1 | - | 1 | - | - | 1 | - |
| - Present | 48 | - | 6 | - | 12 | 19 | - | 1 | - | 3 | 3 | 2 | 2 |
| 1. Enhancing | 47 | - | 6 | - | 12 | 19 | - | 1 | - | 3 | 3 | 2 | 2 |
| 2. Non-enhancing | 12 | 6 | - | - | | 1 | - | - | 1 | - | - | - | - |
| 3. Equilibrium | 1 | - | - | - | | - | - | - | - | - | - | - | - |
| **Delayed** | | | | | | | | | | | | | |
| - Enhancing | 6 | - | - | - | - | - | - | - | - | 3 | 3 | 1 | - |
| - Non-enhancing | 12 | 6 | - | 2 | - | 1 | 1 | - | 1 | - | - | 2 | - |
| - Equilibrium | 27 | - | 6 | - | - | 16 | - | 1 | - | - | - | - | 2 |
| - Washout | 15 | - | - | - | 12 | 3 | - | - | - | - | - | - | - |

**Table No. 4:** Enhancement patterns shown by the lesions on Arterial phase :

| | Metastasis | HCC | Hemangioma | Abscess | Cysts/Hydatid/ VMCs | Others | Total |
|---|---|---|---|---|---|---|---|
| Homogenous | 1 | 2 | 1 | 0 | 0 | 1 | 5 |
| Abnormal internal vessels | 0 | 10 | 0 | 0 | 0 | 0 | 10 |
| Peripheral puddles | 0 | 0 | 7 | 0 | 0 | 0 | 7 |
| Complete Ring | 18 | 0 | 0 | 2 | 0 | 0 | 20 |
| No enhancement | 1 | 0 | 0 | 1 | 6/2/1 | 1 | 12 |
| Total | 20 | 12 | 8 | 3 | 9 | 2 | 54 |

**Table No. 5 :**Arterial phase enhancement patterns of HCC, Haemangioma and Metastasis :

| Diagnosis | Enhancement pattern | Sensitivity | Specificity | PPV |
|---|---|---|---|---|
| HCC | Homogenous | 2/12 (16) | 39/42 (92) | 2/5 (40) |
| HCC | Abnormal internal vessels or variegated | 10/12 (83) | 42/42 (100) | 10/10 (100) |
| Hemangioma | Peripheral puddles | 7/8 (87) | 46/46 (100) | 7/7 (100) |
| Hemangioma | Homogenous | 1/8 (12.5) | 41/46 (89) | 1/5 (20) |
| Abscess | Peripheral enhancement | 2/2 (100) | 32/52 (61) | 2/20 (10) |
| Metastasis | Complete ring | 18/20 (90) | 32/34 (94) | 18/20 (90) |
| Metastasis | No enhancement | 1/20 (5) | 31/34 (91) | 1/12 (8) |

**Table No. 6 :**Causes of Metastasis in liver in the study :

| Primary Malignancy | No. of cases encountered | Percentage |
|---|---|---|
| Colo-rectal | 4 | 20 |
| Breast | 3 | 15 |
| Lung | 4 | 20 |
| Ovary | 3 | 15 |
| Stomach | 3 | 15 |
| Oesophagus | 3 | 15 |

**Table no. 7:** Standards of Reference for Focal Liver Lesions in the study

| Diagnosis | Surgery | Biopsy | Aspiration | MR Imaging | Scintigraphy | Clinical History and Imaging Follow-up | Total |
|---|---|---|---|---|---|---|---|
| HCC | 8 | 4 | 0 | 0 | 0 | 0 | 12 |
| Hemangioma | 2 | 2 | 0 | 0 | 0 | 6 | 8 |
| Metastasis | 0 | 20 | 0 | 0 | 0 | 5 | 20 |
| Hydatid Cyst | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| Abscess | 0 | 0 | 2 | 0 | 0 | 1 | 3 |
| Simple Liver Cysts | 0 | 0 | 0 | 0 | 0 | 6 | 6 |
| Gb Carcinoma | 1 | 2 | 0 | 0 | 0 | 0 | 3 |
| Cholangiocarcinoma | 0 | 3 | 0 | 0 | 0 | 0 | 3 |

**Table 8 :** Correlation of CT diagnosis with histopathology: An observation

| | True Positive | False Positive | False Negative | True Negative | Total |
|---|---|---|---|---|---|
| Abscess | 3 | 0 | 0 | 57 | 60 |
| Hemangioma | 8 | 0 | 0 | 52 | 60 |
| Hepatocellular carcinoma | 12 | 0 | 0 | 48 | 60 |
| Hydatid Cyst | 2 | 0 | 0 | 58 | 60 |
| Metastasis | 19 | 1 | 0 | 40 | 60 |
| Cholangiocarcinoma | 2 | 1 | 0 | 57 | 60 |

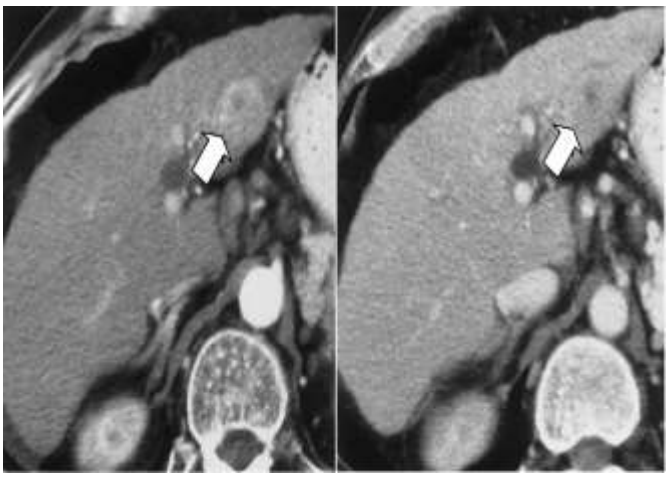

**Figure 1** Homogenous enhancement of HCC: 47 year male patient Small HCC, with a typical finding and washout. Transverse hepatic arterial phase CT image of midliver. The mass (arrow) enhances fairly homogeneously but much less than the aorta. Portal venous phase image at the same level. The mass (arrow) is now hypoattenuating to the liver and blood pool.

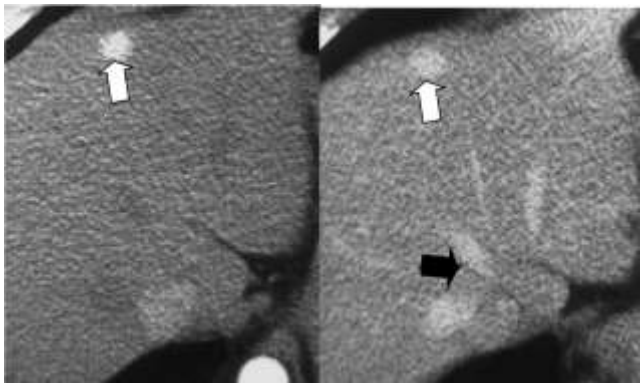

**Figure 2.** Homogenous enhancement of Hemangioma :Small hemangioma, uniform

enhancement. Transverse hepatic arterial phase CT image. The lesion (arrow) shows homogeneous enhancement relative to attenuation in the aorta. Portal venous phase image at same level. Attenuation of the lesion (arrow) is similar to that of the blood pool, such as that in the hepatic veins (black arrow). This is one way of differentiating the enhancement shown by HCC and a small hemangioma

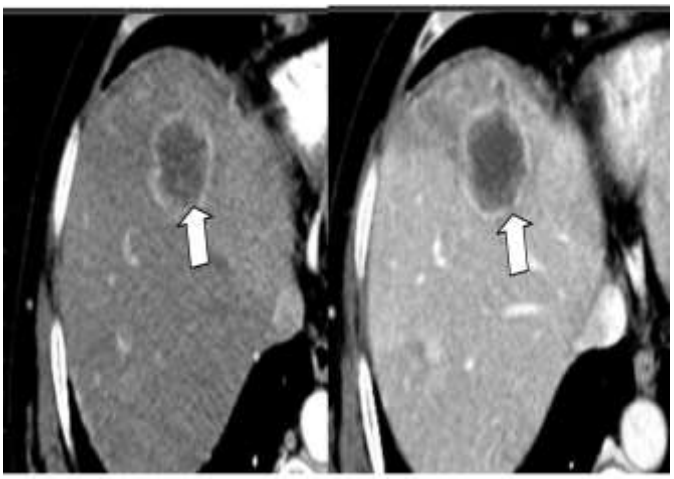

**Figure 3.** Complete ring pattern of Metastasis. Transverse arterial phase CT scan of metastases from a sigmoid colon primary depicts ring enhancement (arrows) with well-defined smooth inner margins surrounding central regions of low attenuation.

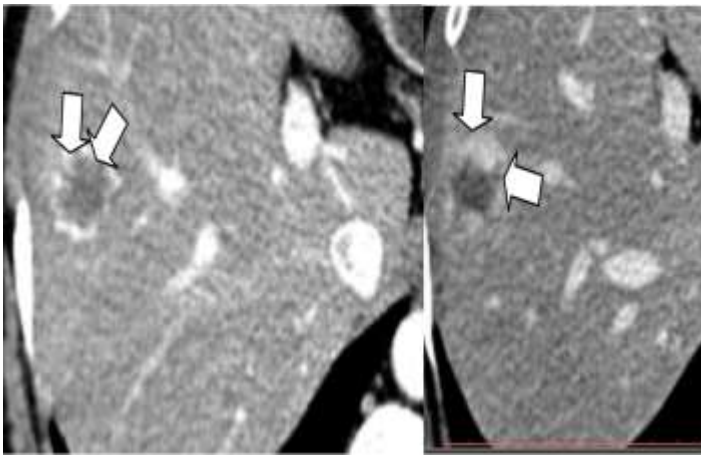

**Figure 4.** Peripheral puddles pattern. Transverse arterial phase CT scan of a hemangioma with peripheral enhancing globules (arrows) with attenuation similar to that of the aorta which follow the blood pool with centripetal filling in the portal phase. In contrast to the complete ring enhancement shown by metastasis the enhancing globules in the periphery of this pattern are discontinuous.

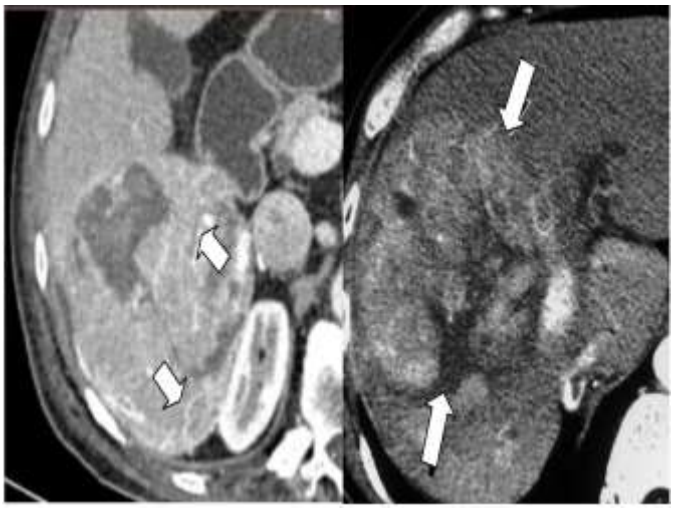

**Figure 5.** Abnormal internal vessels or variegated pattern in two different patients depicted on transverse arterial phase CT scans. HCC with visible internal vessels (arrow) that are irregular in contour. In the second patient HCC (arrows) with randomly distributed hyper- and hypoattenuating regions.

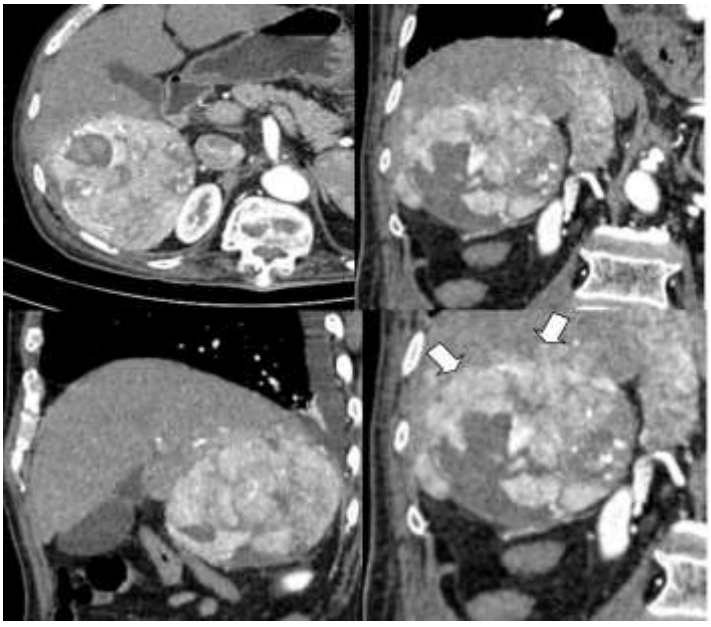

**Figure 6** Exophytic HCC. Often HCC can be entirely exohytic. In this 75 year male patient a heterogeneously enhancing lesion seen arising from the right lobe of the liver. In such cases lesions should bedifferentiated from the masses of the superior pole of the kidney, right adrenal gland. Reconstructed images play a crucial role in the evaluation of such lesions.The margins of the lesion help in determining the organ of origin. Here the lesion margins are seen infiltrating into the liver parenchyma. Hepatic artery branches were seen supplying the lesion.

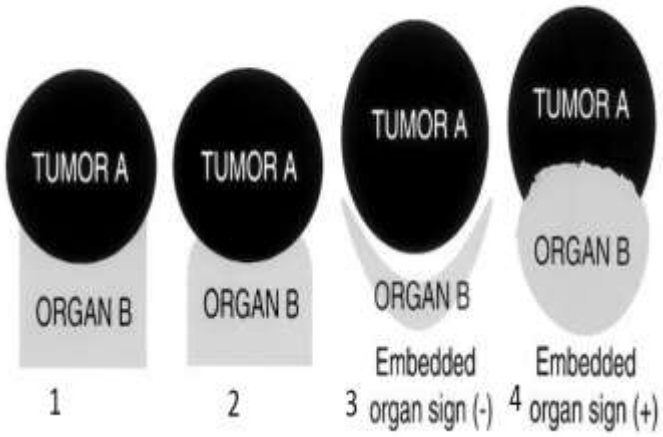


**Figure 7** The above mentioned illustrations will help determine the organ of origin in cases of exophytic liver masses. If a lesion is arising from organ B, the first or the last sign (1 or 4) are seen, where the exophytic lesion either deforms the edge of an adjacent organ into a "beak" shape, it is likely that the mass arises from that organ (BEAK sign) or the tumor is seen infiltrating the organ and the margins of the lesion are embedded into the organ. In the exophytic lesion shown in Illustration No. 6 Embedded organ sign is Positive. If none of the above mentioned signs could be appreciated properly then an attempt to trace the vessel supplying the lesion can help.

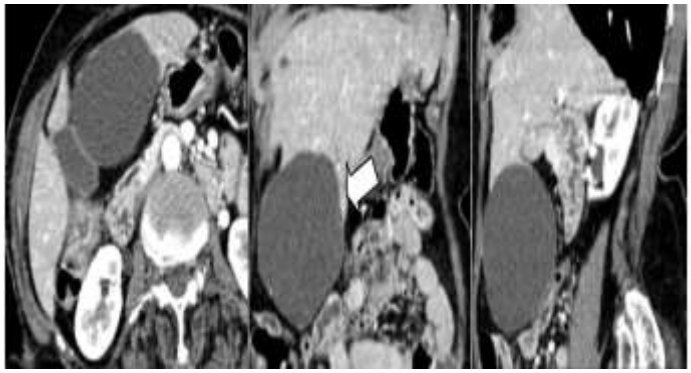

**Figure 8.** Case of an Exophytic Simple liver cyst demonstrating the BEAK sign as described in the illustration no. 7. Hence suggestive of organ of origin to be liver. Simple liver cyst are lesions demonstrating near water density attenuation with an imperceptible wall which may or may not show calcification.

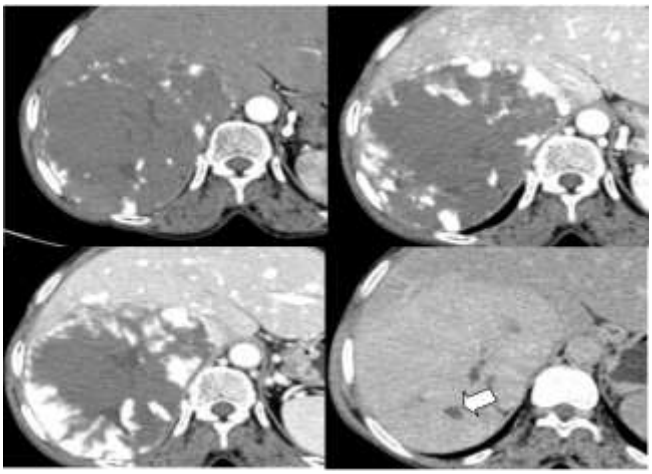

**Figure 9.** Peripheral enhancing lesion with Centripetal Filling :Arterial (Top Left), Portal venous (Top right), Delayed(5 mins) and Delayed (10 mins) CT images obtained at the same level show a large mass in the right hepatic lobe. There is peripheral nodular puddling of contrast material which matches the blood pool as it fills in the lesion through the interstices. Delayed phase CT images show progressive centripetal enhancement of the mass with a central area of low attenuation (arrow), a finding compatible with a fibrous scar.

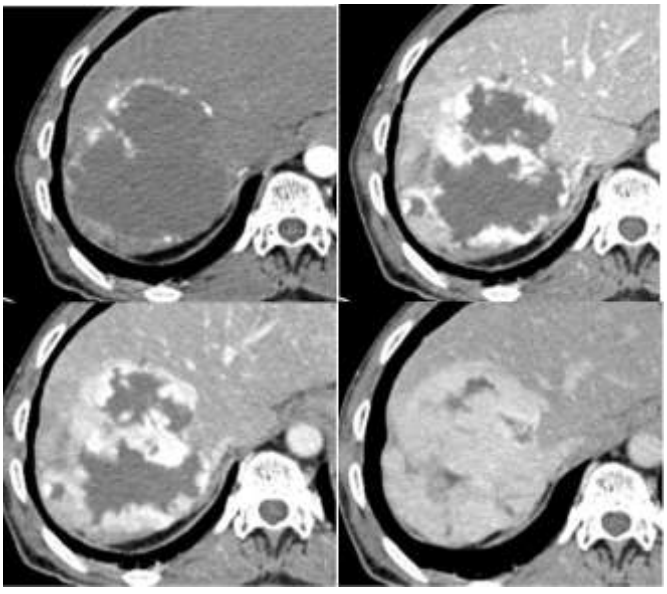

**Figure 10 .** Peripheral enhancing lesion with Centripetal Filling: Arterial (Top Left), Portal venous (Top right), Delayed (5 mins) and Delayed (10 mins) CT images obtained in another patient showed an incidentally discovered Giant Hemangioma in the right hepatic lobe which shows similar enhancing characteristics as described in illustration 9.

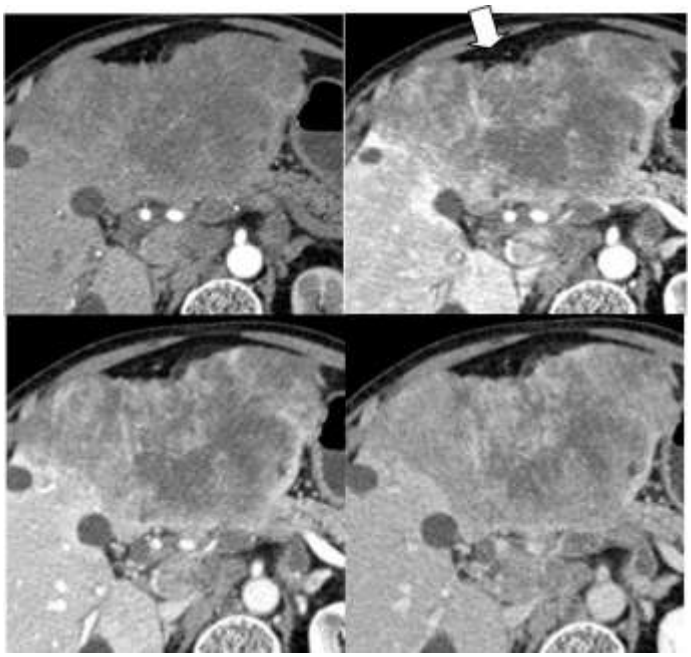

**Figure 11** Peripheral enhancing lesion with Centripetal Filling: 80 Year male patient C/o Pain in the right hypochondrium and loss of weight and appetite since 3-4 months showed a heterogenous lesion in the left lobe of the liver showing peripheral post contrast enhancement on the arterial phase which was seen progressively filling the centre of the lesion. Capsule retraction present (Arrow ). The difference with a giant hemagioma is that peripheral enhancement in this case is continuous unlike puddles seen in hemangioma and it does not match the blood pool. The lesion was a Cholangiocarcinoma on Biopsy.

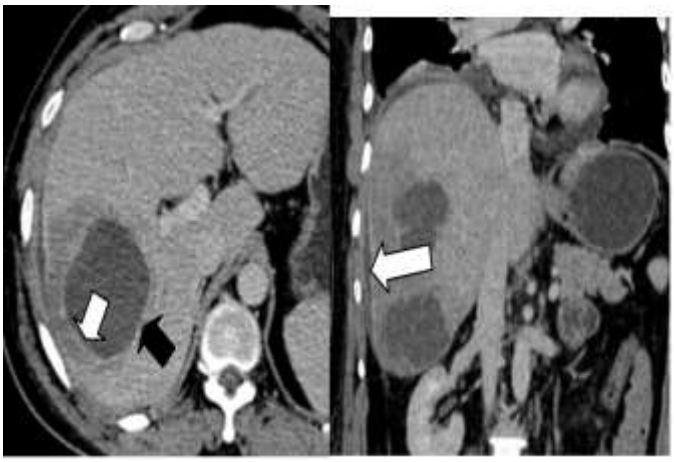

**Figure 12 .**Contrast-enhanced CT scan demonstrates two large, lobulated, well-defined cystic mass in the right hepatic lobe showing peripheral enhancement (white arrow), however there is another thin hypoattenuating rim(Black arrow) outside the enhancing rim with ill-defined hypodensity seen in the perilesional liver parenchyma representing oedematous portion of the liver. A thin rim of collection (Long arrow) can be noted in the subcapsular space of the liver. This was a case of Ruptured Amoebic Abscess. On aspiration Thick brown chocolate coloured collection was seen which is classically described as "Anchovy sauce" pathognomic for amoebic abscess.

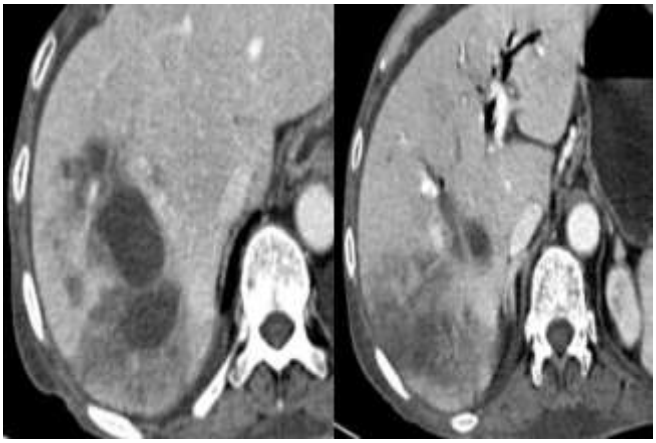

**Figure 13** Delayed-phase contrast enhanced CT scan shows a large, hypoattenuating lesion in the right hepatic lobe with thin peripheral enhancement and surrounded by other smaller hypoattenuating areas (arrows). These smaller abscesses cluster or aggregate in a pattern that suggests coalescence into a single large cavity. Air within the bile ducts can be seen. A case of Pyogenic Liver Abscess.

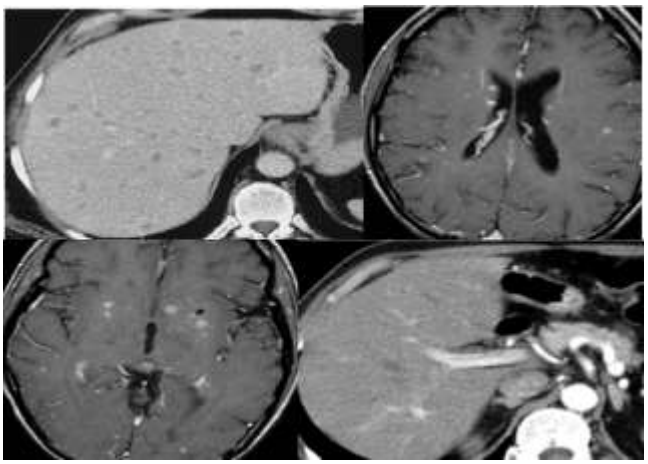

**Figure 14** CECT scan of Abdomen (Top left) Disseminated Fungal Deposits in a patient Acute Myeloid Leukemia who came with generalised weakness and vague abdominal pain there were multiple hypo-attenuating lesions in the liver not more than 1 cm Differential diagnosis of Fungal

Abscesses and Metastasis was given. 1 Month later patient presented with intense headache and blurring of vision MRI brain showed multiple nodular and ring enhancing lesions and a diagnosis of Disseminated Fungal Infection was given. Empirical antifungal therapy was given and a follow-up CT scan was done 2 months later on which lesions resolved. On the initial CT picture a differential of Biliary Hamartomas can also be made.

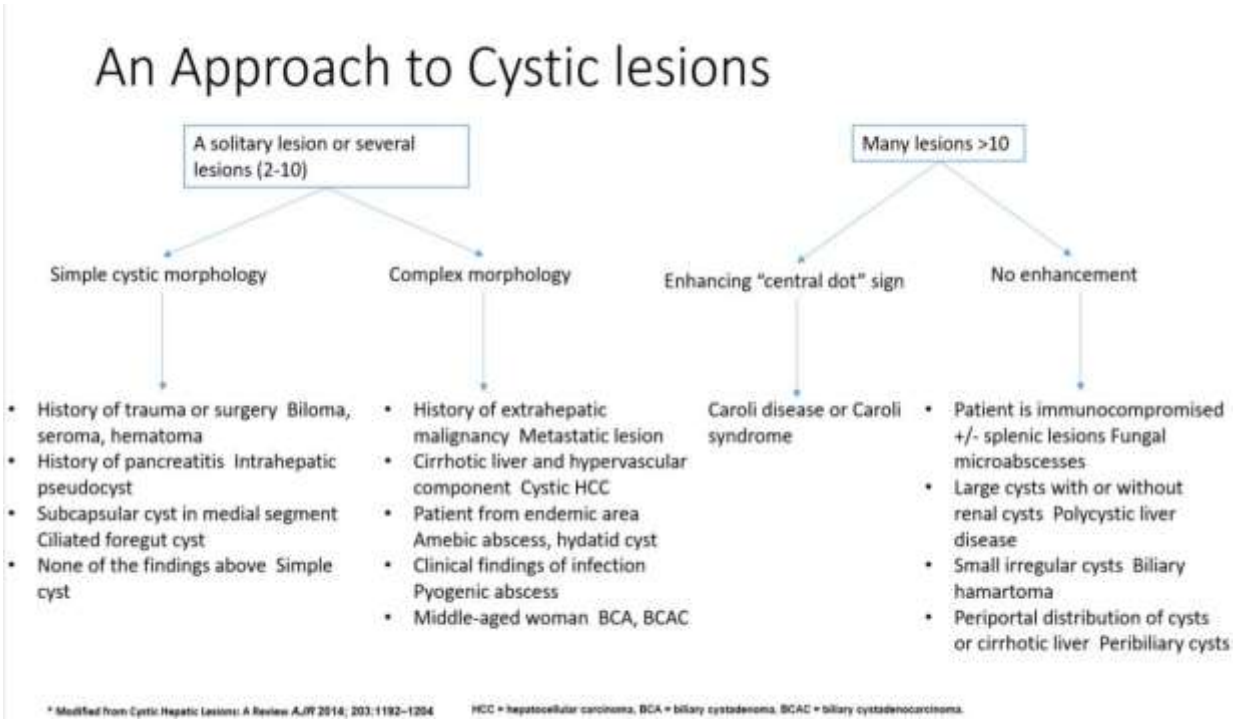


**Figure No. 15 :** An Approach to Cystic Liver Lesions

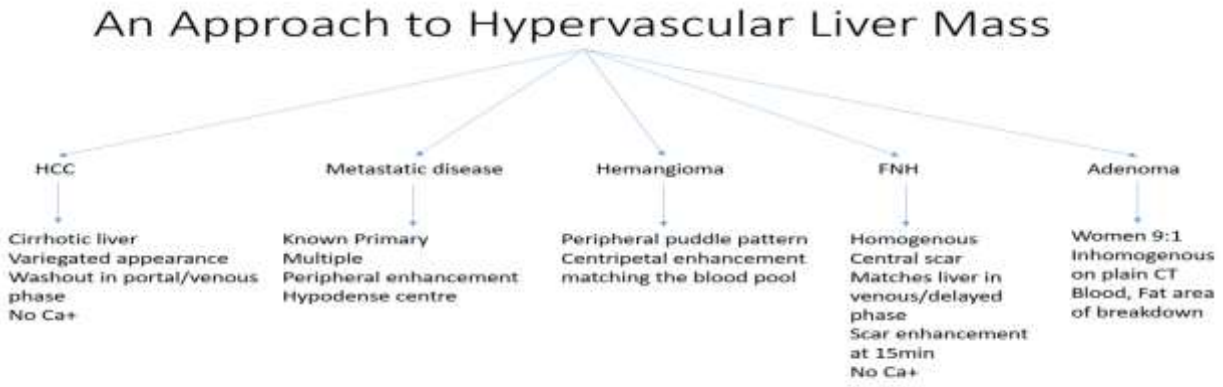


**Figure 16. :** An Approach to a hypervascular liver mass

**DISCUSSION**

Focal liver lesions are common on pathologic or imaging evaluation of the liver and include a variety of malignant and benign neoplasms, as well as congenital and acquired masses of inflammatory and traumatic nature. Evaluation of focal liver lesions is a complex issue which is

often the major focus of the cross sectional imaging study(1).

In our study 60 patients with age ranging between 9-82 years, with clinically suspected liver lesions or radiologically pre-diagnosed liver lesions were studied and evaluated clinico-radiologically correlating with histopathology wherever available. Out of 60 patients, youngest patient was of age 9 years and the oldest was 82 years old with a mean age of 49 years. Majority of patients were between the age range of 51-60 years (33.3%). In a study of 40 patients conducted by Gopalakrishnan et al, 2014, the youngest patient was of age 19 years and the oldest of age 84 years with a mean age of 52 years with majority being in the age group of 50-60 years (1).

In our study out of a total 60, 65% were males and 35% were females. Gopalakrishnan et al, 2014 in their study of 40 patients had a majority of males who numbered 26 (65%) and 14 (35%) were females with the male to female ratio being 1.8:1(1).

Leeuwen et al, 1996(2) in their study documented Spiral computed tomography (CT) as the preferred CT technique for routine liver evaluation because it provides image acquisition at peak enhancement of the liver parenchyma during a single breath hold (1-4 seconds). They also concluded that, fast data acquisition allowed successive scanning of the entire liver at different moments after injection of contrast material, thus creating the possibility of multiphasic liver CT. In our study, out of a total 60 patients underwent computed tomography (CT) evaluation. In non-contrast plain CT evaluation out of a total 60, 85% lesions were hypodense, 13.3 % heterogenous and 1.6% were isodense 8 (9.3%)

On arterial phase :

On contrast administration to all the 60 patients, 75 % of lesions showed enhancement while, 25 % were non-enhancing.

Out of the enhancing lesions: 8.3 % showed homogenous enhancement; 16.6 % showed abnormal internal vessels , 11% showed peripheral puddles ; 33.3 % showed complete ring enhancement 1% showed hetergenous enhancement.

Initially CT was based mainly on their appearance during the portal venous phase of enhancement (3).Unfortunately however, except for hemangiomas, relatively few lesions exhibit a highly specific appearance during the portal venous phase.With helical CT, imaging during the arterial phase became possible.

Arterial phase appearance of hepatic lesions is diagnostically useful (3). The purpose of the study was to apply a classification scheme to the appearance of lesions in the multiple phases was to determine whether a certain appearance suggests a particular diagnosis.

Fifty four out of sixty lesions included in this study exhibited appearances that met criteria for classification into one of the four enhancement categories; the re-maining 20% lesions exhibited no enhancement in the arterial phase. Three arterial phase enhancement patterns were associated with PPVs that exceeded 90%for particular diagnoses, including the abnormal internal vessels or variegated pattern as suggestive of HCC, the peripheral puddles pattern as suggestive of hemangioma, and the complete ring pattern as suggestive of metastases. Accordingly, these arterial phase enhancement patterns can be considered suggestive of these diagnoses.

An ideal imaging sign for the purpose of differentiating one diagnosis from anotheris one that exhibits both high PPV, meaning that the likelihood of a particular diagnosis is great when the sign is present, and high specificity, meaning that the likelihood of the sign being present in the absence of the particular diagnosis is small. All three arterial phase enhancement patterns associated with PPVs of 90 % or greater also were associated with specificity of 83% or greater: the abnormal internal vessels or variegated pattern for the diagnosis of HCC, the peripheral puddles pattern for the diagnosis of hemangioma, and the complete ring pattern for the diagnosis of metastasis.

These three arterial phase enhancement patterns, with both high PPV and high specificity are likely to be the most clinically useful.

The abnormal internal vessels or variegated pattern indicated HCC with a PPV of 100% and a specificity of 100%. Lesions in this category have either abnormal internal vessels or randomly distributed components of both hyperattenuation and hypoattenuation.

The definition for abnormal internal vessels required vessels to be irregular in contour or to branch erratically, findings that reflected neovascularity associated with malignancy in angiographic studies (3). This definition would not include the central feeding vessels described by Van Hoe and colleagues within a small proportion of FNHs, because the arterial supply to such lesions does not exhibit abnormal contours or abnormal arborisation (3). Concerning variegated enhancement, hyperattenuation was required specifically in the series, rather than just heterogeneity as described in the mosaic pattern in portal venous phase imaging, to confer specificity for HCC, which often is hyperattenuating in the arterial phase (3). This enhancement feature may reflect the presence of viable tumor interspersed with necrosis, as suggested by previous authors.

The peripheral puddles pattern was associated with hemangiomas in all cases. Thus, the PPV and specificity of this pattern for hemangioma were 100% and 100%, respectively. The appearance of discrete well-defined peripheral globules iso-attenuating with vascular structures has been well established as characteristic of hemangiomas (4).

Lesions with circumferential ring enhancement usually were malignant.

When all lesions exhibiting this enhancement pattern were considered, malignancy was predicted with a PPV of 90% and specificity of 94%. These findings are similar to those in the series of Van Leeuwen and colleagues (2), who found that a hyperattenuatingring in the arterial phase was associated with malignancy in all cases. It is important to bear in mind, however, that not all ring-enhancing lesions are malignant; for example, as noted in one patient in our series, this feature may also be noted with abscesses (3). Lesions with circumferential ring enhancement in this classification scheme were most frequently encountered in metastatic disease. Peripheral enhancement seen in metastases may reflect perfused, viable tumor tissue in the periphery of the lesion and fibrosis or necrosis in the centre.

The remaining enhancement pattern in the categorization scheme, the homogeneous pattern, were associated with PPVs too low to be considered clinically useful for the purpose of distinguishing lesions of different histologic origins.

25% of the 60 lesions did not exhibit any arterial phase enhancement, including1 metastasis and 1 abscess

Speculation that the higher frequency of enhancement observed in our study may reflect differences in the severity of disease in patients enrolled at different institutions.

An important observation is that overlap can occur between the appearances of benign and malignant lesions. For example, as found in this study and others, the homogeneous pattern can be exhibited by lesions such as HCC, hemangiomas, and FNH. Correlation with portal venous phase images, may help differentiate lesions that exhibit similar arterial phase enhancement patterns. Correlation with MR imaging, scintigraphic studies, or biopsy may be required to achieve a definitive diagnosis if in doubt.

A number of limitations should be considered with this study. First, we focused on visible features exhibited by lesions in the arterial phase, not their detectability or conspicuity. Second, it is possible that the results would differ with a larger series. For example, relatively few hemangiomas and hypervascular metastases were included in our study, and further work will be necessary to more fully examine their enhancement patterns.

In practice, portal venous phase imaging may also contribute useful information. Finally, our thresholds for considering PPVs and specificity to be clinically useful are subjective and based on our own clinical experience.

Our experience suggests that the peripheral puddles, complete ring, and abnormal internal vessels or variegated enhancement patterns in the arterial phase are associated with the diagnoses of haemangioma, metastasis, and HCC, respectively, with PPV of 90-100% and specificity of 89-100%. Thus, the appearance of hepatic lesions in the arterial phase of enhancement has potential use in the determination of specific diagnoses, and the classification scheme presented herein may be a useful tool for the interpretation of arterial phase CT studies.

In the remaining phases portal venous and delayed phases:

Most of the lesions were defined by their appearance on arterial phase CT but overall tumor burden on the liver was better recognized on portal phase, so if only lesion detection is the only issue, portal phase images alone have better detection rates but better characterization was done on arterial phase images, however some studies suggest that smaller lesions (<1.5cm) are better detected on arterial phase and thereby increasing the importance of arterial phase images.

Out of 60 lesion in the portal phase ; 78.3 % were enhancing out of which 18% showed a progressive centripetal filling ; the progressive centripetal filling which was observed were of two types one which was observed in hemangioma and one which was seen in the cholangiocarcinoma. The centripetal filling which was observed in the hemangioma was of the similar intensity (HU) to that of the aorta in all phases. The centripetal filling enhancement of cholangiocarcinoma was to a lesser intensity as compared to hemangioma.

20 % were enhancing more as compared to the arterial phase and 20% were non enhancing and 1.6 % showed equilibrium.

In the delayed phase 10% showed enhancement, 20% showed no enhancement, 45 % showed equilibrium and 25 % showed washout.

These findings are found to be in correspondence with the study conducted by Hollett et al, 1995(5) where they found that unenhanced scans had a low sensitivity for detection of small lesions because they were often impossible to distinguish from non-opacified vessels; even with contrast-enhanced scans available for comparison this was found to be difficult. Bolus or arterial phase scans were found to be advantageous in small lesions that enhanced to a greater degree than the adjacent liver (positive contrast)(5). They also found that arterial phase helical CT of the liver improved the detection of some small hepatic neoplasms when compared with portal venous scanning alone (2). In the study conducted by Leeuwen et al, 1996 parenchymal enhancement of the liver in the arterial phase was found to be well below than that in the portal phase. They found visually good enhancement of the liver parenchyma in the portal phase in all the patients. (2)

The final CT diagnosis in our study revealed Hepatocellular carcinoma (20%), Metastasis(33.3%), Hydatid cyst(2%), Abscess(5%), Hemangioma (13.3%), Gb carcinoma , Cholangiocarcinoma and other (5% each) and simple liver cysts (10%).

On final analysis with statistical evaluation in our study CT was found to be 100% sensitive and 100% specific in diagnosis of Liver hemangiomas, Simple liver cysts and Liver hydatidosis. For liver abscess, primary malignant liver tumors, liver secondaries and cholangiocarcinoma its sensitivity and specificity was found to be 100% and 100%, 100% and 100% , 100% and 97.56%, 100 and 98.28% respectively.

**Limitations**

A number of limitations should be considered with this study. First, we focused on visible features exhibited by lesions in the arterial phase, not their detectability or conspicuity. Second, it is possible that the results would differ with a larger series. For example, relatively few hemangiomas and hypervascular metastases were included in our study, and further work will be necessary to more fully examine their enhancement patterns. In practice, portal venous phase imaging may also contribute useful information. Finally, our thresholds for considering PPVs and specificity to

be clinically useful are subjective and based on our own clinical experience.

## CONCLUSION

Liver lesions are of varying etiology and are important that proper etiological diagnosis is arrived in order to treat correctly Clinical diagnosis based on examination can be very inaccurate, radiological investigations using ultrasonography and computed tomography can help us to arrive at an accurate diagnosis most of the times. Image guided FNAC/FNAB can confirm/dispute radiological diagnosis. Three arterial phase enhancement patterns were associated with PPVs that exceeded 90%for particular diagnoses, including the abnormal internal vessels or variegated pattern as suggestive of HCC, the peripheral puddles pattern as suggestive of hemangioma, and the complete ring pattern as suggestive of metastases. Accordingly, these arterial phase enhancement patterns can be considered suggestive of these diagnoses. Metastases observed in the liver;20% cases were from colorectal malignancies,20% from lung,15% from breast,15% from ovary and 15% from oesophagus and 15% from stomach making the highest percentages of liver metastases from colon and rectum followed by lungs, oesophagus and stomach, and breast and ovary. Our study showed an accuracy of 98% in diagnosing various lesions by confirming these diagnosis using image guided FNAC/FNAB. This shows excellent correlation between radiological diagnosis and histological diagnosis of various liver lesions.

## REFERENCES


1. Gopalakrishnan S, Sethurajan, Adaikappan, Gunasekaran P, Vivek R. Real Time Ultrasonography Evaluation of Focal Liver Lesions: A Cross- Sectional Study. International Journal of Scientific Study. 2014; Vol 2:7.
2. Leeuwen MS, Noordzij J, Feldberg MAM, Hennipman AH, Doornewaard H. Focal Liver Lesions: Characterization with Triphasic Spiral CT. Radiology 1996; 201: 327-336.
3. Nino-Murcia M, Olcott E, Jeffrey R, Lamm R, Beaulieu C, Jain K. Focal Liver Lesions: Pattern-based Classification Scheme for Enhancement at Arterial Phase CT. Radiology. 2000;215(3):746-751.
4. Prasanna P, Fredericks S, Winn S, Christman R. Giant Cavernous Hemangioma. RadioGraphics. 2010;30(4):1139-1144.
5. Hollett MD, Jeffrey RB, Nino-Murcia M, Jorgensen MJ, Harris DP. Dual-Phase Helical CT of the Liver: Value of Arterial Phase Scans in the Detection of Small (≤1.5cm) Malignant Hepatic NeoplasmS. AJR 1995;164:879-884.
6. Mortele KJ, Ros PR (2001) Cystic focal liver lesions in the adult: differential CT and MR imaging features. Radiographics 21 :895–910
7. McEvoy S, McCarthy C, Lavelle L, Moran D, Cantwell C, Skehan S et al. Hepatocellular Carcinoma: Illustrated Guide to Systematic Radiologic Diagnosis and Staging According to Guidelines of the American Association for the Study of Liver Diseases. RadioGraphics. 2013;33(6):1653-1668.
8. Bächler P, Baladron M, Menias C, Beddings I, Loch R, Zalaquett E et al. Multimodality Imaging of Liver Infections: Differential Diagnosis and Potential Pitfalls. RadioGraphics. 2016;36(4):1001-1023.
9. Ebied O, Federle MP, Blachar A (2003) Hepatocellular cholangiocarcinoma:helical computed tomography findings in 30 patients. J Comput Assist Tomogr 27:117–124
10. Stoupis C, Ros PR, Dolson DJ (1994) Recurrent biliary cystadenoma:MR imaging appearance. J MagnReson Imaging 4: 99–101