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Efficacy of CECT in Diagnosis of Hepatocellular Carcinoma with Histopathogical Correlation

Ramiya R[1*]; V. Sivaprakash[2]; Rubi P[3]

[1;2;3](MSc Medical Imaging Technology)
[1]Lecturer, Department of Radio-Diagnosis Panimalar College of Allied Health Sciences, Varadharajapuram, Poonamalle, Chennai Tamil Nadu- India
[2]Assistant Professor & RSO, Department of Radio-Diagnosis Panimalar College of Allied Health Sciences, Varadharajapuram, Poonamalle, Chennai Tamil Nadu – India
[3]Lecturer, Department of Radio-Diagnosis, Allied Health Sciences, Trichy SRM Medical College Hospital & Research Centre, Irungalur, Tiruchirappalli, Tamil Nadu- India

Corresponding Author: Ramiya R[1*]

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Abstract:

- ***Introduction***

Hepatocellular carcinoma (HCC) is a primary liver cancer that originates in the hepatocytes, the main functional cells of the liver. The advancements of Computed Tomography (CT) play major role in detecting liver pathologies. Injection of contrast media is primary while imaging liver region, So Contrast Enhanced Computed Tomography (CECT) is the best choice for this imaging. Though, CECT performed with hepatocellular carcinoma plays important role in assessing the size, margins and relationship with other structures.

- ***Methods***

The retrospective observational crossover study included 30 patients who undergone for Contrast Enhanced Computed Tomography in department of Radio-Diagnosis at saveetha Medical College & Hospital. Patient demographics were analyzed & Chi-square test was used to perform statistical analysis for hypothesis.

- ***Results***

The study included 24 males and 6 females with mean age of 40 years. Histopathology examination revealed 22 cases of HCC, out of which 19 were provisionally diagnosed in CECT.Out of this 22 patients, 16 were male and 6 were female, revolving a significant male gender predisposition.

- ***Discussion***

The use of CECT improves lesion detection, size, type of carcinoma .This re -emphasizes the fact that male have significantly higher risk of liver cancer which composed to females. Multiple diagnosis like alcohol consumption coupled with cirrhosis, hepatitis B and Hepatitis C infection, increased iron storage level have been postulated for males having a higher predisposition for HCC than females.

- ***Conclusion***

The diagnosis of hepatocellular carcinoma and co-relation with histopathology contrast enhanced CT and conventional contrast enhanced CT, both performs equal role in detecting pathologies in the Abdomen region. Applying the correct useful technique in the region of interest helps to demonstrate the anatomical position and nature of the pathology.

Keywords: *Hepatocellular Carcinoma; Contrast Enhanced Computed Tomography; Cirrhosis; Hepatitis.*

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I. INTRODUCTION

The liver, the largest solid organ in the body, accounts for approximately 2% of the total body weight, varying between 1200-1500 grams in adults. It is anatomically and functionally complex, consisting of a specialized parenchymal matrix that is highly vascularized by both systemic and splanchnic blood supply. Due to its size, location, dual blood supply, and nutrient-rich environment, the liver is a common site for neoplastic lesions, which exhibit greater numbers and diversity compared to other organs. These lesions include primary and metastatic carcinomas, sarcomas, leukemic infiltrates, and lymphomas. Liver pathology can be categorized into focal, diffuse, and mixed forms, with both primary and secondary origins. Cirrhosis is a significant risk factor for hepatocellular carcinoma (HCC), with around 80% of HCC cases arising in patients with cirrhosis.

Triphasic CT imaging, consisting of the Hepatic Arterial Phase (HAP), Portal Venous Phase (PVP), and Late Phase (LP), is a key diagnostic tool for evaluating various liver lesions such as focal nodular hyperplasia, hepatic adenoma, HCC, and hyper vascular metastases. This imaging modality enhances lesion detection, characterization, and morphological evaluation, especially for HCCs.The objectives where:

- To characterize liver tumors using contrast-enhanced triphasic multidetector computed tomography, focusing on the pattern of enhancement of liver carcinoma during the arterial, portal venous and late phases.
- To compare the radiological findings from triphasic CT with histopathological results.

II. METHODS

➢ *Study Design*

This retrospective observational crossover study was conducted at a hospital over a period of two years, from March 2019 to July 2021. The inclusion criteria for the study were: patients with a clinical history of liver disease, patients with suspicious findings from ultrasonography, patients with confirmed hepatocellular carcinoma (HCC) supported by histopathological reports, and patients undergoing surgery for hepatocellular carcinoma. The exclusion criteria included: pregnancy, allergies to contrast media, and elevated renal function test (RFT) values.

➢ *Data Collection Procedure*

This study included 30 patients referred for CECT abdomen to the Department of Radio-Diagnosis. All patients underwent CECT abdomen, and histopathological correlation was performed. Data were collected using a proforma, which included information such as age, sex, indication, type of carcinoma observed in the CECT abdomen studies, and histopathology findings. The efficacy of CECT in diagnosing hepatocellular carcinoma, with histopathological correlation, was assessed by analyzing the radiographic images of each patient. The diagnostic accuracy of hepatocellular carcinoma was evaluated through the analysis by both radiologists and pathologists to find the diagnostic accuracy of hepatocellular carcinoma.

➢ *Patient Consent Declaration*

The authors certify that they have obtained all appropriate consent from all patients.

➢ *Ethical Approval*

Institutional Review Board approval is not required for this study.

➢ *Data Analysis*

The data analysis of efficacy is Contrast-Enhanced Computed Tomography (CECT) in diagnosing Hepatocellular Carcinoma (HCC) with histopathological correlation will use both descriptive and inferential statistical methods. Descriptive statistics will summarize the patient demographics, clinical characteristics, and tumour details such as size, location, and enhancement patterns in the hepatic arterial, portal venous and late phases of CECT. These findings will be compared with histopathological results to assess the diagnostic accuracy of CECT.

To evaluate diagnostic performance, sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) is been calculated. These metrics will help determine how accurately CECT identifies and excludes HCC. The overall diagnostic accuracy has been assessed by comparing correct diagnoses (true positives and true negatives) for the 30 no of cases. Chi-square tests was used in analyse the correlation between radiological and histopathological findings.

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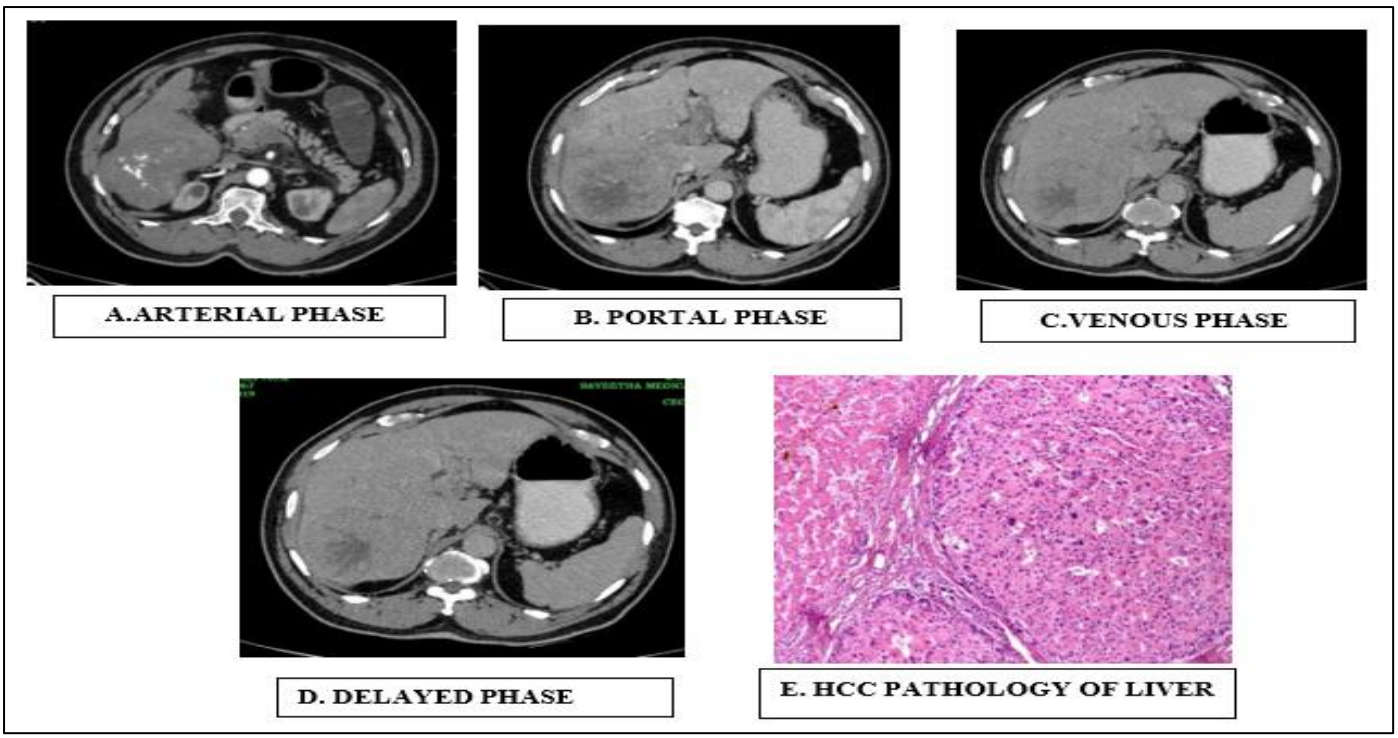
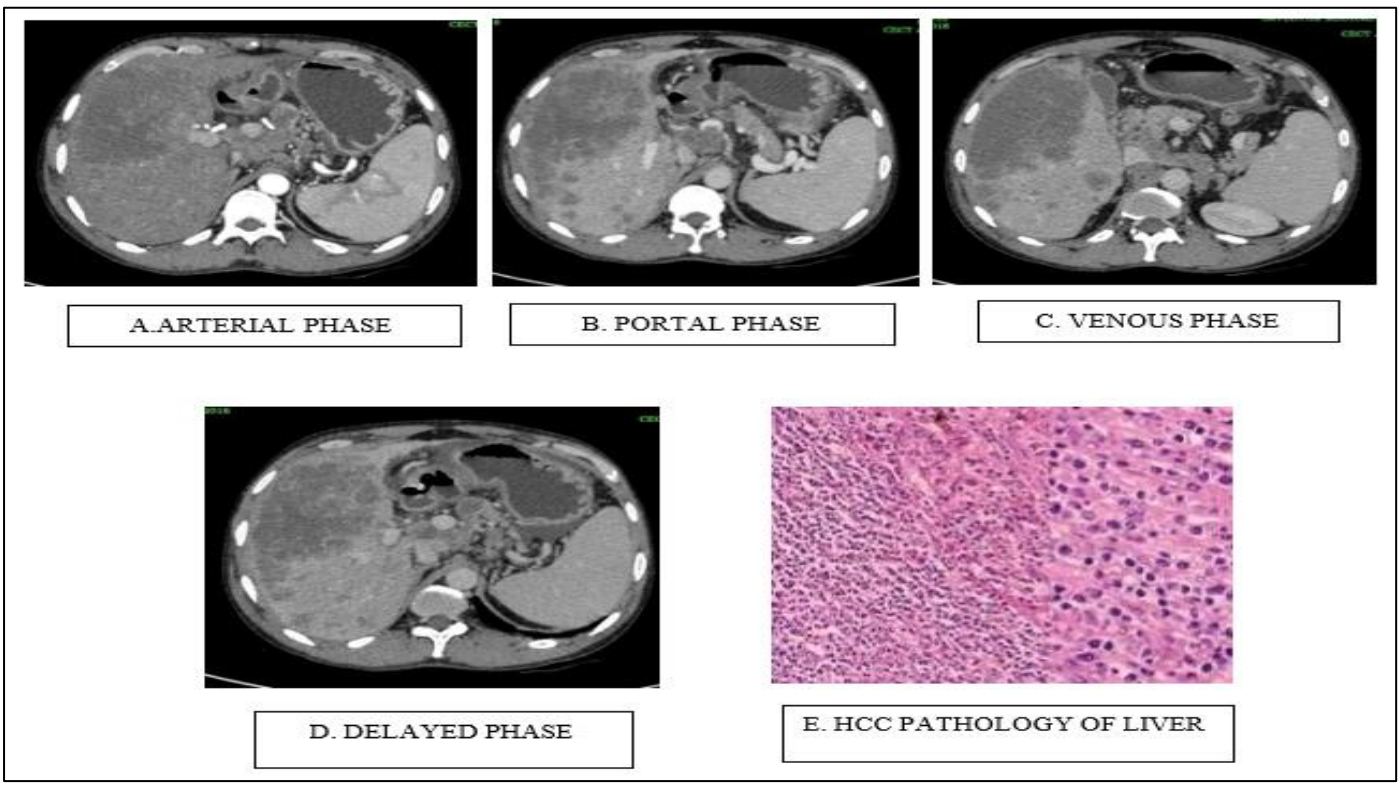
III. CASE STUDY

➢ *Case Study 1 – 70 Years Old Man came with a History of Sol Liver*



Triphasic CT shows **(A)** non enhancing area with few feeding arteries in arterial phase.**(B)** and **(C)** Parenchymal and sub- capsular, focal exophytic mild heterogeneous enhancing hypo dense mass lesion in right lobe of liver (5^{th} ,6^{th} and 7^{th} segment) of size ~92×91×129mm, volume - 539cc, central heterogeneous with no calcification, peripheral lobulated to ill-defined margins in portal and venous phase. **(E)** USG guided biopsy, liver- features suggestive of hepatocellular carcinoma.

➢ *Case Study 2 - 53 Years Old Man came with a History of? HCC*



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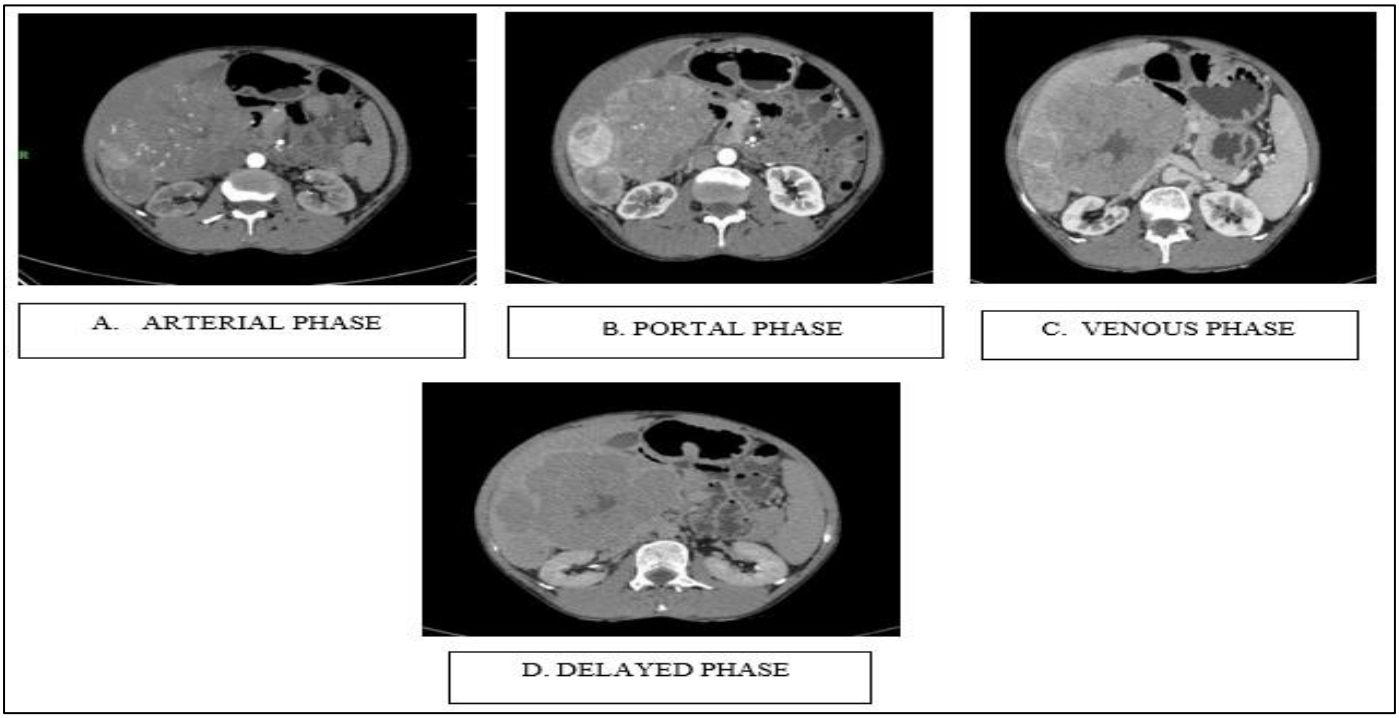
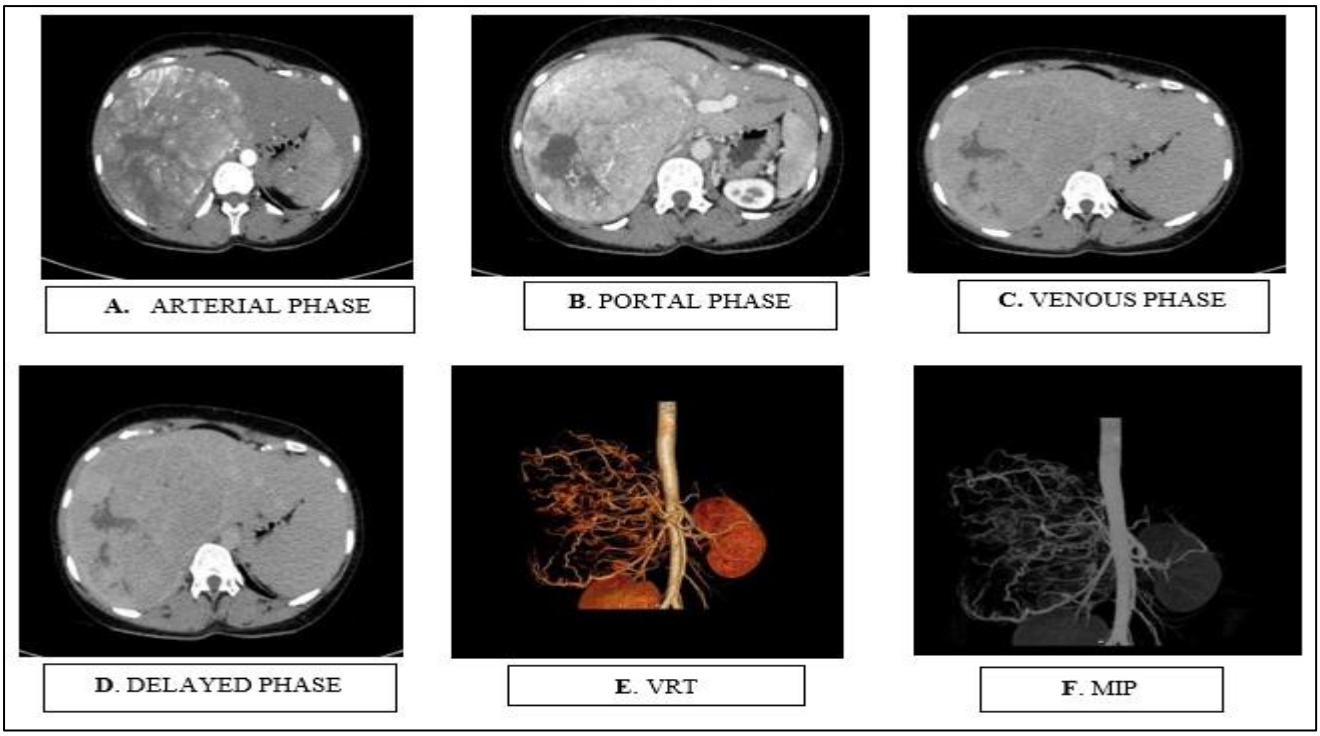
Triphasic CT shows Enlarged 21(cm). **(A)** No definite arterial phase enhancement or delayed enhancement seen. **(C)** Diffusely infiltrative, ill- defined, partially sub capsular, heterogeneously hypo-enhancing seen epicentered in segment 5 of right lobe of liver measuring ~ 11×7.5×10.5 cm seen in venous phase.

- *Case Study 3–60 Years Old Man came with a Complaint of? HCC /Upper Abdomen Pain × 2 Months.*



Triphasic CT shows **(A)** A large lobulated well defined exophytic lesion showing enhancement in arterial phase with central scar. **(B)** and **(C)** In portal phase a well- defined three smaller satellite lesions is seen in segment 6 ,adjacent the aforementioned large lesion and lesion appears hypodense in portal venous phase **(D)** Non enhancing areas , suggestive of necrosis seen in the right lobe of liver lesions . Delayed enhancing lesion is seen in the right lobe.

- *Case Study 4– 48 Years Old Man came with a History of HCC and Complaints of Vomiting, H/o of Jaundice × 2 Months.*



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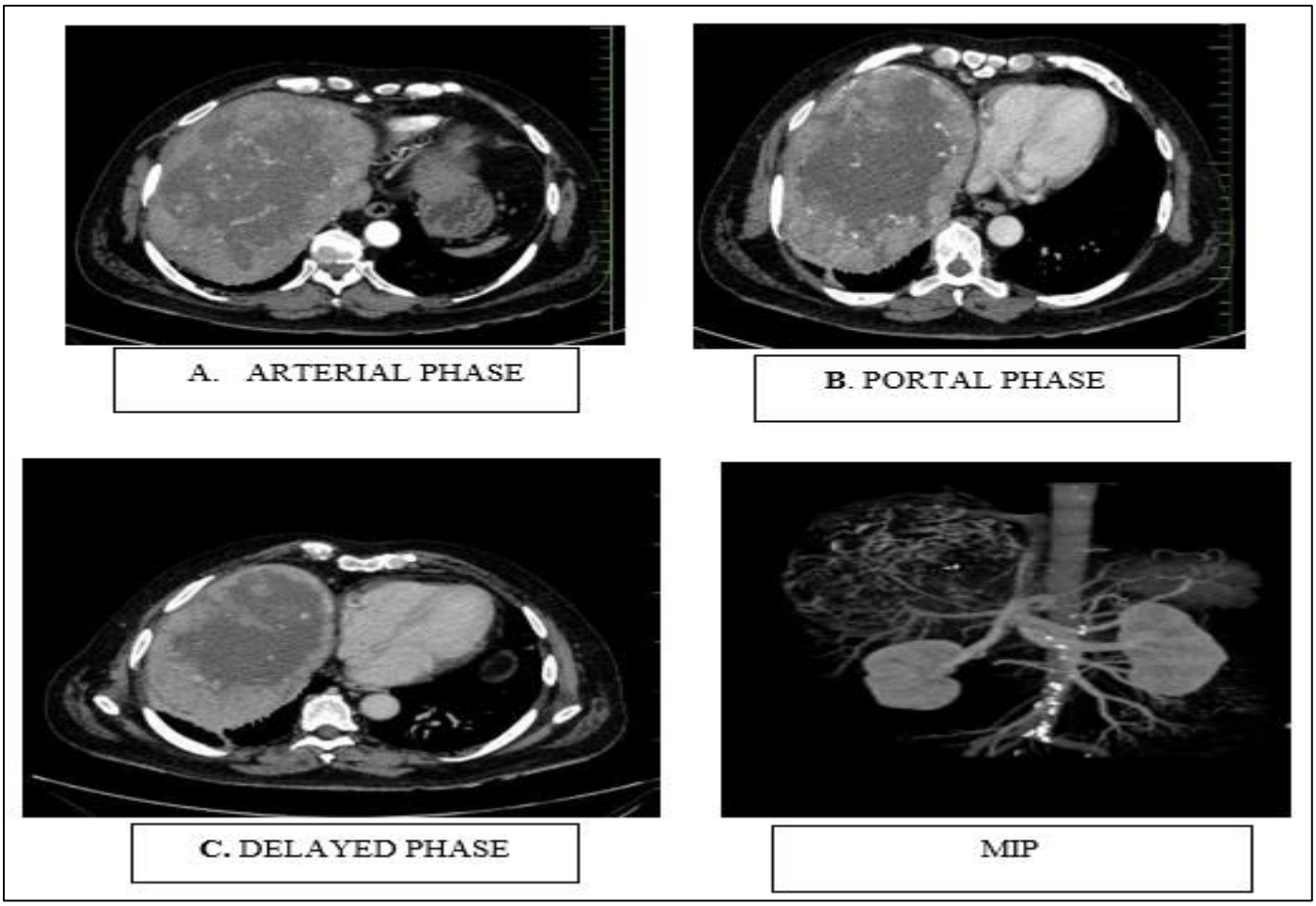
Multiphase CT shows **(A)** few intraparenchymal and subcapsular well-defined hypodense lesion noted in segment 4a and 4b of left lobe of liver. **(B**) and **(C)** Portal and venous phase shows relative attenuation of enhancement in the venous phase. **(D)** Lesion appears hypodense in delayed phase. Whereas **(E)** and **(F)** show few small branches of the left hepatic artery are seen traversing in the large lesions. No, filling defect noted in the hepatic artery, portal vein and hepatic IVC and their branches.

➢ *Case Study 5 – Patient came with a Diagnosis of? HCC*



Triphasic CT shows: Liver measures 17 cm increased in size, hypertrophy of right and left lobe of liver. **(A)** In arterial phase large ill-defined conglomerate heterogeneously hypodense space occupying lesion/ mass in segment 7, 6, 5 of right lobe of liver. **(B)** And **(C)** on post contrast shows predominantly arterial and portal phase peripheral irregular heterogenous enhancement with central ill-defined necrotic non enhancing areas, with rapid wash out on venous phase. MIP shows vascular supply/ arterial feeders noted from right hepatic artery and amtero-medially lesion seen extending into the main portal vein before its bifurcation showing enhancing malignant thrombus of size 10 × 15 cm.

IV. OBSERVATION

➢ *Age Wise Distribution of Hepatocellular Carcinoma-*

Table 1 A Total Number of 30 Subjects were Included in the Analysis.

Age	No. of Cases	Percentage
>20	2	7%
20-40	4	13%
40-60	13	37%
60-80	11	43%
TOTAL	30	100%

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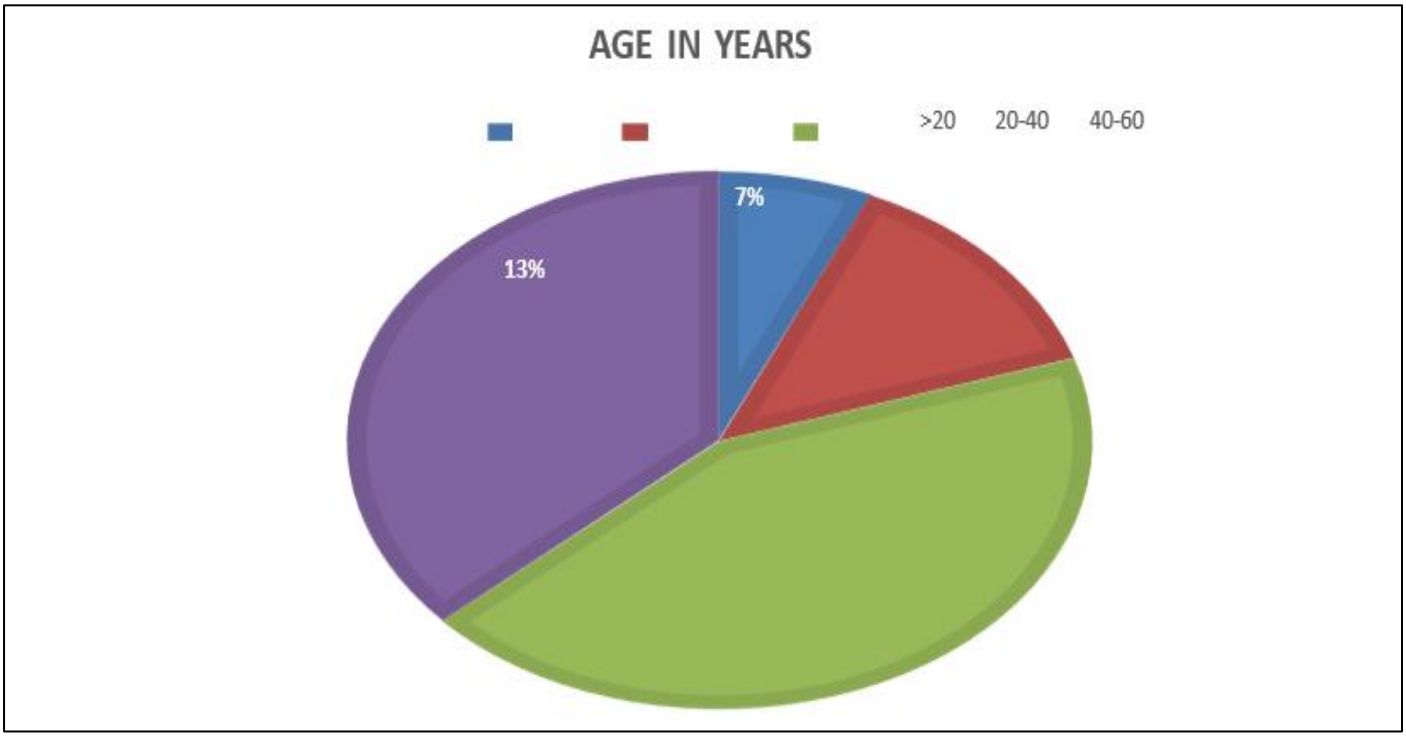

Fig 1 The Maximum Number of Patients with Hepatocellular Carcinoma was in the Age Group of 60-80 Years.

Table 2 Gender Wise Distribution of Hepatocellular Carcinoma

Sex	No of Cases	Percentage
FEMALE	6	20%
MALE	24	80%
TOTAL	30	100

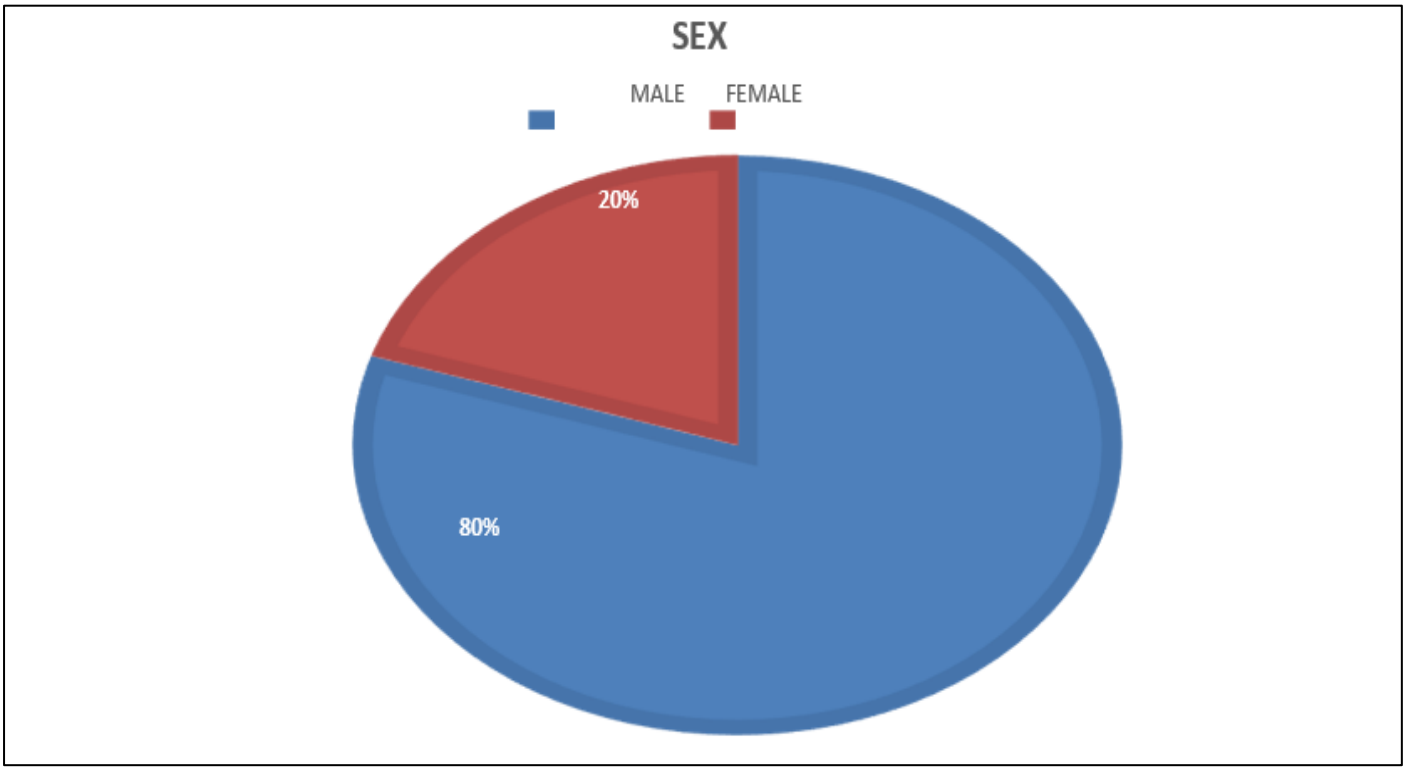

Fig 2 In this Study. Out of 30 Patients, 24(80%) were Males and 6 (20%) were Females. Out of 30 Patients of Malignant Liver Lesions 25(80%) were Males and 5 were Females (20%).

Male have significantly higher incidence of hepatocellular carcinoma in this study.

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Table 3 Distribution of Patients Accounting to Diagnosis

Lesions	Frequency	Percentage
SOL Liver	1	4%
Hepatocellular Adenoma	1	3%
Obstructive jaundice	1	3%
Hepatomegaly	1	3%
Liver mass	2	7%
? Hepatocellular carcinoma	24	80%
Total	30	100%

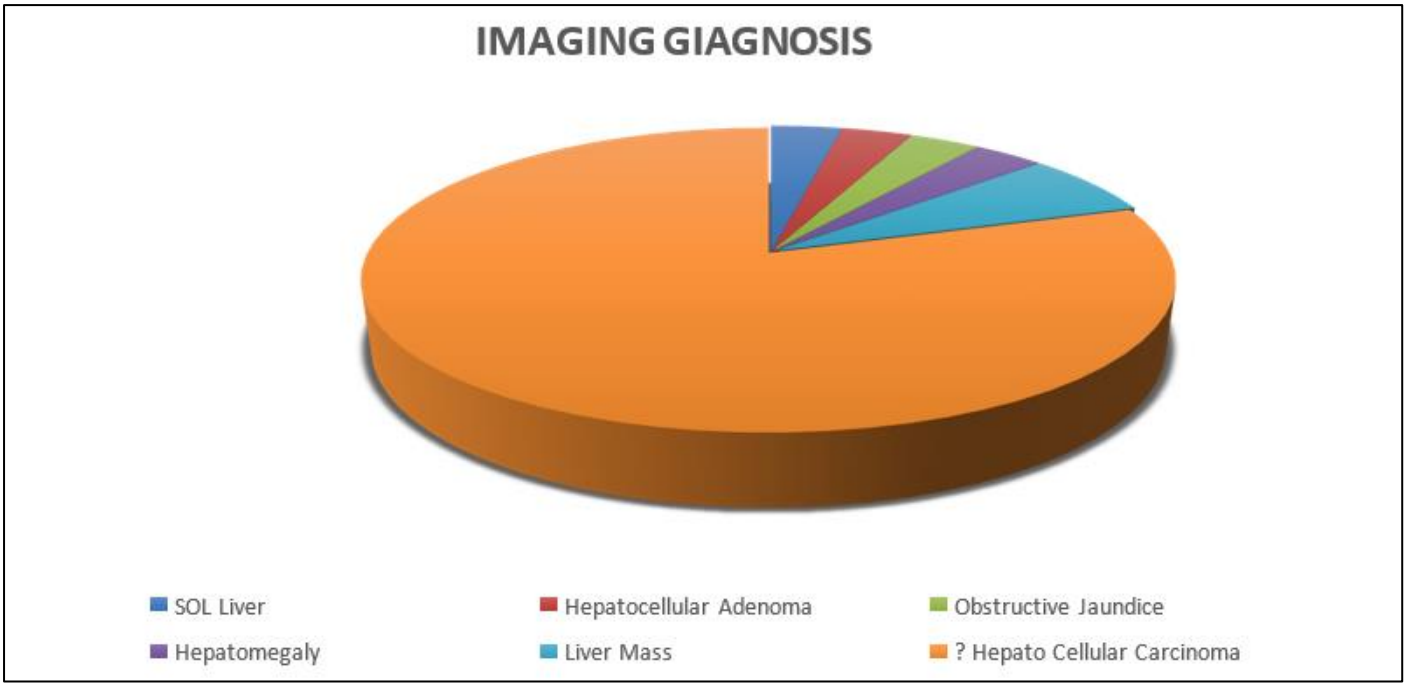

Fig 3 In this Study Include 30 Patients with Complaints of SOL Liver, HCA, Obstructive Jaundice, Hepatomegaly, Live Mass being the Commonest benign Hepatic Lesion. Whereas, Hepatocellular Carcinoma is the Commonest Malignant Hepatic Lesion.

Table 4 Distribution of thE Lesions According to their Multiplicity

Multiplicity	Frequency	Percentage%
Single	6	27.7
Multiple	24	72.3
Total	30	100.0

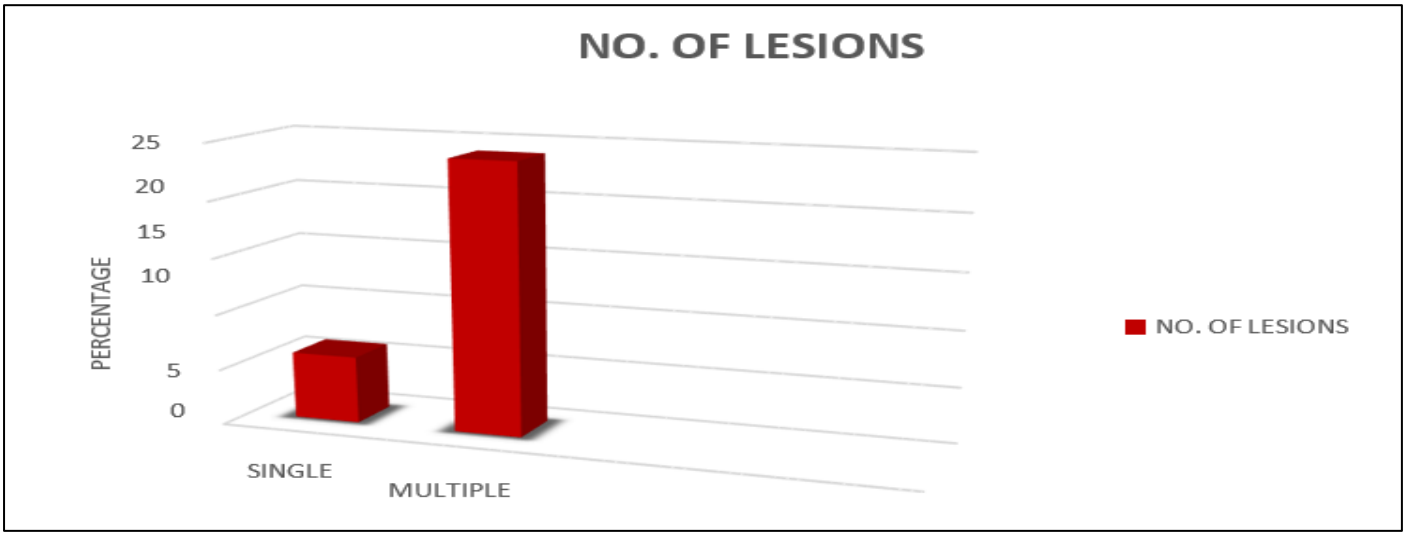

Fig 4 Shows the Distribution of Lesion according to their Multiplicity in which 27.7% whereas Single Type of Lesions and out of 30 Samples 72.3% where Multiple Types of Lesions.

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Table 5 Distribution of the Lesions according to the Lobe Involved

Lobe	Frequency	Percent
Right	9	30.0
Left	5	16.7
Both	16	53.3
Total	30	100.0

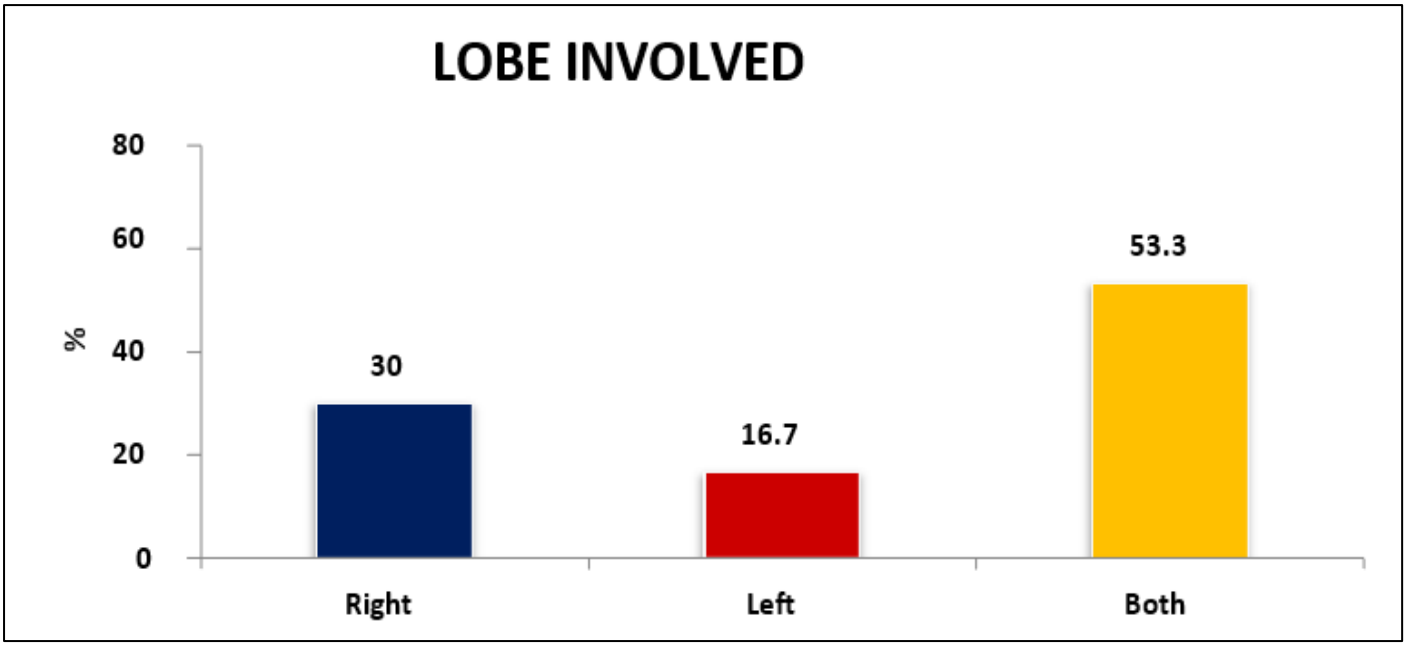

Fig 5 Due to Increased Multiplicity of the Lesions in the Study, Both Lobes were Most Commonly Involved, however Among Both, Right Lobe Showed a Higher Incidence.

Table 6 Computed Tomography Findings

CT FINDINGS	NO. OF PATIENTS (n=6)	PERCENTAGE %
ARTERIAL		
Enhancing	28	93.33%
Non - Enhancing	2	6.67%
VENOUS		
Enhancing	3	10%
Hypo- Enhancing	25	83.33%
Non - Enhancing	2	6.67%
DELAYED		
Enhancing	1	3.33%
Non- Enhancing	4	13.34%
Washout	25	83.33%
DIGNOSIS		
Hepatocellular carcinoma	23	6.67%
Hydatid cyst	1	3.33%
Biliary Cystadenoma	1	3.33%
Hepatoblastoma	2	6.67%
Liver Abscess	2	6.67%
A Typical Haemangioma	1	3.33%

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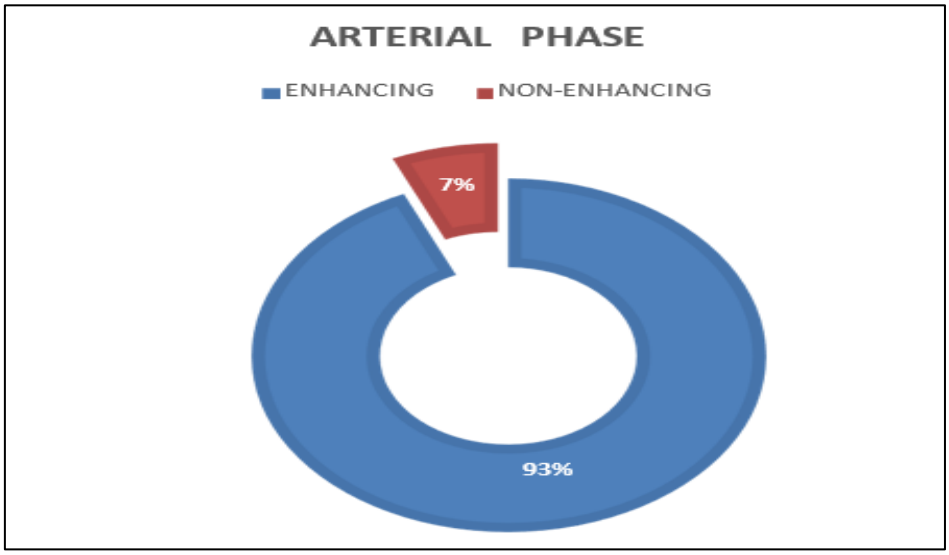

Fig 6 Arterial Phase

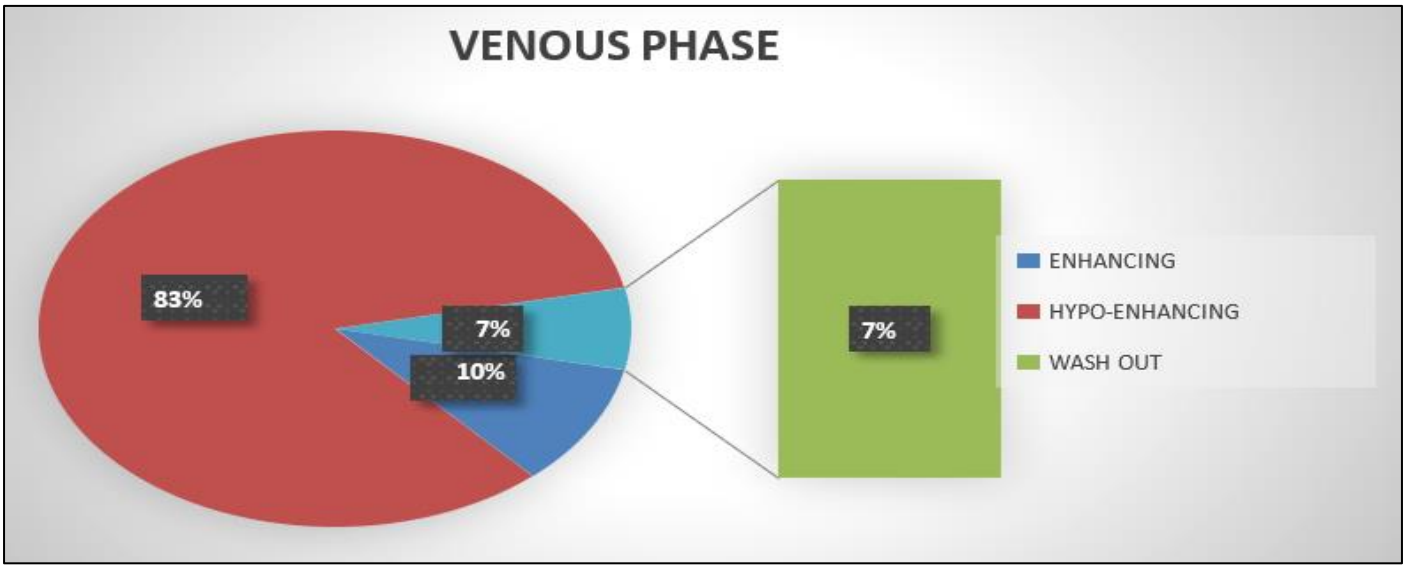

Fig 7 Venous Phase

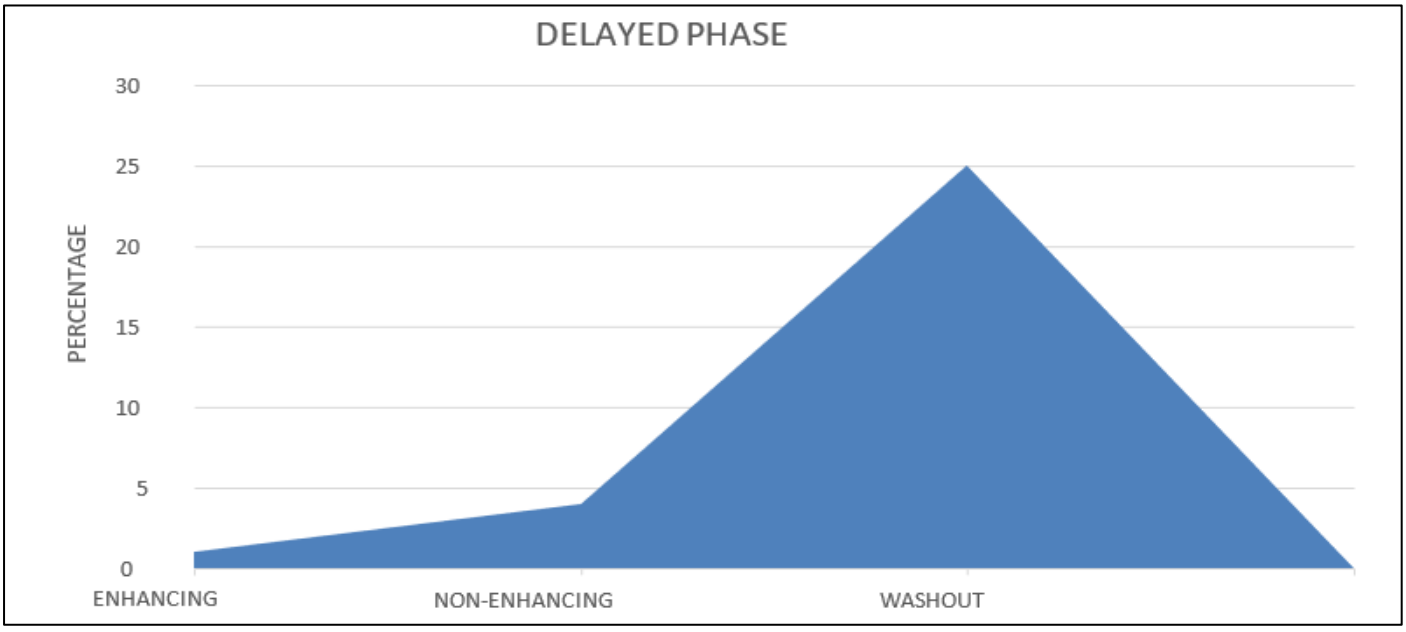

Fig 8 Delayed Phase

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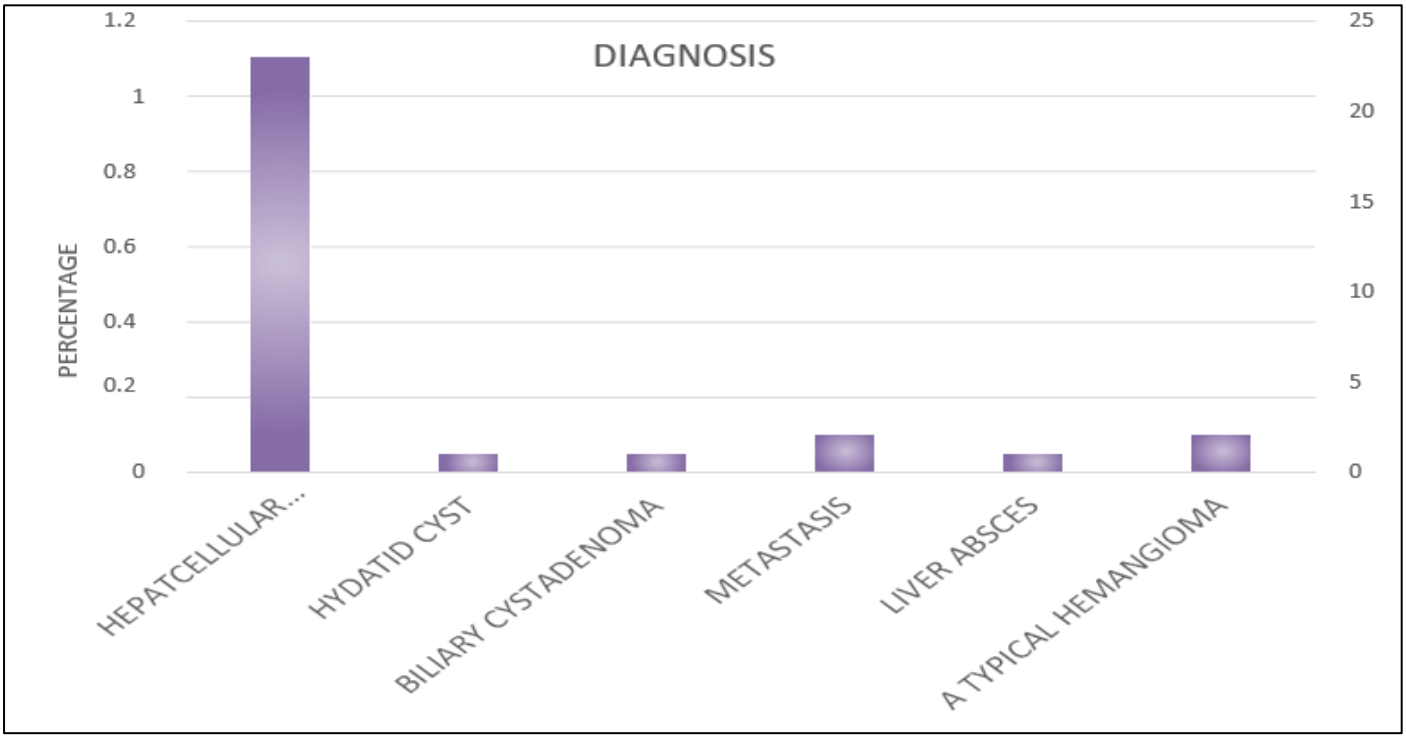

Fig 9 Diagnosis

Table 7 Histopathology

Histopathology Findings	No. of Patients	Percentage
Hepatocellular carcinoma	22	73.33%
Hydatid Cyst	1	3.34%
Intra Hepatic Cholangio Carcinoma	2	6.66%
Metastasis	2	6.67%
Liver Abscess	2	6.66%
Biliary Cystadenoma	1	3.34%

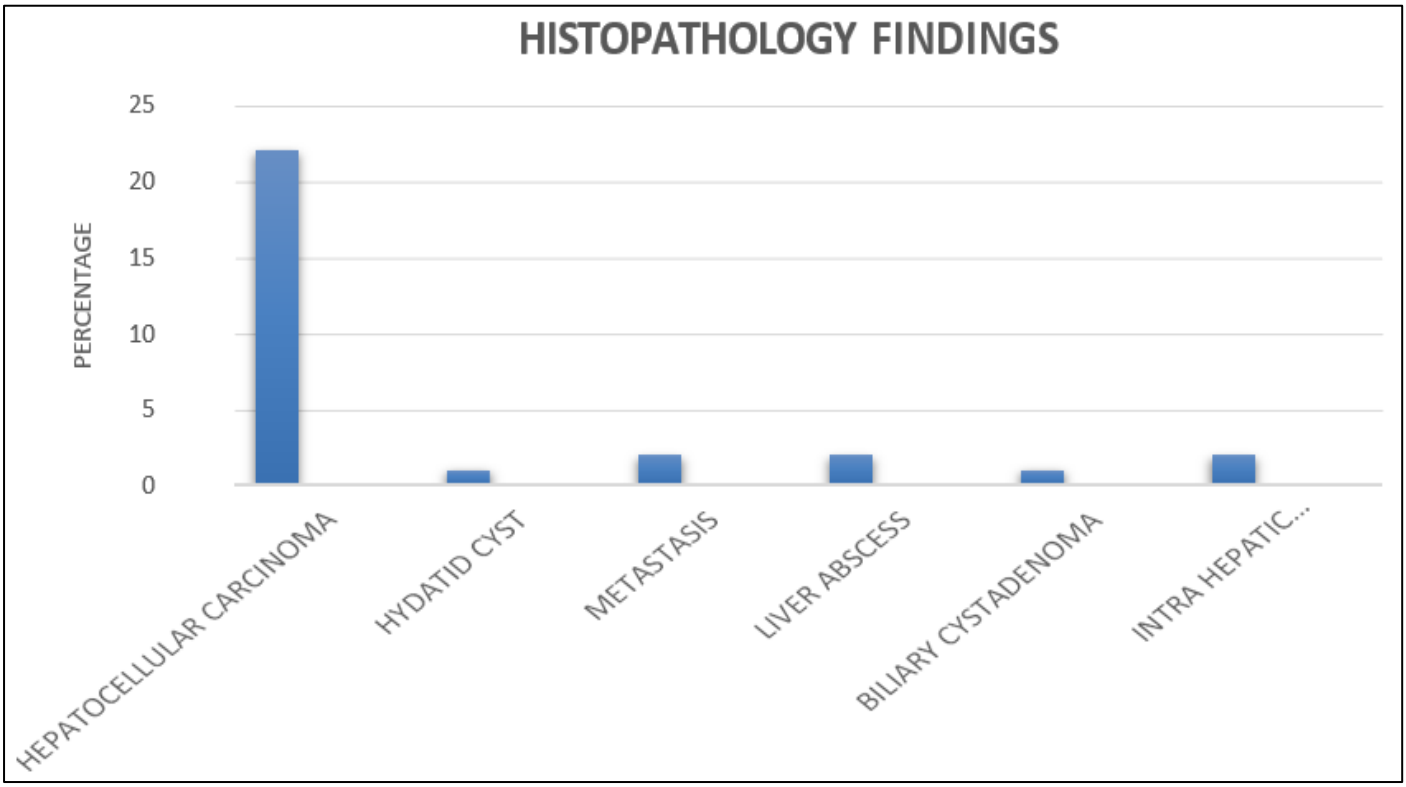

Fig 10 Histopathology Findings

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V. STATISTICAL ANALYSIS

Results were tabulated by using **FISHER EXACT TEST** and analyzed by Sensitivity, Specificity, Positive Predictive Value and Negative Predictive Value was obtained.

Table 8 Correlation of CT Diagnosis with Histopathology -

CECT DIAGNOSED HCC	**HPE PROVEN HCC**	
	TRUE POSTIVE **19**	FALSE POSTIVE **4**
	FALSE NEGATIVE **3**	TRUE NEGATIVE **4**

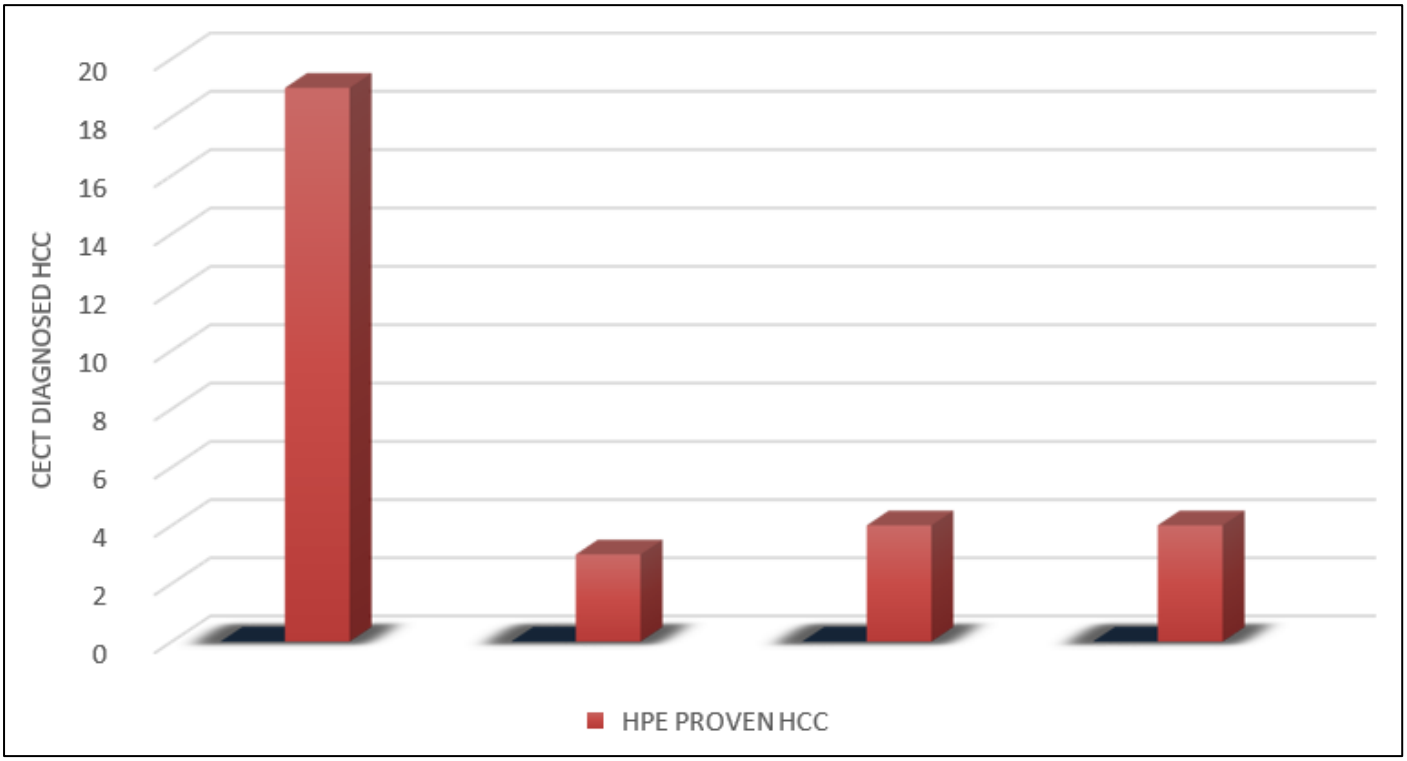

Fig 11 CECT Diagnosed HCC

Total case suspected as HCC = **30**
Total case proven by HPE as HCC **=22**

VI. RESULT

In this study, the age presentation varied widely from 20 years to 80 years with the mean age of 50 years.

Table 1 & Figure 1 presents patient demographic characteristics in this study, which includes age.

Out of 30 patients selected for the study, 80% of the patients were male & 20% of them were female.

Table 2 & Figure 2 presents patient demographic characteristics in this study, which includes gender.

Table 3 & Figure 3 presents the types of lesions by CECT Triphasic Abdomen Study. In this study include 30 patients with complaints of SOL Liver, HCA, Obstructive jaundice, Hepatomegaly, Live mass being the commonest benign hepatic lesion. Whereas, Hepatocellular carcinoma is the commonest malignant hepatic lesion.

Table 4 & Figure 4 shows the distribution of lesion according to their multiplicity in which 27.7% whereas single type of lesions and out of 30 samples 72.3% where multiple type of lesions.

Table 5 & Figure 5 demonstrates the involvement of lesions in different lobes i.e right lobe, left lobe or both lobe. Out of 30 samples both lobe have more no. of lesions.

Table 6 & Figure 6, presents the varies CT Findings used in this study. In this study contrast phases plays major role which shows hepatocellular carcinoma in many patients.

Table 7 shows the Histopathology findings of hepatocellular carcinoma with highest percentage 73.33%.

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This section investigates the significant relation between the histopathology and CECT Abdomen with respect to chi-square values. 30 subjects were investigated. Chi-square test is used & the results shown in the following table 8.

Table 5, shows the chi-square value is 116.47; that indicates hypothesis is satisfied at 5% level. This shows that there is significant relation between the region of interest and techniques.

Where, significant level= 0.05

Degree of freedom= 20

P= 0.00001

The result is significant at < 0.05

Patient dose data (1 scan phase for each patient) from dose information shows the mean value of DLP (Dose Length Product) was 589.66 mGy cm, mean value of CTDIvol (CTDI volume) was 6.91 mGy for 30 patients. The result of this study indicates that the CECT Triphasic Abdomen and Histopathology, both performs major role in detecting the hepatocellular carcinoma in the neck region, with the knowledge of correct useful contrast techniques in the region of interest.

VII. DISCUSSION

In this study included 24 of male patients and 6 of female patients between the age groups of 6 to 70 years. These patients came to the radiology department with clinically suspected hepatic pathology. According to the age limitation, 17% patients belonged to the 0-40 years category, 43 % patients belong to 40 -60 years category and the rest 45% belongs to the 60-80 years category. Patients were taken up for CT Abdomen Plain which revealed 27.7% cases to have single lesion and the rest 72.3% cases had multiple liver lesions. On Contrast Enhancement of Abdomen majority of cases 93.3% revealed to be arterial enhancing lesion 83.3% lesions showed hypo enhancement in venous phase and washout in delayed phase. 2 Cases 6.66% were diagnosed of abscess which showed peripheral arterial and venous enhancement with central non-enhancing areas 1 case of biliary cystadenoma and 1 case of hydatid cyst showed non enhancement in all phases. On histopathology examination, 73.33% of lesions were hepato cellular carcinoma, 6.67% cases were hyper vascular hepatic metastases and 6.67% were intrahepatic cholangio carcinoma. 2 cases of abscess, 1 cases of Biliary Cystadenoma and 1 case of hydatid cyst were diagnosed the same in histopathology. So, CECT correlation with histopathology findings was 100% accurate in abscess, hydatid cyst and biliary cystadenoma.

- *Discussion*

In this study included 24 of male patients and 6 of female patients between the age groups of 6 to 70 years. These patients came to the radiology department with clinically suspected hepatic pathology. According to the age limitation, 17% patients belonged to the 0-40 years category, 43 % patients belong to 40 -60 years category and the rest 45% belongs to the 60-80 years category. Patients were taken up for CT Abdomen Plain which revealed 27.7% cases to have single lesion and the rest 72.3% cases had multiple liver lesions. On Contrast Enhancement of Abdomen majority of cases 93.3% revealed to be arterial enhancing lesion 83.3% lesions showed hypo enhancement in venous phase and washout in delayed phase. 2 Cases 6.66% were diagnosed of abscess which showed peripheral arterial and venous enhancement with central non-enhancing areas 1 case of biliary cystadenoma and 1 case of hydatid cyst showed non enhancement in all phases. On histopathology examination, 73.33% of lesions were hepato cellular carcinoma, 6.67% cases were hyper vascular hepatic metastases and 6.67% were intrahepatic cholangio carcinoma. 2 cases of abscess, 1 cases of Biliary Cystadenoma and 1 case of hydatid cyst were diagnosed the same in histopathology. So, CECT correlation with histopathology findings was 100% accurate in abscess, hydatid cyst and biliary cystadenoma.

Histopathology examination revealed 22 cases of HCC, out of which 19 were provisionally diagnosed in CECT. Hence, showing a sensitivity of 86.36%. Out of these 22 patients, 16 were male and 6 were female, revolving a significant male gender predisposition. This re -emphasizes the fact that male have significantly higher risk of liver cancer which composed to females. Multiple diagnosis like alcohol consumption coupled with cirrhosis, hepatitis B and Hepatitis C infection, increased iron storage level have been postulated for males having a higher predisposition for HCC than females.

VIII. CONCLUSION

Hepatic lesions consist of multiple etiologies and it is vital to react the correct diagnosis, to manage the patient accurately. In most cases, clinical examination cannot ritual the specific etiology. Hence radiological imaging especially contrast enhanced CT of abdomen will be useful in giving the provisional diagnosis often. However, only histopathology can confirm the diagnosis and it remains the gold standard. Whereas, CT is a good non- invasive procedure in characterising and differentiating benign from malignant liver lesions. In this study it shows accuracy in detecting 86.36% of cases confirmed by histopathology as HCC. This study also established 100% accuracy in diagnosis of abscess, biliary cystadenoma and hydatid cyst confirmed by histopathology. This shows excellent corelations between CECT triphasic of abdomen and HPE correlation in diagnostic hepatic lesions.

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FINDING

This study did not receive any specific grant from funding agencies in the public, commercial or not-for-profit sectors.

ABBREVIATIONS

CT: computed Tomography ; CECT : Contrast Enhanced Computed Tomography ;RFT: Renal function Test ; HCC : Hepato Cellular Carcinoma ;CTDI :Computed Tomography Dose Index : CTDIVol : Computed Tomography Dose index Volume ; DLP :Dose Length Product.

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