**EAS Journal of Radiology and Imaging Technology**
*Abbreviated Key Title: EAS J Radiol Imaging Technol*
ISSN: 2663-1008 (Print) & ISSN: 2663-7340 (Online)
Published By East African Scholars Publisher, Kenya

Volume-3 | Issue-3 | May-Jun-2021 | DOI: 10.36349/easjrit.2021.v03i03.010

OPEN ACCESS

**Original Research Article**

# Triphasic Computed Tomography Scan as a Non-Invasive Imaging Tool in Differentiating Benign and Malignant Focal Liver Lesion

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**Article History**
Received: 13.04.2021
Accepted: 23.05.2021
Published: 30.05.2021

**Journal homepage:**
https://www.easpublisher.com

**Quick Response Code**

**Abstract:** ***Background:*** Liver cancer is the 10th most prevalent cancer in the United States, and its occurrence has been raising for many decades. Early identification, diagnosis, and management of diseases are crucial. Computed tomography (CT) is among the most effective and reliable imaging methods for detecting liver lesions and different tumors. CT scanners can perform multiple-phase continuous scan of the entire liver. ***Objective:*** To determine the accuracy of triphasic computed tomography in the differentiation between benign and malignant focal liver lesions in patients observed and selected in Gondal medical and diagnostic complex, Gujranwala. ***Materials and Methods:*** An observational and cross-sectional study performed at Gondal medical complex and diagnostic center Gujranwala, Pakistan. Total 100 patients were observed during the period of this study and the data of 60 relevant patients were collected on the basis of inclusion criteria set for this study. ***Results:*** In this study of 60 patients, males were dominant (56.7%) than females (43.3%). The most dominating age of patients in the study was 41-55 years which accounts for 40% of entire sample. About 38 patients (63.3%) showed increased level of AFP between 401-500ng/ml. Out of 60, 17 patients (28.3%) were diagnosed with benign focal liver lesions and 43 patients (71.7%) were diagnosed with malignant focal liver lesions through different enhancement patterns. The most common malignancy in the current study was HCC and all the patients diagnosed with HCC had an ultrasound detected history of Cirrhosis and CLD. ***Conclusion:*** It is concluded that Triphasic CT scan is first line and non-invasive imaging modality which efficiently differentiated benign focal liver lesions from malignant focal liver lesions and the study evidently concluded that raised AFP level is associated with malignant focal liver lesions mostly with HCC.

**Key words:** Hepatocellular carcinoma, Alpha-feto protein, focal liver lesion, FNH, Hemangiomas, CLD, SOL.



## INTRODUCTION

Focal hepatic lesions could be specified as almost any lesion in liver apart from usual parenchyma with causing or without causing functional and structural malformations of the hepatobiliary system but may differ in size [1]. They may be benign and sometimes may be malignant [1, 2]. Furthermore, hepatic focal lesions might be categorized into three classes Initially, benign conditions where no medication was needed such as FNH, hemangiomas, benign hepatic cysts etc [2, 5]. The second one was benign conditions where medication was needed such as adenomatosis, abscess of liver, biliary cyst adenoma, inflammatory pseudotumor and adenoma of liver [2, 6]. In last, cancerous mass abnormalities where medication is always necessary if possible, such as liver progression from any other initial site, angiosarcomas of liver, cholangiocarcinoma, lymphomas, and HCC etc. [2, 6, 7]. FNH and liver adenoma, each of which occur mainly in both younger and middle-aged people and is mostly incidental finding. Distinction is important due to various clinical approaches [2, 3].

Previous studies indicated FNH is not a malignancy, perhaps a hyperplastic reaction of functional tissue to already present vessel disorder. In comparison to FNH, adenoma of liver is a malignancy,

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comprising of usual or aberrant hepatic cells, mostly deficient in bile ducts and Kupffer cells [3]. Incidental hepatic lesions are most frequently detected as a result of improvement in imaging procedures. In some studies, incidental focal liver lesions have been detected in approximately 33% of radiological research. It hit more than 50% of autopsy cases [4, 5] History and physical inspection were the core of the assessment of these types of patients. Patients who have family background of past cancers or serious liver illness must be taken into account for a deferential diagnosis of HCC vs metastases. Whereas I n a stable population with no serious health history, the differential diagnosis should provide greater options for both malignant and benign patients [6]. The emergence of computed tomography must be considered as it greatly facilitated the detection of hepatic lesions. Besides that, the main arguments why liver cancers that could be diagnosed by computed tomography have gained attention [7].

SPIRAL CT had quickly acquired acceptance as the favorable CT procedure for regular hepatic examination as it offers an image acquisition at optimum hepatic parenchymal enhancement even with only one breath hold [8, 9]. The rapid data acquisition facilitates the sequential scanning of the whole liver at varying moments after contrast media injection thereby providing the likelihood of multiphasic hepatic computed tomography [10]. Some studies have documented advancement in lesion identification when arterial phase imaging is conducted additionally after portal venous imaging, particularly when there is a hyper vascular cancer such as HCC [11]. In a previous study, a triphasic CT procedure has been identified that enabled hepatic scanning in arterial phase, portal phase, as well as equilibrium phase, and for the comparison of CT findings to root factors [12, 11].

In multiphase CT Arterioportal shunt is mostly concerned with hemangiomas, particularly in the rapid-fill form. [13]. Correlation with arterio-portal shunt is commonly assumed to be a defining feature for malignancy. Conversely, in minor tumors whose diameter is less than 3 cm, arterio-portal shunt is generally more common in hemangioma as compared hepatocellular carcinoma [14]. Gradually enhancing hemangiomas with chronic hypoattenuation of triphasic computed tomography can be troublesome in patients having cancer. Awareness of the bright dot symbol as well as tiny enhancement dots inside these hemangiomas which do not advance to typical globular enhancement due to the limited sized lesion and the potential for gradual filling is useful in detecting this kind of hemangiomas [15].

## MATERIALS AND METHODS

This is an observational and cross-sectional study performed at Gondal medical complex and diagnostic center Gujranwala, Pakistan. Total 100 patients were observed during the period of this study and the data of 60 relevant patients were collected on the basis of inclusion criteria set for this study.

**Inclusion criteria**

Patients above age 30 were selected in the observation based collected data. Every patient who was diagnosed with cirrhotic liver, portal hypertension and any space occupied lesion during an ultrasound investigation within study duration, referred for triphasic CT abdomen and have Alpha feto protein results as an indicator of abnormality are included in this research study.

**Exclusion criteria**

Patients having age less than 30, contrast allergic patient and patients who have no RFT report, and the pregnant females were excluded from the study.

This research was carried out during 4 months between November 2020 and February 2021. Triphasic CT protocol was performed in all the selected patients to determine the different appearances in arterial, venous, and delayed phases to confirm diagnosis.

**Machine used**

Triphasic CT scans were performed across the entire abdomen on Aquillion 64 slice computed tomography scanner. In each patient's scan, nearly 25 to 30 CT images were collected. A radiologist from the Clinical Centre evaluated the computed tomography scans. The data was statistically analyzed using a statistical package for social sciences (SPSS-20).

**Technique used**

Collimation of 5mm and table speed of 5mm/sec were used. Every scan was performed with single breath hold and in craniocaudal orientation. Unenhanced scan of the liver was obtained after receiving a scout image. With the help of power injector 100-200ml of contrast material was injected at the rate of 1.5 to 2ml/sec. The whole liver was scanned in arterial phase after 20 to 22 seconds then after the delay of 25 seconds at by the end of arterial phase the early portal venous phased scan of the liver was obtained at about 45-50 seconds. he liver was scanned in late portal venous phase after 70-80 seconds of contrast injection. Then a 20 second delay was given for the patient to breath and then again scan position was maintained cephalad to liver. Following these two phases, the third scan was performed in the delayed phase 6-10 minutes after the contrast injection also called washout or equilibrium phase. The images obtained in each phase were examined in detail to distinguish lesions.

## STATISTICAL ANALYSIS

The data was statistically analyzed using a statistical package for social sciences. (SPSS-20)

**Table-1: Patients are distributed according to Gender**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | MALE | 34 | 56.7 | 56.7 | 56.7 |
| | FEMALE | 26 | 43.3 | 43.3 | 100.0 |
| | Total | 60 | 100.0 | 100.0 | |

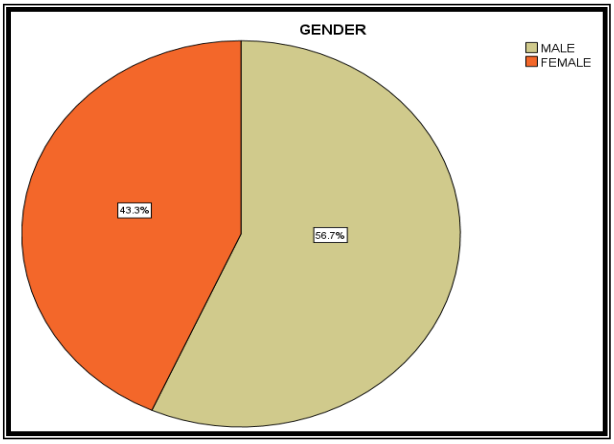


**Chart-1: Shows the Gender based distribution of patients**

**Table-2: Patients are distributed according to Age**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 26years-40years | 9 | 15.0 | 15.0 | 15.0 |
| | 41years-55years | 24 | 40.0 | 40.0 | 55.0 |
| | 56years-70years | 17 | 28.3 | 28.3 | 83.3 |
| | 71years-85years | 6 | 10.0 | 10.0 | 93.3 |
| | 86years-100years | 4 | 6.7 | 6.7 | 100.0 |
| | Total | 60 | 100.0 | 100.0 | |

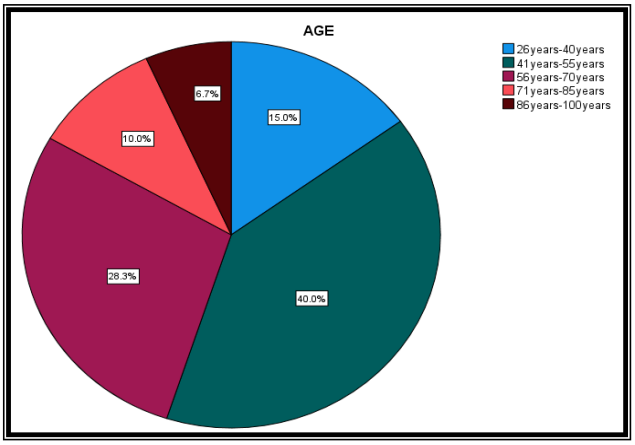


**Chart-2: Shows age-based distribution of patients**

**Table-3: Patients are distributed according to their Ultrasound findings**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | NO History Provided | 4 | 6.7 | 6.7 | 6.7 |
| | CLD | 13 | 21.7 | 21.7 | 28.3 |
| | Portal Hypertension | 4 | 6.7 | 6.7 | 35.0 |
| | SOL | 9 | 15.0 | 15.0 | 50.0 |
| | CIRRHOSIS | 11 | 18.3 | 18.3 | 68.3 |
| | Hepatic Lesion | 8 | 13.3 | 13.3 | 81.7 |
| | HEPATOMEGALY | 2 | 3.3 | 3.3 | 85.0 |
| | Hepatic Mass | 9 | 15.0 | 15.0 | 100.0 |
| | Total | 60 | 100.0 | 100.0 | |

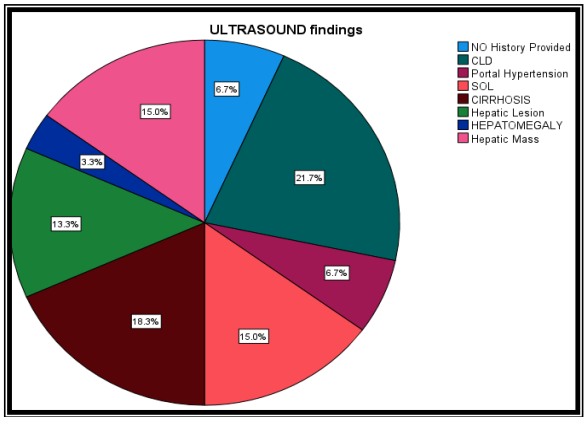


**Chart-3: Shows patient's distribution based on their US findings.**

**Table-4: Patients are distributed according to their Alpha-Feto Protein (AFP level)**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | 1ng/ml-100ng/ml | 17 | 28.3 | 28.3 | 28.3 |
| | 201ng/ml-300ng/ml | 1 | 1.7 | 1.7 | 30.0 |
| | 301ng/ml-400ng/ml | 4 | 6.7 | 6.7 | 36.7 |
| | 401ng/ml-500ng/ml | 38 | 63.3 | 63.3 | 100.0 |
| | Total | 60 | 100.0 | 100.0 | |

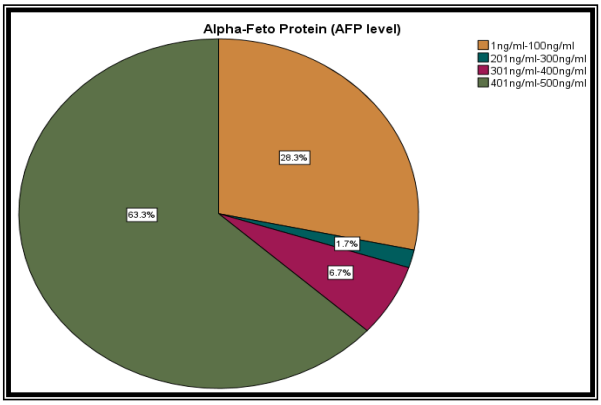


**Chart-4: Shows patient's distribution based on their AFP level.**

**Table-5: Distribution of patients having Benign Focal Liver Lesion**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | ABSENT | 43 | 71.7 | 71.7 | 71.7 |
| | Focal Nodular Hyperplasia | 5 | 8.3 | 8.3 | 80.0 |
| | Hepatic Cyst | 5 | 8.3 | 8.3 | 88.3 |
| | Hemangioma | 7 | 11.7 | 11.7 | 100.0 |
| | Total | 60 | 100.0 | 100.0 | |

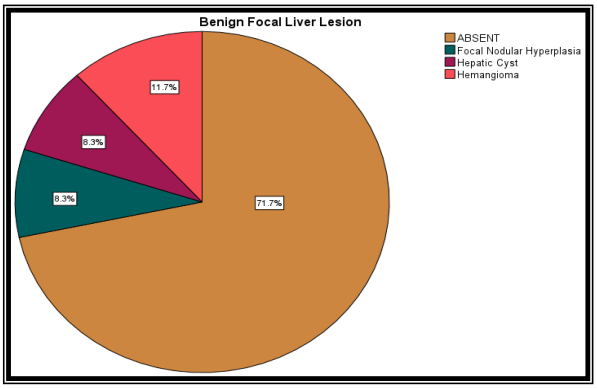


**Chart-5: Shows patient's distribution having different type of benign focal liver lesions**

**Table-6: Distribution of patients having Malignant Focal Liver Lesions**

| | | Frequency | Percent | Valid Percent | Cumulative Percent |
|---|---|---|---|---|---|
| Valid | ABSENT | 17 | 28.3 | 28.3 | 28.3 |
| | Hepato-Cellular Carcinoma | 24 | 40.0 | 40.0 | 68.3 |
| | Secondary Mets | 7 | 11.7 | 11.7 | 80.0 |
| | Cholangio-Carcinoma | 7 | 11.7 | 11.7 | 91.7 |
| | Focal Hepatic Lesion | 5 | 8.3 | 8.3 | 100.0 |
| | Total | 60 | 100.0 | 100.0 | |

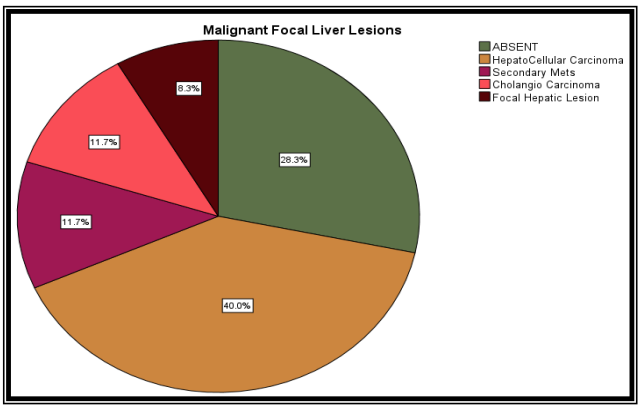


**Chart-6: Shows the distribution of patients having different type of malignant focal liver lesions**

## RESULTS

In this research study of 60 patients 34 were males (56.7%) and 26 were females (43.3%) (Table 1). Male patients having liver disease were dominant in this study. (Chart-1) The most dominating age of patients in the study was 41-55 years which accounts for 40% of entire sample (Chart-2) while patients between 26-40 years accounts for 15%, between 56-70 years accounts for 28.3%, between 71-85 years accounts for 10% and between 86-100 years accounts for 6.7% patients (Table 2). In the data collected for the study 4 patients have no ultrasound detected finding (6.7%), 13 patients were diagnosed with CLD on ultrasound (21.7%), 4 patients had portal hypertension (6.7%), 9 patients had SOL (15%), 11 had diagnosed with cirrhosis on ultrasound (18.3%), 8 patients had hepatic lesion (13.3%), 2 patients had hepatomegaly (3.3%), and 9 had hepatic masses (15%) (Table 3).

About 38 patients (63.3%) showed increased level of AFP between 401-500ng/ml, 4 patients (6.7%) had AFP level between 301-400ng/ml and 1 patient (1.7%) had mild high level of AFP between 201-300ng/ml indicative of malignancy. While 17 patients (28.3%) had AFP level less than 100ng/ml which was not associated with malignancy. (table 4) In all the 60 patients, 60 focal liver lesions were evaluated with the help of different enhancement patterns out of which 17 patients (28.3%) were diagnosed with benign focal liver lesions and 43 patients (71.7%) were diagnosed with malignant focal liver lesions. (table 5,6) and all the patient diagnosed with malignant liver lesions already showed increased level of AFP's in which the mean AFP level was 430ng/ml ± 40ng/ml. (Chart-4) Out of 17 patients having benign focal liver lesions, 5 patients (8.3%) were detected with Focal Nodular hyperplasia, 5 patients (8.3%) had hepatic cyst while remaining 7 patients (11.7%) were detected with hemangioma (table 5). So, hemangioma is the most common benign finding present in the study. (Chart-5) Out of 43 patients diagnosed with malignancy, out of them 24 patients (40%) were detected with Hepatocellular carcinoma, 7 patients (11.7%) had Secondary Mets, 7 patients (11.7%) had cholangiocarcinoma and remaining 5 patients (8.3%) were diagnosed with Focal hepatic lesion (table 6).

So, the most common malignancy in the current study was HCC (Chart-6) and all the patients diagnosed with HCC had an ultrasound detected history of Cirrhosis and CLD. So CLD (21.7%) and Cirrhosis (18.3%) are most common ultrasound detected findings associated with malignancy and mostly with HCC (Chart-3).

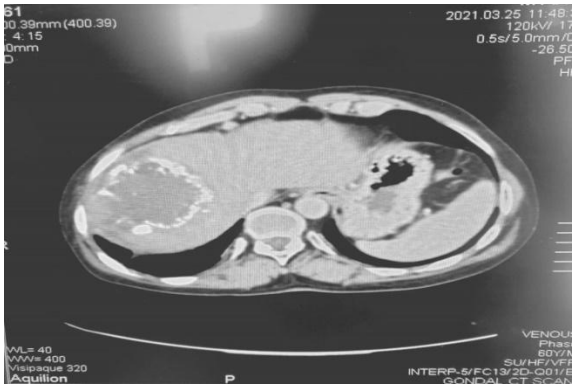

**Fig-1: Triphasic CT scan post venous phase of a 60 year old male patient demonstrates a well-defined typical Hepatocellular carcinoma present in the right lobe of the liver**

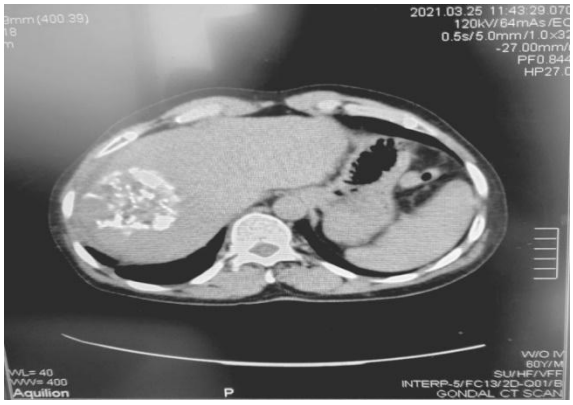


**Fig-2: Triphasic CT scan taken in washout phase of a 60 year old male patient demonstrates a well-defined typical Hepatocellular carcinoma present in the right lobe of the liver**

## DISCUSSION

Triphasic spiral CT of the liver is a reliable tool for analyzing a wide range of benign vs malignant focal liver lesion. This contributes to a reduction in mortality rates for patients with liver disease [12]. Quick data acquisition also allows for sequential scanning of the whole liver at various intervals after injecting iodinated contrast material, thus arising the possibility of multiphase liver computed tomography [9, 15].

In this study about 60 patients were taken who had Abdominal ultrasound scan and AFP serum report as a baseline and for comparison and came to the radiology department for triphasic liver CT scan. All these patients were enrolled in the study on the basis of inclusion criteria set for the research study as it is an observational and cross-sectional study, and all the patients were above the age of 30 years. According to our study analysis mostly male patients (56.7%) were having liver disease as compared to females (43.3%) and our study results are compatible with the study performed by Gadgil et al. in 2019 in which multiple focal hepatic lesions were analyzed on CT scan in 100 different patients. Out of these 100 patients 64 were males whereas 36 were females [16]. The patients from 30-100 years of age were enrolled in our study and the most dominating age of patients with liver disease was 41-55 years (40%) and after that 56-70 years (28.3%) which made a sense that the most common age relating to liver disease according to our study was 41-70 years which accounted for 68.3% patients. (Chart-2) The results about age were similar to the study results performed by Khalid et al. in 2020 in which 75 patients were enrolled in the study from 17-80 years of age group having different types of liver diseases to evaluate frequency of different hepatic lesions. The most common age group analyzed in their study was 40-80 years and mean age was 48.5 year [17, 23].

In this study according to inclusion criteria all the patients had ultrasound scan and AFP serum report along with them as baseline and comparison. According to study analysis the most common US finding related to malignancy was CLD accounted for 21.7% and cirrhosis accounted for 18.3% while other findings have different but a smaller number of percentages. The results are similar to the study analysis performed by Khalid et al. and Vinod et al. in 2020 in which CLD and Cirrhosis was most common sonographically detected lesion associated with the malignant liver disease or serious liver illness [1, 17]. Our study results indicated that raised AFP level 400-500ng/ml was associated with malignant focal liver lesions mostly with HCC and the mean range was 430ng/ml ± 40ng/ml. (Chart-4) this results about AFP serum level was supported by a prospective study performed by Carr et al. in 2014 and 2016 who concluded that the increased tumour size was highly associated with platelet count and AFP serum level and declared the raised AFP level as an indicator about tumour size [18, 19].

In this study out of all 60 patients, 17 patients (28.3%) were detected with benign focal liver lesions and the most common benign liver lesion was Hemangiomas which accounted for (11.7%) of benign liver lesions evaluated by triphasic CT procedure (table 5) and the previous study performed in 2020 by Kadam M, and Khalid et al., also analyzed that hemangioma is most common benign liver lesion found when differentiation benign liver lesions on triphasic CT scans [17, 20].

In our study malignant focal liver lesions were detected in 43 patients (71.7%) in which frequency of HCC was highest (40%) on triphasic CT scans round about present in 24 patients and best differentiated from benign lesions and the results supported by the previous studies conducted by Vinod et al., Kadam M, in 2020 and Ibrahim AKA et al., in 2017 that HCC is most common malignant focal liver lesion that can be well distinguished on triphasic spiral CT from benign lesions like hemangiomas and hepatic cysts [12, 20].

Two studies published in 2011 and 2012 revealed that in arterial phase HCC had characteristic enhancement relative to adjacent parenchyma of the liver, in portal venous phase it showed washout of contrast while in delayed phase HCC was hypo dense. Following patterns in different phases were supposed to be suggestive of HCC in liver with cirrhosis. Conversely, several HCC lesions may not comply with this pattern. Few hyper-vascular lesions (HCCs) do not exhibit washout neither on portal venous nor on delayed phases. Other tumours, either benign or malignant, exhibit washout [21, 22, 24].

This study demonstrated that benign lesions such as haemangiomas can be accurately distinguished from malignant liver lesions and invasive biopsy procedures can be prevented. It is also effective for

detection of hyper vascular lesions, which are frequently overlooked on CT scanning.

## CONCLUSION

It is concluded that Triphasic CT scan is first line and non-invasive imaging modality which efficiently differentiated benign focal liver lesions from malignant focal liver lesions and the study evidently concluded that raised AFP level is associated with malignant focal liver lesions mostly with HCC and sonographically detected CLD and cirrhosis are most common findings associated with malignant focal liver lesions.

## RECOMMENDATIONS

It is highly recommended for all the patients having mild liver illness to exercise on daily basis, avoid junk food, avoid drinking (alcohol drinks) and maintain a lower caloric body weight for preventing the disease getting worse.

### ETHICAL CONSIDERATIONS

Our institute's ethical committee approved the proposal. All patients who participated in this study were asked to give their verbal consent, and their medical history was documented. Written informed consent (attached) was taken from all the participants. All information and data collection will be kept confidential. Participants will remain anonymous throughout the study. The subjects were informed that there are no disadvantages or risks on the procedure of the study.

They will also be informed that they will be free to withdraw at any time during the process of the study. All the patients were told that I will do everything I can to protect your privacy. Your identity will not be revealed in any publication resulting from this study.

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**Cite This Article:** Syed Mohsin Ali Naqvi *et al* (2021). Triphasic Computed Tomography Scan as a Non-Invasive Imaging Tool in Differentiating Benign and Malignant Focal Liver Lesion. *EAS J Radiol Imaging Technol, 3*(3), 179-186.