

Research Article

EVALUATION OF LIVER LESIONS ON BIPHASIC COMPUTED TOMOGRAPHY (CT) SCAN- AN OBSERVATIONAL STUDY

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ABSTRACT

Purpose: The purpose of this study was to evaluate liver lesions on dual phase computed tomography scan (CT scan) especially in the HCV patients having cirrhotic liver. One of the significant aspects is to improve the diagnostic facility for hepatocellular carcinoma (HCC), besides its prevention. Early stage diagnosis is helpful in asymptomatic patients where liver function remains preserved. It also provides better opportunities for tumor treatment via medications and radio therapy. Radio imaging is an imperative tool to diagnose HCC in early stages. HCC shows typical vascular enhancement on arterial phase in CT scan and MRI, and washout in venous phase. This review summarizes the current knowledge about imaging techniques for early diagnosis and staging of HCC. Primary hepatocellular carcinoma is among 10 most common tumors, and is one of the most common primary liver malignancies in the world. **Method and material:** 130 patients were evaluated on ultrasound to have liver defect. 106 were confirmed to possess liver lesions that were evaluated on biphasic CT scan. After maintaining the IV line, injection was injected through pressure injector and acquisition was started. At 15-20 sec arterial phase was taken and at 50-60 second portal venous phase was taken. **Result:** Out of 106 patients, 64.71% possessed hepatocellular carcinoma along with HCV and cirrhotic liver. The patients diagnosed with HCC were 23.53%. The percentage of patients diagnosed with HCC together with HCV was same as patients having HCC and cirrhotic liver i.e., 5.88%. **Conclusion:** Biphasic computer tomography is a great diagnostic tool for the detection of liver lesions where lesion conspicuity is dependent on vascularity of the lesion.

Keywords: Dual phase computer tomography, HCC, HCV, cirrhotic liver, liver lesion.

INTRODUCTION

The most frequent disease of liver is focal liver lesions. Primarily liver lesions are of two types i.e. benign and malignant. Benign lesions are mostly cystic lesions, focal nodular, hyperplasia infections, hemangioma, hepatic adenoma, biliary hamartoma, regenerative nodule, and focal fatty liver. However, malignant lesions are generally metastatic, hepatocellular carcinoma cholangio carcinoma, lymphoma and sarcoma (Algarni, Alshuhri, Alonazi, Mourad, and Bramhall, 2016). The liver infections may be viral, bacterial, parasitic and amebic. Hemangiomas are most common vascular liver lesions (Lv, Lin, Li, Li, and Chen, 2011). These lesions may result due to the dilation of existing blood vessels (Marrero, Ahn, and Reddy, 2014). The hepatic cyst may be abscess, cyst adenoma, metastatic cyst and hydatid cyst (Singh, Winick, and Tabbara, 1997). A simple cyst is regular thin walled, unilocular and generally asymptomatic, while a large cyst may be slightly symptomatic (Bailey, 1995). Presence of thick separation or masses inside the cyst may enhance its vascularity then it may be termed as abscess or neoplastic cyst. On the other hand if abscess is infectious due to Echinococcus then it is known as hydatid cyst (Singh *et al.*, 1997). Cell necrosis or blood circulation alternation may derive regenerative nodules formation (Hanna *et al.*, 2008). Hepatic adenoma is rarely found benign tumor usually formed in females consuming hormonal medicines or oral contraceptives (Assy *et al.*, 2009; Marrero *et al.*, 2014). Focal nodular hyperplasia is a solid and hyper vascular lesion (Murakami and Tsurusaki, 2014). Cholangio carcinomas may be intra hepatic or extra hepatic cholangio carcinomas (Marrero *et al.*, 2014). These are hyper vascular malignant lesions (Murakami and Tsurusaki, 2014). Liver is the most common site where the metastases can move from gastrointestinal tract, pancreas, breast and lungs.

These metastases can also be calcified (Assy *et al.*, 2009). Computer tomography is clinically very important in the diagnostics. It has high accuracy in diagnosis and staging of liver lesions. The development of rapid scanning technique has played a vital role in accurate diagnosis (Hollett *et al.*, 1995). It has become the standard for detection and characterization of the liver lesions (Baron *et al.*, 1996; Hollett *et al.*, 1995; Hwang, Kim, Yoo, and Lee, 1997; Ohashi, Hanafusa, and Yoshida, 1993). Increased enhancement of tumor compared with the surrounding liver parenchyma during hepatic arterial phase is the cornerstone for diagnosis of lesion at multi phasic MDCT (Khan and Hafeez, 2017). By using the images some important parameters are taken e.g. size of lesion, vascularity of lesion etc. It is important to use high injection rates and appropriate bolus timing. The liver tumors will be strongly enhanced during the arterial phase (beginning 15-20 sec after the start of a bolus injection) but of similar density to enhanced normal parenchyma during the portal venous phase (50-60 sec). Some tumors are most conspicuous during early-phase arterial scanning (25 sec after the start of bolus injection), others later, during the late arterial phase 35 sec after the start of bolus injection. After the initial triphasic-phase protocol, delayed images at 5 and 10 minutes are obtained (Chapman and Nakielny, 2001). On the basis of lesion enhancement, the lesions can be divided into two types 1) Hyper vascular lesion 2) Hypo vascular lesion. The hyper vascular lesions are those having high concentration of blood vessels due to which has high ability to grow. For example: HCC, focal nodular hyperplasia etc. The hypo vascular lesions are those having low concentration of blood vessels due to which has low ability to grow. For example: fatty liver, liver cirrhosis etc.

MATERIALS AND METHODS

The study was conducted at Islamabad Diagnostic Center Faisalabad (October 2019 to January 2020). The data was collected through CT

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films and reports by using convenient (non-probability) sampling technique. Sample size was 130 patients and patients of all age groups especially diagnosed with hepatitis C were included. Exclusion criteria included patients having serum creatinine level more than 1.5mg/dl, no liver mass on abdominal ultrasound and pregnant ladies. All the patients fulfilling the inclusion criteria were included in the study. Multi detector 16 slice helical CT scan machine (Toshiba) was utilized for taking images. All CT reports were diagnosed by the experienced radiologists. A multi slice computer tomography was used to scan the liver in multiple times in a very short duration using a single bolus injection of contrast medium. Patients having normal renal function tests i.e. urea and creatinine level were considered to be fit for the contrast media administration. Patients were asked to sign the informed consent form and were guided regarding lying down in supine position and restriction of movements was addressed.

Table1. Lesions on CT-Scan (Assy et al., 2009)

Lesion	On CT
Haemangioma	Peripheral puddles, fill in from periphery, enhancement on delayed scan
Focal fatty liver	Sharp interface and low density
Focal nodular hyperplasia	Homogeneous enhance strongly with hepatic arterial phase Iso dense with liver; Central low density scar
Hepatoadenoma	Homogenous > Heterogeneous, Peripheral feeders filling in from periphery
Hepatocellular carcinoma	Hyper vascular, often irregular borders, Heterogeneous > Homogeneous abnormal internal vessel, Hallmark is venous washout
Cholangiocarcinoma	Hypo dense lesion. Delayed enhancement
Metastasis	Complete ring enhancement

The 18-20 gauge cannula was passed and IV line was fixed. Pressure injector was used to inject the 100ml of contrast media. Initially scan gram image was taken to draw the field of view after that bolus injection was injected and scan was started. Arterial phase was taken after 15-20 seconds of the start of bolus injection. Then at 50-60 seconds after injection portal venous phase was taken. Early and late arterial phase were also be taken. Early arterial phase was taken at 15 seconds and late arterial phase was taken at 35 seconds, since some lesions are more conspicuous during early or late arterial phase. The lesions were best visualized in contrast enhanced axial images of arterial phase of biphasic CT. Mostly axial images were preferred but sagittal and coronal images were also taken for accurate evaluation. All data was analyzed by using Microsoft excel 365. Mean and percentages were calculated for all the numerical or quantitative variable such as gender, frequency of hyper vascular lesion, hypo vascular lesion and cirrhotic liver with lesion. Graphs, tables, component and multiple bar charts and pie chart were used to express different frequencies.

RESULTS

Out of 130 patients, 24 patients showed normal liver on CT scan e.g., they had other problems like cholelithiasis, hence were excluded from the study. 106 patients represented with liver lesions. Out of these 130 patients, 67(52%) were females and 63(48%) were males.

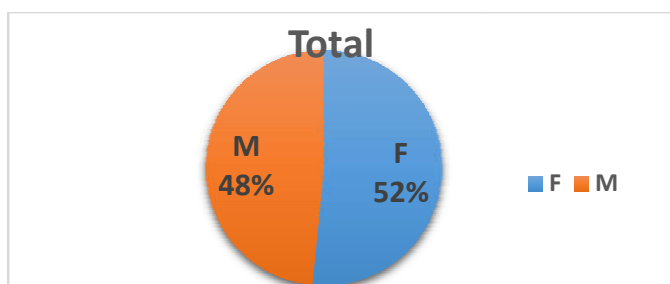


Figure1. Gender distribution among the sample size

For hyper vascular lesion like for HCC, the lesions in the HCC showed arterial enhancement and also venous enhancement or washout phase. This was also noticed for focal nodular hyperplasia and metastatic patients. Out of 106 patients, 75patients presented hyper vascular lesions i.e., showed both phases of biphasic CT scan in 100% cases. In the hemangiomas there was complete enhancement in both phases and no washout phase. The graph shows the enhancement in both phases.

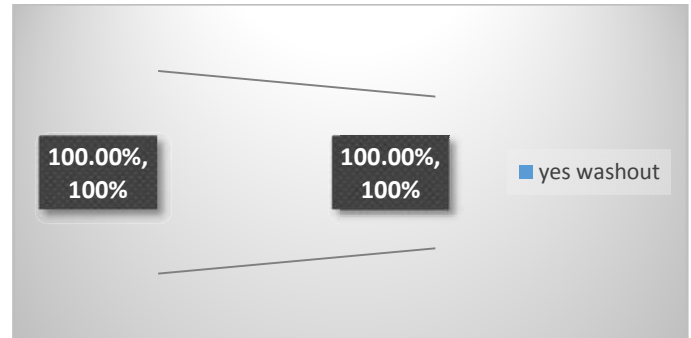


Figure 2. Arterial and venous comparison for Hyper vascular Lesion

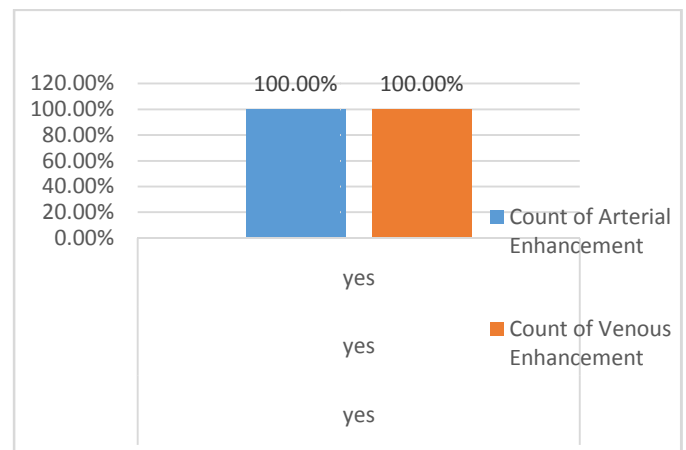


Figure3. Arterial to Venous Enhancement Percentage for Hemangioma

This study concluded that all hyper vascular lesions have arterial enhancements as well as venous enhancements on biphasic computer tomography. Finally the result for hyper vascular lesion was 100% in arterial phase. Out of 106 patients, 31 patients presented hypo vascular lesions and showed no enhancement in both phases of CT scan. In this result 29% represented with hypo vascular lesions and 71% with hyper vascular lesions. Although all have different enhancement pattern but basically they are showed enhancement or no enhancement on the bases of their vascularization.

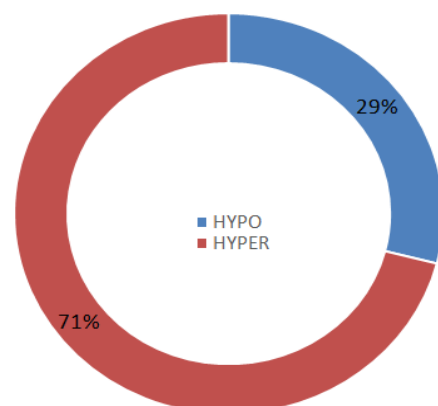


Figure 4. Ratio of patient on the bases of 2 types of lesions

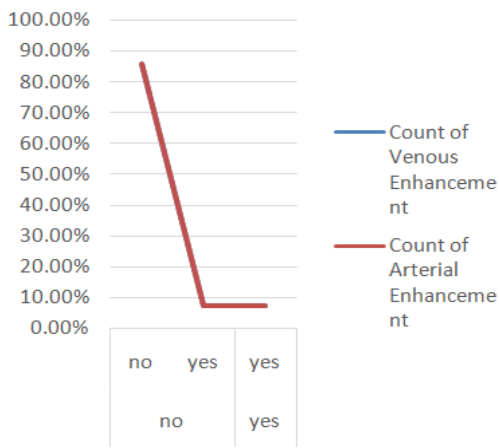


Figure 5. Arterial to Venous Enhancement for Hypo vascular Lesion

Conclusively, lesions of two types were presented and both types showed two different percentage of enhancement on arterial and venous phase.

Table 2. Lesions Enhancement

Lesions	Arterial Enhancement	Venous Enhancement	Percentage of patients
Hyper vascular	100%	100%	71%
Hypo vascular	0.0%	0.0%	29%

In these 71% hyper vascular patients, they possessed hepatocellular carcinoma with HCV along with cirrhotic liver were 64.71%. The patients having only HCC were 23.53%. The patients having HCV and HCC are 5.88%. The patients having HCC with cirrhotic liver are 5.88%.

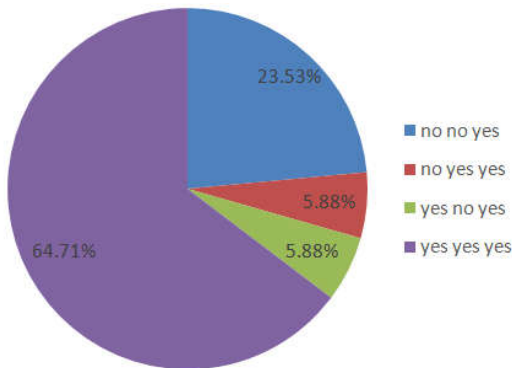


Figure 6. Relation between HCC, HCV and cirrhotic liver

DISCUSSION

The vascularity of a liver lesion is still a point of conflict. The early work on animals showed that lesion in the liver acquires its blood supply from hepatic artery. (Breedis *et al.*, lien *et al.*) However recent work evaluated that portal vein also contributes in supplying the blood. It may be through collaterals (Akeraman *et al.*, Lin *et al.*, N.B akeraman *et al.*, Matsui *et al.*, Kan *et al.*). According to Breedis *et al.*, adenocarcinoma is circulated by 80% hepatic artery supply and 20% portal vein supply. However, prominent blood supply of liver lesion is hepatic artery. As the size of tumor increases, the vascularity of lesion depends upon the type of lesion. The main two types of lesions are hyper vascular and hypo vascular. The hyper vascular malignant liver lesions are best seen on the arterial phase of computer tomography. Hyper vascular lesions show full enhancement on arterial phase (Hollett *et al.*) (Figure 7). This study correlated with these results as 100% enhancement of hyper vascular lesion was observed.

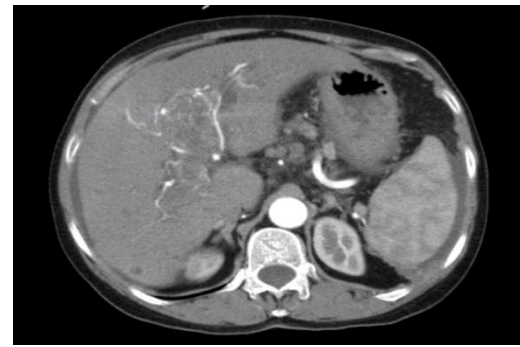


Figure 7. The Hyper vascular Lesion on the Arterial Phase of CT Scan

This figure represents that hyper vascular lesion show enhancement on the arterial phase because of the involvement of hepatic artery. Biphasic computer tomography is also convenient for hypo vascular lesion like adenomas and infections. Mostly hypo vascular lesions are best seen on the portal venous phase. There relative attenuation difference is checked between lesion and normal parenchyma of liver. (Figure 8)



Figure 8. Hypo vascular Lesion on Portal Venous Phase

The study shows 7.14% enhancement on portal venous even though biphasic computer tomography is best for hyper vascular lesion but in some cases it was also seen the lesion become iso intense with liver after the contrast administration, especially in the cases when the dose of contrast injection is not enough. Then it is more convenient to see lesion on unenhanced scan (Bressler *et al.*). The unenhanced scan is not suitable for detection of small lesions because it becomes difficult to differentiate between small lesions and hyper tense vessels. It relates to the low sensitivity of the unenhanced CT for detection of liver lesion. Therefore, it can be stated that arterial phase is more suitable to detect the small lesions (Heiken *et al.*). Arterial phase maximizes the possibility for detection of small lesions and hyper vascular lesions. Previously, biphasic computer tomography was used to evaluate only hepatocellular carcinoma with a very slow rate of contrast infusion and the delayed scan was taken at the 6 minutes after the contrast administered (Ohashi *et al.*). But when the arterial phase was required then it became compulsory that the scanner should be capable enough to capture images of the entire liver in a very short time such as 6 second after the infusion of contrast material arterial phase is taken and then patient is allowed to breath for few seconds like 10-20 second, at 50-60 second portal venous phase is taken (Heiken *et al.*). An appropriate rate of injection is set to maximize the arterial enhancement. Arterial phase improve the lesion detection in all types of lesions as well as the venous phase. But alone venous phase is not reliable. As the result show that hyper vascular lesions are more enhanced on biphasic CT as compared to hypo vascular lesions. But there can also be chances of false detection of lesion like in Hollett *et al.*

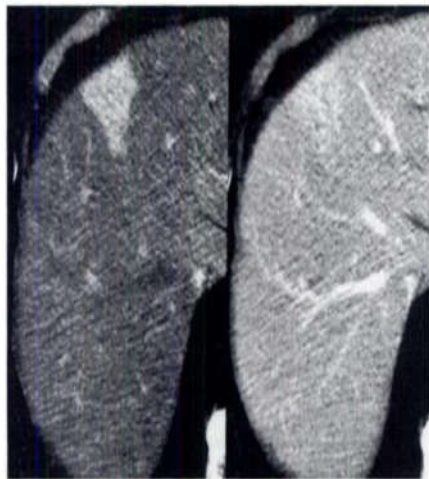


Figure 9. A False Positive Liver Lesion Shown on the CT Arterial Phase in a female of 60 Years and Its Correction on MRI

CONCLUSION

Biphasic computer tomography is best diagnostic technique for the detection of liver lesion. Although some lesion does not show any enhancement on the arterial or venous or on both phases but biphasic study increases the conspicuous of lesion for the radiologist. And it becomes easier to identify and differentiate the lesions through contrast enhanced images.

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