

# Triphasic Helical CT Scan :Value of Arterial Phase Acquisition in Detection of Focal Lesion in Cirrhotic Liver

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## Abstract

**Background:** To determine the value of triple phase CT scan and the phase acquisition in which maximum tumour conspicuity can be obtained, in a population of patients with chronic liver disease.

**Methods:** In this descriptive study triphasic CT scan of 50 chronic liver disease patients who presented with sonographic suspicion of space occupying lesion, were evaluated. CT scan appearances of different focal liver lesions, in arterial and portal venous phases, were evaluated. Tumour conspicuity was assessed on different phases of CT acquisition to determine the phase which provided maximum tumour to parenchymal difference, while using multidetector CT with fixed timing delay.

**Results:** Focal hepatic lesion was found to be present in 41 out of 50 patients. 24 patients had morphological characteristics of hepatocellular carcinoma(HCC). Tumour was found to be most conspicuous in late arterial phase of acquisition in 30 patients

**Conclusion:** Triphasic helical CT of liver, using early, late arterial and portal venous phases with fixed timing delays is quick, easy and non-invasive useful imaging modality in detection and characterization of focal lesions and especially diagnosis of HCC in cirrhotic patients.

**Key Words:** Triphasic Helical CT Scan; Focal hepatic lesions.

## Introduction

Spiral CT is most commonly used modality for detection and characterization of focal hepatic defects in patients with chronic liver disease. Tumor conspicuity has to be maximized to ensure its detection. For this purpose CT is done in different phases of contrast enhancement i.e., early and late arterial and portal venous phases. It is seen that hypervascular tumors are best seen in late arterial phase.<sup>1</sup>In more recent studies it is seen that although most of tumors have maximum conspicuity in late arterial phase but a combination of early and late arterial phases maximizes number of tumors detected.<sup>2</sup> Using two arterial phases instead of one is beneficial for

tumor detection. However it exposes patients to more radiation, requires additional films, additional data storage capacity and requires more time of radiologists for reporting.

Presently triphasic CT scan of liver is imaging modality of choice for detection and characterization of focal lesions in cirrhosis of liver, for exclusion of multifocal disease, to select candidates for curative surgery, embolotherapy, selection of patients for percutaneous ethanol injection, radiofrequency ablation and trans-arterial chemoembolization. Helical CT scanners allow images of the entire liver to be obtained during the phase of maximum parenchymal enhancement, enabling optimal detection of focal hepatic lesions, as most of the hepatic neoplasms are relatively hypovascular.<sup>3</sup>

Accurate detection of small hepatic neoplasms is critical to the examination of patients as they are possible candidates for curative surgery. On the other hand, some patients are referred for CT in an attempt to localize focal lesion already detected by ultrasound. CT technique used for examination of these patients should be optimized not only for detection but also for differentiation of benign and malignant tumours.<sup>4</sup>

In triple phase helical CT images obtained, during the phase of preferential early and late arterial enhancement can be obtained together with portal venous phase images during a single bolus injection. Different studies have shown that this technique allows improved detection of hypervascular neoplasms.<sup>5</sup>

## Patients and Methods

A prospective study from May to October 2007 was carried out in the Department of Radiology of Sheikh Zayed Hospital Lahore. A total of 50 patients were included in the study. All of them had clinical or ultrasonic suspicion of hepatic lesion. Clinically they had features of chronic liver disease and supporting lab evidence. On ultrasound they had cirrhotic liver and focal hepatic defect. Age range was 40-90 years. Informed consent was obtained and triple phase helical CT scan images were obtained on multi

detector spiral CT. Images were interpreted by the consultant radiologist for presence of focal lesion in liver and its characteristics and conspicuity with respect to the phase of imaging.

In all patients CT was done using Spiral CT scanner. Water was given as an oral contrast before scanning. 100 ml of 1/V contrast (omnipaque) was given through pump injector at the rate of 3 ml/sec and axial images were obtained from dome of diaphragm to the level of iliac crest. Images were obtained after 20 seconds of start of injection for early arterial phase then at 35 seconds of start of injection for late arterial phase. These timing delays were explicitly chosen so that both arterial phases could be performed within a single breath-hold that ranged from 30 to 50 seconds. These two phases were obtained during a single breath hold to minimize the effect of respiratory variation on lesion conspicuity and detection. Liver was scanned in a cephalo-caudal direction using a detector collimation of 5mm with a table speed per rotation of 15mm/0.8 seconds, a pitch of 3 in scanner's HQ mode and an image thickness of 5mm. After 60 seconds' scanning delay, imaging was done for portal venous phase. Hard copy images were obtained on abdominal windows.

## Results

Tumor was found to be most conspicuous in late arterial phase of acquisition in 30 patients. In 5 patients tumor conspicuity was maximum in early arterial phase and in 6 patients in portal venous phase (Table 1). Focal hepatic lesion was found to be present in 41 out of 50 patients. 24 patients had morphological characteristics of HCC. In 8 patients, differential was between HCC or metastatic disease. Three patients had metastatic liver disease (Table 2). One had haemangioma and 5 had regenerative nodules.

**Table 1: Subjective analysis of tumour conspicuity (n=50)**

CT Imaging Phase	Number of lesions detected
Early Arterial	5
Late Arterial	30
Portal Venous	6

## Discussion

Incidence of hepatocellular carcinoma in our country has been rapidly increasing over past several years mainly because of rising rates of hepatitis C virus infection. Imaging plays a central role in

management of HCC, including screening population at risk, confirming the diagnosis, planning the treatment, guiding therapy and follow up after treatment. <sup>6</sup> The fact that contrast enhanced CT is the most valuable imaging modality in detection and characterization of focal hepatic lesions is well documented. The purpose of this study was to assess whether images obtained in three phases, i.e. early and late arterial and portal venous phase contribute to improved detection of hepatic lesions. Moreover, enhancement patterns on early and late arterial and portal venous images were analyzed to assess tumor conspicuity and to detect features of different type of lesions. <sup>7</sup>

**Table 2: Characteristic Features of Detected Hepatic Lesions on CT**

Pattern of Enhancement	Phase of Acquisition with maximum tumor conspicuity	No of Cases	Suggested Diagnosis
Single heterogeneous lesion with hyperdense component	Early Arterial	1	HCC
	Late Arterial	12	
	Portal Venous	1	
Multifocal lesions with arterial phase enhancement and portal venous phase washout of contrast	Early Arterial	2	HCC/ Metastasis
	Late Arterial	6	
	Portal Venous	0	
Diffusely infiltrating lesions with heterogeneous enhancement	Early Arterial	1	HCC
	Late Arterial	7	
	Portal Venous	2	
Multiple homogenous predominantly hypodense lesions with atypical peripheral enhancement	Early Arterial	0	Metastasis
	Late Arterial	0	
	Portal Venous	3	
Single predominantly hyperdense lesion with homogenous enhancement	Early Arterial	1	Regenerating Nodule/ Adenoma
	Late Arterial	4	
	Portal Venous	0	
Globular enhancement isodense to aorta	Early Arterial	0	Haemangioma
	Late Arterial	1	
	Portal Venous	0	

HCC: Hepato Cellular Carcinoma

Results of present and previous studies show that addition of late arterial phase images not only significantly improves detection but also helps in

characterization of focal hepatic lesions. As most of the hepatic tumors receive their blood mainly from the hepatic artery (and not from the portal venous system), differences in perfusion between tumor and hepatic parenchyma is most conspicuous on arterial phase images.<sup>7</sup>

Hepatocellular carcinoma was found to have three growth patterns: a solitary lesion, a multi focal lesion or diffuse hepatic infiltration. Larger masses were heterogeneous, moderately and in homogeneously hyperattenuating to surrounding liver on arterial phase of enhancement and in homogeneously hypoattenuating on portal venous phase. This arterial hypervascularity and heterogeneous appearance is a hallmark of HCC with washout of intralésional contrast on portal venous and delayed phase images. Additional imaging features associated with HCC were signs of cirrhosis, invasion of hepatic or portal veins, presence of partial or complete capsule, foci of calcifications well seen on portal venous phase images. Arteriportal shunting was evident on arterial phase images in some patients and could not be identified on portal venous images for those patients. These features suggest acquisition of both arterial and venous phases improves the characterization of focal hepatic lesions.

Other hyperattenuating liver lesions are haemangiomas, focal nodular hyperplasia, adenomas, benign regenerative nodules and hypervascular metastasis. Awareness of key imaging characteristics of benign lesions and evaluation of enhancement pattern in dynamic CT can be used to avoid false positive diagnosis and is helpful in distinguishing benign and malignant focal hepatic lesions. Follow up helical CT is also helpful to confirm benign diagnosis.

Many authors have reported findings of dual phase CT for detection of hepatic tumors using single detector CT scanners. Our study with spiral CT allows more rapid image acquisition and allows greater separation of arterial and venous phase. Our results differ from earlier studies in that in our study, tumor conspicuity for hypervascular liver tumors was superior on late arterial phase images rather than early arterial phase images.<sup>8</sup> Our finding regarding tumor conspicuity is similar to those of maximal tumor-to-parenchyma differences reported by Foley et al.<sup>9</sup> In that study maximum tumor to liver contrast difference occurred in late arterial phase. As regards hypovascular tumors portal venous phase was found to be superior to or equivalent to late arterial phase.

We also found that portal vein opacification is greater during portal venous phase. These findings are similar to results of Foley et al.<sup>9</sup>

In summary although late arterial phase images were found to be superior as regards tumor conspicuity but a combination of early and late arterial phase and portal venous phases that is triphasic CT imaging resulted in improved tumor detection. Using two arterial phases instead of one adds some complexity to scanning as patient exposure to radiation increases, more data storage capacity and more films are required but is beneficial as it improves chances of detection of hepatic tumors.

## Conclusion

For practical purposes using triphasic CT technique in all patients referred for work up of focal hepatic lesions seem justified as it improves the chances of detection of focal hepatic lesions.

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