CHARACTERIZATION OF HEPATIC MASSES WITH DYNAMIC COMPUTERIZED TOMOGRAPHIC SCANNING

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INTRODUCTION

The introduction of computerized tomography (CT) has revolutionized medical imaging. It is the most important radiological investigation in the evaluation of hepatic masses; whether malignant or benign. The differentiation amongst the hepatic masses is significantly improved by difference in enhancement patterns. Different protocols have been developed and used for the evaluation of hepatic masses. The commonly used and simpler technique is the plain scan, followed by a bolus of contrast administration and then the images are taken after an interval of 25 seconds for arterial phase, 70 seconds for portal venous phase and 5 minute for equilibrium phase[2].

We present three patients of hepatic masses who were evaluated by dynamic CT scanning and showed the typical enhancement patterns for these masses.

CASE 1

A 60 year female presented with one day history of recurrent vomiting, upper abdominal pain and low grade fever. On examination her general physical examination and systemic examination were unremarkable. Her blood chemistry including LFTs did not reveal any abnormality. Her abdominal USG revealed a well defined echogenic mass (6.4 x 5.5 x 5.4 cm) having lobulated outer margins in the right lobe of liver with areas of reduced echogenecity. Diagnosis of haemangioma was suggested but considering her age, differential of a mitotic lesion was also mentioned. Her contrast enhanced CT scan was performed, which showed a well defined iso to hypodense mass in right lobe of liver. Marginal nodular enhancement was seen on arterial phase imaging (Fig1.1) with centripetal extension in portal venous phase (Fig 1.2) and delayed imaging performed at 5 min showed diffuse enhancement (Fig 1.3), except for two small non enhancing areas. No lymph node enlargement was seen. This typical enhancement pattern clinched the diagnosis of hemangioma.

CASE 2

A 32 year lady was referred to our department from Pakistan Air Force Complex Hospital, Kamra, for CT scan. She had an USG of abdomen done for vague abdominal pain and a hypoechoic mass was detected in liver. On multi phase dynamic CT scanning the lesion appeared isodense on plain scans (Fig 2.1) and arterial phase imaging. It was slightly hyperdense to liver in portal venous phase (Fig2.2) and isodense on 5 min scanning (Fig2.3). It was further evaluated by sulfur colloid radioisotopic imaging which confirmed the diagnosis of adenoma.

CASE 3

A 73 year male was advised USG of abdomen for right upper quadrant pain of two weeks duration. Pain was a dull ache and was not affected by food, respiration or change of posture. Small (1.8 x 1.5 cm) hypoechoic lesion was seen in right lobe of liver, in subcapsular location. Patient had history of prostate cancer and was treated & declared tumour free about five years ago. CT scan of abdomen and pelvis was carried out with dynamic scanning only for the liver. Apart from the lesion detected on USG three other smaller lesions were detected on CT scanning. These lesions were hypodense with liver parenchyma on plain scans (Figure 3.1) and showed peripheral rim enhancement on CE scans (Fig 3.2). His serum PSA levels were well within normal limits. USG guided FNA biopsy of the largest lesion was done which revealed metastasis from prostatic cancer.

DISCUSSION

Dynamic hepatic CT scanning is a technique which improves the detectability of focal hepatic masses, as compared to nondynamic, contrast material infusion technique[3]. Multidetector computed

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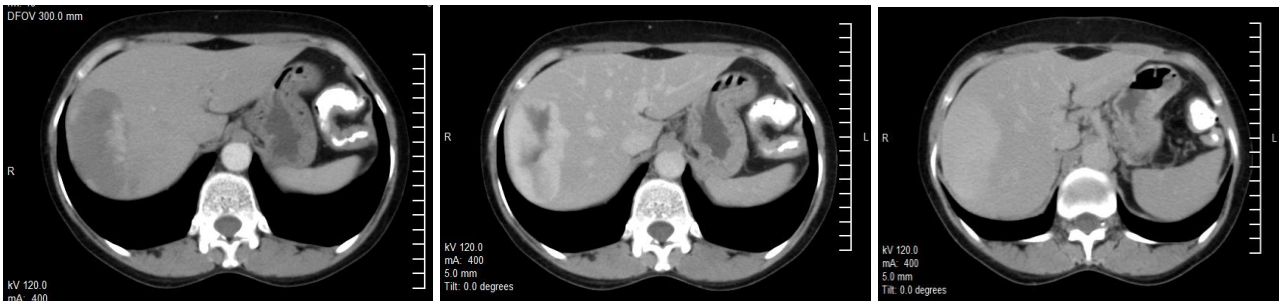
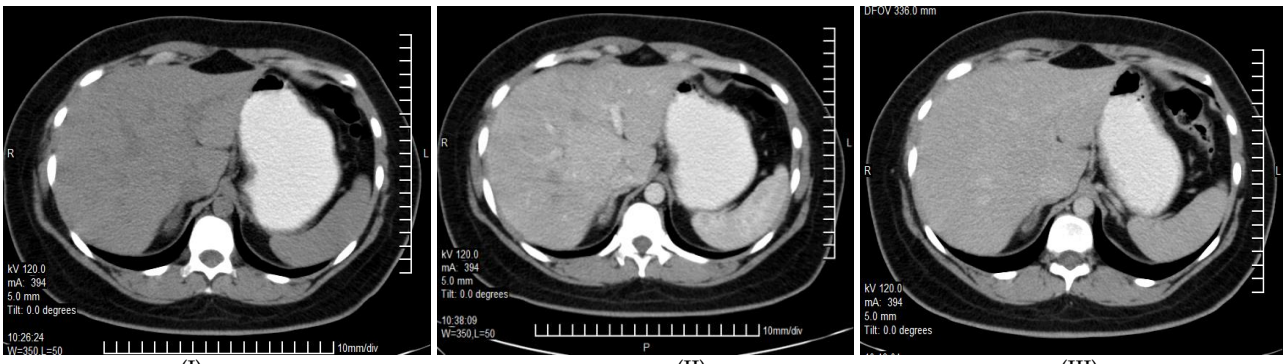
tomography (MDCT) represents an advance in CT technology that involves use of multiple-row detector array instead of the traditional single-row detector array used in spiral CT. This innovation allows scanning four to eight or more times faster than scanning with spiral CT[4]. As a result, MDCT permits scanning during multiple specific phases of intravenous contrast enhancement and the acquisition of very thin sections over a long area, allowing the creation of multiplanar reconstructions with high z-axis resolution[5]. Multiphasic helical computed tomographic examination of the liver following intravenous contrast material injection has become an important technique for the detection and characterization of hepatic masses[6]. In dual phase scanning the images are acquired in hepatic arterial & portal venous phases while in triple phase scanning additional scanning is done in equilibrium phase after 5 minutes of contrast injection[2]. Triphasic liver CT enables characterization of a wide range of focal liver lesions, including the benign liver lesions that occur most frequently[7-9]. Van Leeuwen et al[10] reported on



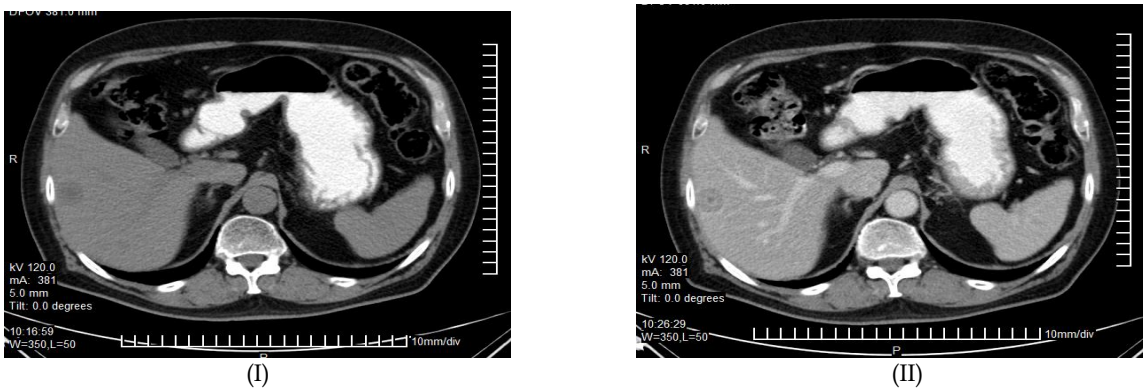
(I) (II) (III)

Figure 1: Showing Arterial phase CT scan shows peripheral nodular enhancement (black arrow) (I), Portal venous phase shows centripetal extension (II) and shows diffuse enhancement in equilibrium phase (III).



(I) (II) (III)

Figure 2: shows an isodense mass on plain scan (I), Portal venous phase shows mass appearing slightly hyperdense as compared to liver. There is displacement of vessels around the mass (II) isodense mass in delayed image (wash out) (III).



(I) (II)

Figure 3: Plan scan showing the larger hypodense mass in right lobe of liver (I) and Rim enhancement is seen in portal venous phase.

characterization of focal liver lesions with triphasic (arterial, portal, and equilibrium phase) helical CT and they mainly evaluated the degree but not the pattern of enhancement. Practically the number of phases that are usually imaged with CT is kept to a minimum, due to radiation hazard. Choice of examination will depend upon the type of suspected lesion to be investigated. The issue of radiation is even more important in young healthy adults with an incidentally discovered hepatic mass that needs characterization or follow-up, such as haemangioma and focal nodular hyperplasia.

Focal nodular hyperplasia and hemangiomata are benign and generally asymptomatic hepatic tumours that are increasingly discovered as incidental findings with USG. A study conducted by Vilgrain et al concluded that patients with focal nodular hyperplasia are more likely to have an associated hepatic hemangioma than are those with another type of focal hepatic masses[11]. Hepatic hemangiomas display a typical enhancement pattern on dynamic CT scanning. It has diminished attenuation prior to intravenous contrast medium administration, peripheral nodular contrast enhancement during the bolus dynamic phase and complete isodense fill in on delayed images. In a study conducted by Freeny & Marks[12] it was concluded that there is an 86% chance that a lesion with typical CT appearance of hemangioma is actually a hemangioma. However a small number of hemangiomas could exhibit atypical enhancement patterns due to the presence of intralesional non-enhanced thrombotic, fibrotic, degenerated or calcified components. In addition, variable vascularity of hemangiomas could also influence the lesion's enhancement rate and result in atypical enhancement patterns[11]. An atypical hemangioma may mimic a malignant hepatic tumor, causing diagnostic confusion, especially in patients at risk of malignancy. Except that hemangiomas can exhibit peripheral rim enhancement, the presence of such enhancement could also be observed in hepatic metastatic lesions. However, the peripheral rim enhancement in a metastatic lesion often has a serrated margin and not a nodular margin as seen in a hemangioma[13].

Focal nodular hyperplasia is a benign hamartoma which classically shows intense enhancement in arterial phase except for central scars. The lesion becomes isodense during portal venous and equilibrium phase. Central scar shows enhancement on delayed images. Hepatic adenomas are usually seen in young women on oral contraceptives. Small adenomas show avid enhancement on arterial phase imaging and larger adenomas show peripheral enhancement with centripetal filling. There is washout of contrast in delayed scans. It may appear isodense to liver in all phases of contrast enhancement[14]

Hepatocellular carcinoma (HCC) shows variegated pattern on arterial phase imaging with decreased attenuation in portal venous phase and inhomogeneous areas of contrast accumulation. Typically it shows thin enhancing capsule due to rapid wash out or appears isodense on delayed scans. Wedge shaped areas of decreased attenuation may be seen due to portal vein occlusion[15].

Metastatic deposits are the most common hepatic masses. They are best seen in portal venous phase. Small lesions may fill in during delayed scans. Peripheral washout when present is characteristic of metastases. Hypervascular metastases are best seen in arterial phase imaging[14].

Five patterns of arterial phase enhancement have been described in a study conducted by Nino-Murcia et al[13]. These included homogenous enhancement, abnormal internal vessels or variegated pattern, the peripheral puddles pattern, complete ring pattern and incomplete ring pattern. Among these HCC typically shows variegated pattern, metastases usually show complete ring pattern and the peripheral puddles pattern is strongly suggestive of haemangioma. These arterial phase enhancement patterns can be considered suggestive of these diagnoses. Atypical arterial pattern of enhancement of haemangioma includes homogenous and incomplete ring of

enhancement. Peripheral puddle pattern can be seen only in haemangiomas and metastases from the melanoma.

REFERENCES

1. W. Dennis Foley, MD. Special Focus Session Multidetector CT: Abdominal Visceral Imaging. RadioGraphics 2002; 22:701–19.
2. David Sutton, Text book of Radiology and Imaging. Seventh edition, volume 1; Churchill Livingstone, 2003; 754.
3. Foley WD. Dynamic hepatic CT. Radiology 1989; 170: 617–22.
4. Berland LL & Smith JK. Multidetector array CT: once again, technology creates new: opportunities (editorial).Radiology 1998; 209: 327–9.
5. Ji H, McTavish JD, Mortele KJ, Wiesner W & Ros PR. Hepatic imaging with multidtector CT. Radiographics 2001; 21: S 71–80.
6. Tonsok Kim MD, Michael P, Federle MD, Richard L. Baron, MD Mark S. Peterson, MD Yasuhiro Kawamori, MD. Discrimination of Small Hepatic Hemangiomas from Hypervascular malignant Tumors Smaller than 3 cm with Three-Phase Helical CT Radiology 2001; 219:699–706
7. Choi BI, Lee HJ, Han JK, Choi DS, Seo JB. Detection of Hypervascular Nodular Hepatocellular Carcinomas: Value of Triphasic Helical CT Compared with Iodized-Oil CT. AJR 1997; 168: 219-24.
8. Lim JH, Choi D, Kim SH, et al. Detection of hepatocellular carcinoma: value of adding delayed phase imaging to dual-phase helical CT. AJR Am J Roentgenol 2002;179:67–73.
9. Iannaccone R, Laghi A, Catalano C, et al. Hepatocellular carcinoma: role of unenhanced and delayed phase multi-detector row helical CT in patients with cirrhosis. Radiology 2005; 234:460–7.
10. Van Leeuwen MS, Noordzij J, Feldberg MA, Hennipman AH & Doornewaard H. focal liver lesions: characterization with triphasic spiral CT. Radiology 1996; 201: 327–36.
11. Vilgrain V, Uzan F, Brancatelli G, Federle MP, Zapa M & Menu Y. Prevalence of hepatic hemangioma in patients with focal nodular hyperplasia: MR imaging analysis. Radiology 2003; 229: 75–9.
12. Freeny PC & Marks WM. Patterns of contrast enhancement of benign and malignant hepatic neoplasms during bolus dynamic and delayed CT. Radiology 1986;160: 613-8.
13. Matilde Nino-Murcia, MD, Eric W. Olcott, MD. Liver Lesions: Pattern-based Classification Scheme for Enhancement at Arterial Phase CT. Radiology 2000; 215:746–51
14. Ralph Weissieder, MD, PhD, Jack Wittenberg, MD, Mukesh G. MD. Primer diagnostic imaging, 4th Edition, Mosby Elsevier, 2007; 218-9.
15. Wolfgang Dahnert, MD. Radiology Review Manual, 6th Edition, Lippincott Williams & Wilkins, 2007; 725.