THE NEW ARMENIAN MEDICAL JOURNAL
Vol.4 (2010), N 4 , p. 73-75

EFFECT OF ARTERIAL PHASE CONTRAST COMPUTED TOMOGRAPHY IN PATIENTS WITH HEPATOCELLULAR CARCINOMA

Harutyunyan G.A.

Central Military Hospital, Yerevan, Armenia
"Nairi" Medical Center, Yerevan, Armenia

INTRODUCTION

It is shown that radiologic pattern of liver in patients with hepatocellular carcinoma (HCC) depends on time of scanning after contrasting. The short scanning time after contrasting is accompanied by homogeneous contrast enhancement of liver. The maximal peak contrast enhancement of liver after contrasting occurs in 18 seconds post the contrasting injection.

Thus, in patients with HCC the optimal scanning time determination in arterial phase contrast computed tomography (CT) increases the diagnostic accuracy by improving the radiologic pattern.

Most HCCs are hypervascular and demonstrate as hyperatenuated lesions during the hepatic arterial phase (HAP) of hepatic dynamic computed tomography [*Baron R. et al. 1996; Choi B. et al., 1995*].

However, almost uniform enhancement can be achieved throughout the liver using a 64-detector CT scanner, because this type scanners can theoretically scan the entire liver in less than 3 seconds with high spatial resolution. Therefore, when one is using a 40- or 64-detector scanner, it is important to choose a scan time that is adequate for depicting lesions throughout the liver. Timing hepatic arterial phase (HAP) imaging in each patient to enable the detection of hypervascular HCCs can be difficult without automatic computer-assisted bolus tracking [*Oliver J. et al., 1996; Itoh S., 2004*] or a test bolus [*Hu H. 1999; Itoh S. et al. 2004; Kim S. et al. 2002; Kirchner J. 2000*].

Address for Correspondence:
119 Mouratsan Street
Yerevan, Armenia
Tel.: (374 91) 428 881
E-mail: gharutunyan@mail.ru

MATERIAL AND METHODS

In 2009 we enrolled 27 patients, who met our inclusion criteria:

(a) diagnosis of type B, C, or alcoholic hepatitis;
(b) confirmed HCC untreated during the 3 months preceding CT examination or suspicion of space-occupying hepatic lesions based on a sonographic study or elevated levels of tumor markers or protein induced by vitamin K absence or antagonist – II); and
(c) absence of both renal failure (serum creatinine <1.5 *mg/dL*) and contraindication to iodinated contrast material.

As the mean CT number of the normal liver parenchyma is about 60 *HU* on unenhanced images and about 80 *HU* during the hepatic arterial phase (HAP) [*Choi B. et al., 1995*], we defined as hypervascular those tumors, the CT number of which during the HAP was 25 *HU* greater than that on unenhanced scans.

Nineteen of 27 patients had solitary or multiple hypervascular HCC nodules.

The definite diagnosis of hypervascular HCC was based on the following findings:

- histopathologic evidence after hepatic surgery, 2 patients;
- findings at needle biopsy, 4 patients;
- hypervascularity at CT arteriography or hypoattenuation at CT portography, 14 patients;
- or/and substantially increased levels of α-fetoprotein or protein induced by vitamin K absence or antagonist-II with follow-up CT demonstrating no change or an increase in tumor size within 3 months, 17 patients.

In our hospital institution, CT arteriography or CT portography is performed in all patients with HCCs before the initial treatment as a routine clinical practice.

CT scanning and Contrast Material Infusion Protocols: All patients were scanned with a 64 slice CT-scanner (Siemens, Germany) at the following settings: rotation time, 0.5 second; beam collimation, 32h1.25 *mm*, section thickness and intersection gap, 5.0 *mm*; helical pitch (beam pitch), 0.781 *mm*; table movement, 62.5 *mm*; scan field of view, 40 *cm*; voltage, 120 *kV*; and tube current, 250-300 *mA*. Image reconstruction was performed in a 25-35 *cm* display field of view, depending on the patient's physique.

Three-phase contrast-enhanced CT scanning of liver was performed during the hepatic arterial, portal venous, and equilibrium phases.

Hepatic Enhancement: The mean values for hepatic enhancement were

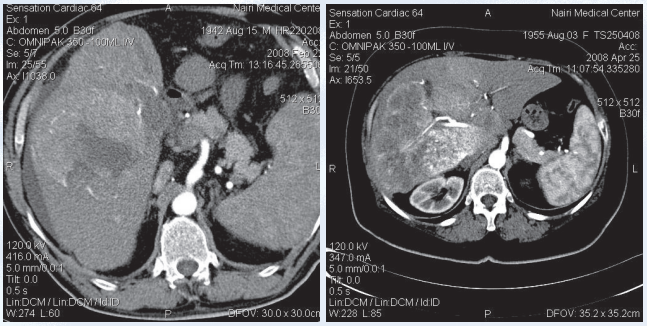
6.0 *HU* ± 5.5;
9.7 *HU* ± 7.5;
12.8 *HU* ± 6.6;
17.8 *HU* ± 8.6 and
21.2 *HU* ± 7.2.

Thus, the shorter scanning time for the liver may achieve more homogenous enhancement throughout the liver. Accordingly, with rapid scanning performed using a 64-detector CT scanner, the ability to depict the lesions is almost constant throughout the liver. However, stricter scan timing is required with a 64-detector CT scanner than with a four- or 16-detector scanner.

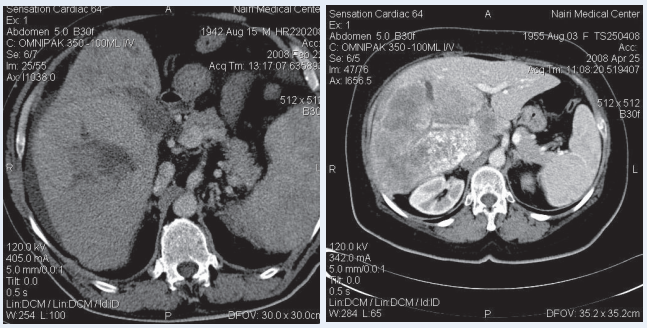
In our visual evaluation of tumor conspicuity, the lower limit of the 95% CL for tumor liver contrast was 44.3 *HU* for grade 3. Given these results, we regarded 44.3 *HU* as the lower limit for an excellent depiction of hypervascular HCCs, and 28.3 *HU* as the lower limit for a fairly good depiction.

Portal Vein Enhancement: The mean values for enhancement of the portal vein were

34.0 *HU* ± 19.7;
55.8 *HU* ±21.0;



Pictures 1-2. *Hepatocellular carcinoma in arterial phase.*



Pictures 3-4. *Hepatocellular carcinoma in venous phase.*

74.2 *HU* ± 26.3;
90.7 *HU* ± 27.0, and
104.0 *HU* ± 30.0,

respectively, after 9; 12; 15; 18 seconds HAP scanning start. Enhancement was significantly lower, when hepatic arterial phase scanning started at a specific internal after the trigger threshold was reached: 9 seconds.

CONCLUSION

We believe that the use of computer-assisted bolus tracking or a test bolus is important to determine the appropriate scan time during the HAP when a 64-detector CT scanner is used for hepatic dynamic CT. The peak tumor liver contrast during the hepatic arterial phase occurred 18 seconds after triggering, when a 60-detector CT was used and the trigger threshold level was set at an increase of 100 *HU* over the aortic baseline CT number.

In future, it will be important to clarify how much time elapses between attainment of the trigger threshold for bolus tracking and aortic peak enhancement with various injection protocols.

REFERENCES

1. *Baron R.L., Oliver J.H. 3rd, Dodd G.D. 3rd, Nalesnik M., Holbert B.L., Carr B*. Hepatocellular carcinoma: evaluation with biphasic, contrast-enhanced, helical CT. Radiology. 1996; 199: 505-511.
2. *Choi B.I., Han J.K., Cho J.M., et al.* Characterization of focal hepatic tumors: value of two phase scanning with spiral computed tomography. Cancer. 1995; 76: 2434-2442.
3. *Hu H.* Multi-slice helical CT: scan and reconstruction. Med. Phys. 1999; 26: 5-18.
4. *Itoh S., Ikeda M., Achiwa M., Satake H., Iwano S., Ishigaki T.* Late- –arterial and portal venous phase imaging of the liver with a multislice CT scanner in patients without circulatory disturbances: automatic bolus tracking or empirical scan delay? Eur. Radiol. 2004; 14: 1665-1673.
5. *Kim S.K., Lim J.H., Lee W.J., et al*. Detection of hepatocellular carcinoma: comparison of dynamic three-phase computed tomography images using multidetector row helical computed tomography. J. Comput. Assist. Tomogr. 2002; 26: 691-698.
6. *Kirchner J., Kickuth R., Laufer U., Noak M., Liermann D*. Optimized enhancement in helical CT: experiences with a red-time bolus tracking system in 628 patients. Clin. Radiol. 2000; 55: 368-373.
7. *Oliver J.H. 3rd, Baron R.L., Federle M.P., Rockette H.E. Jr*. Detecting hepatocellular carcinoma: value of unenhanced or arterial phase CT imaging or both used in conjunction with conventional portal venous phase contrast –enhanced CT imaging . Am. J. Roentgenol. 1996; 167: 71-77.