The Egyptian Journal of Hospital Medicine (July 2018) Vol. 72 (3), Page 4175-4178

Role of Computed Tomography Perfusion Compared to Computed Tomography Triphasic Study in Assessment of Hepatic Focal Lesions

Sherif Abou Gamra , Mohamed Amin Nassef , Merhan Ahmed Nasr
Department of Radiology, Faculty of Medicine, Ain Shams University, Cairo, Egypt
Corresponding author: **Abeer Muneer Ali Farag,E mail: abeer_muneer@hotmail.com**

ABSTRACT

Purpose of this study is: to evaluate the role of computed tomography perfusion and computed tomography triphasic in assessment of hepatic focal lesions.

Methods: The study included 43 patients (between 30 to 60 years old) referred from radiodiagnosis department. Each patient included in the study was subjected to full history taking and availability of the previous studies. **Results:** The study showed that CT perfusion revealed more accurate results than CT triphasic. **Conclusion:** The current application of CT perfusion to patient with hepatic focal lesions showed that it enhanced our understanding of the disease diagnosis staging, prognostic evaluation and monitoring therapeutic response.

Keywords: ct perfusion – hepatic focal lesions.

INTRODUCTION

Early diagnosis is important to improve survival rates in the affected individuals. The liver has a dual blood supply and most liver diseases cause changes in blood flow (BF). Hence it is important to evaluate the hemodynamic changes to discover lesions early and assess therapeutic response [1].

Currently, the perfusion imaging techniques with multi-slice computed tomography (CT) allow quantification of the perfusion parameters of tissues [2].

Conventional cross-sectional imaging methods such as CT and magnetic resonance, as well as imaging with ultrasonography, may not be adequate for detection of tumor-associated vascularity. CT perfusion imaging is a recently developed noninvasive imaging technique that allows both qualitative and quantitative evaluation of tumor vascularity [3].

One goal of perfusion CT is to improve detection and characterization of liver lesions compared to standard triphasic imaging [4].

AIM OF THE WORK

The aim of the work is to show the role of CT perfusion and triphasic imaging in the assessment of hepatic focal lesions.

PATIENTS AND METHOD

This study was be done with pathologically proven hepatocellular carcinoma patients, primary malignancy with liver metastases and hepatic hemangiomas who will were referred by the Hepatology Departments of different hospitals. The study was approved by the Ethics Board of Ain Shams University. During routine abdominal CT examination using multi-detector CT and with IV contrast media injection, CT Perfusion parameters of blood flow (BF), blood volume (BV), arterial perfusion (AP), portal perfusion (PP), and hepatic perfusion index (HPI) were calculated in the normal liver parenchyma and hepatic focal lesion samples.

Study place: Police Authority Hospital-Radiodiagnosis Department.

Sample size: 43 patients

Equipment used: 320-dual energy detector row CT

Inclusion Criteria:

1. Patients over 30 years old.
2. Both sexes are included.
3. Known patient with hepatocellular carcinoma, primary malignancy with metastases and hepatic hemangiomatas.
4. Average kidney function tests.

Exclusion Criteria:

1. Children.
2. Lactating and pregnant females.
3. Patients known to have end stage liver disease.
4. Known patients with allergy.

All cases had been subjected to the following:

-Full clinical assessment.

-Revision of the patient's investigations including renal function tests (urea and creatinine).

-Revision of the previous radiological investigations done for the patients.

-Written consent was taken from all patients.

The liver perfusion protocol:

All cases were performed using Toshiba Aquilion One 320-DE MDCT scanner.

A. Liver perfusion scan protocol:

1. Select the liver perfusion protocol.
2. Acquire AP and lateral scanograms.
3. Position the dynamic volume sequence to cover the liver.

Received:8/4/2018
Accepted:17/4/2018

4. Set the contrast injection protocol (Table 1)

Table (1): Contrast injection protocol

Body weight (kg)	Injection rate (mL/s)	Contrast volume (mL)	Saline flush (mL)
< 50	6.0	30	30
50-69	7.0	35	30
70-89	8.0	40	30
90 +	10	50-80	40

5. Perform final check.

Start the injector and the scan simultaneously. This ensures correct timing of the scan sequence. The protocol acquires and reconstructs the 23 volumes automatically.

B. Liver perfusion analysis:

Analysis algorithm: Dual input maximum slope.

Analysis range: Soft tissue

The liver has a dual blood supply, so the dual input maximum slope algorithm is used for perfusion analysis. ROIs were placed in the aorta, portal vein, normal liver tissue and spleen. The following parametric maps are generated (Table 2).

Table (2): Perfusion parametric maps

Perfusion parameter	units
Portal flow (PF)	mL/min/100mL
Arterial flow (AF)	mL/min/100mL
Hepatic perfusion index (PI)	AF/(AF+PF) as percentage.

Initial experience with quantitative measurement of liver perfusion suggests the following guidelines for normal values (Table 3).

Table (3): Guidelines for normal values of quantitative measurement of liver

Perfusion parameter	Normal range (mL/min/100mL)
Portal flow (PF)	100-200
Arterial flow (AF)	10-45
Hepatic perfusion index (PI) %	Threshold 40 %

STATISTICAL METHODS

Data were analyzed using Statistical Program for Social Science (SPSS) version 18.0. Quantitative data were expressed as mean ± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done:

- Receiver operating characteristic (ROC curve) analysis was used to find out the overall predictivity of parameter in and to find out the best cut-off value with detection of sensitivity and specificity at this cut-off value.
- Sensitivity: Probability that a test result will be positive when the disease is present (true positive rate, expressed as a percentage). Sensitivity = (true +ve)/ [(true +ve) + (false –ve)].
- Specificity: Probability that a test result will be negative when the disease is not present (true negative rate, expressed as percentage). Specificity = (true –ve) / [(true –ve) + (false +ve)].
- PPV (positive predictive value): probability that the disease is present when the test is positive (expressed as a percentage of true positive cases to all positive).

  PPV = (true +ve) / [(true +ve) + (false +ve)].
- NPV (negative predictive value): probability that the disease is not present when the test is negative (expressed as a percentage of true negative subjects to all negative).

  NPV = (true –ve)/ [(true –ve) + (false –ve)].
- Probability (P-value):
  - P-value <0.05 was considered significant.
  - P-value <0.001 was considered as highly significant.
  - P-value >0.05 was considered insignificant.

RESULTS

Table (4): Metastatic deposits, HCC and hemangioma distribution of the study group.

Pathology	No.	%
Hemangioma	11	25.58
HCC	21	48.84
Mets.	11	25.58
Total	43	100.00

This table shows the percentage of the hemangioma (25.58%), HCC (48.842%) and metastasis (25.58%) of the study group.

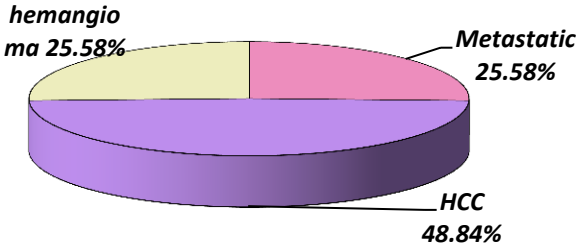

Fig. (1): Hemangioma, HCC and metastatic deposits distribution of the study group.

Table (5) : Triphasic results distribution of the study group

Triphasic results	No.	%
Non visible lesion	6	13.95
Visible lesion	37	86.04
Total	43	100.00

This table shows the triphasic results is (14%) in non-visible lesion and (86%) in visible lesion of study group.

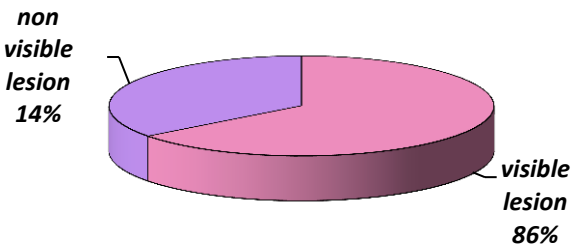

Fig. (2): Pie chart triphasic results distribution of the study group.

Table (6) : Perfusion parameters distribution of the study group.

Perfusion parameters	No.	%
Positive	40	93.02
Negative	3	6.98
Total	43	100.00

This table shows the perfusion percentage is (93%) in positive and (7%) negative of study group.

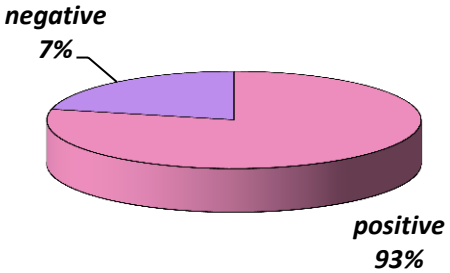

Fig. (3): Pie chart triphasic results distribution of the study group.

Table (7): Diagnostic Performance of triphasic results and perfusion parameters in discrimination of the patients group

	Triphasic results	Perfusion parameters
Positive	37	40
Negative	6	3
Sensitivity	90%	94.87%
Specificity	50%	75%
+PV	94.59%	97.36%
-PV	33.33%	60%
Accuracy	86.04%	93.02%
p-value	**<0.001 (HS)**	**<0.001 (HS)**

Receiver operating characteristics (ROC) curve was used to define:

- **Triphasic results*:*** the sensitivity of 90% specificity of 50% positive predictive value of 94.59%, negative predictive value of 33.33% with diagnostic accuracy of 86.04%, p-value <0.001 HS
- **Perfusion parameters*:*** the sensitivity of 94.87% specificity of 75% positive predictive value of 97.36%, negative predictive value of 60% with diagnostic accuracy of 93.02%, p-value <0.001 HS.

DISCUSSION

A study done by ***Kanda et al.*** demonstrated perfusion CT imaging permits the qualitative and quantitative assessment of liver perfusion. In perfusion CT, a quantitative tissue perfusion map is obtained from dynamic CT data and displayed using a color scale permitting the quantification of tissue perfusion in absolute units at high spatial resolution. Perfusion CT efficiently locates abnormal tissue perfusion which is difficult to detect accurately with conventional CT [5].

CT perfusion may reflect tumor aggressiveness and therefore may allow for the prediction of prognosis based on tumor vascularity because it can provide indirect information regarding tumor neoangiogenesis [6]. This is somewhat similar to our result.

Our findings revealed CT perfusion imaging has been used for early identification of tumor recurrence after various imaging-guided therapies of liver tumors including both primary and metastatic tumors. This is similar to the result done by ***Mahnken et al*** [7]**.**

CONCLUSION

CT perfusion and spiral CT are useful and noninvasive technique for evaluating hepatic malignancies. Malignant and normal tissue can be accurately differentiated using perfusion maps.

Hepatic malignancy derive neo vasculature through process of angiogenesis mediated through several angiogenic factors which are critical for tumor growth and metastasis.

So perfusion CT is found to be helpful in oncology with a wide array of application in tumor diagnosis, staging, prognostic evaluation and monitoring therapeutic response.

REFRENCES

1. **Ippolito D, Bonaffini PA and Ratti L (2010):** Hepatocellular carcinoma treated with transarterial chemoembolization: dynamic perfusion CT in the assessment of residual tumor. World J Gastroenterol.,16(47):5993–6000.
2. **Tsushima Y, Funabasama S, Aoki J, Sanada S, Endo K(2004):** Quantitative perfusion map of malignant liver tumors, created from dynamic computed tomography data. Academic Radiology,11:215-23.
3. **Sahani D.V, Holalkere NS, Mueller PR and Zhu AX (2007):** Advanced hepatocellular carcinoma: CT perfusion of liver and tumor tissue--initial experience. Radiology,243:736-743.
4. **Boas EF, Kamaya A, Do B et al(2015):** Classification of hypervascular liver lesions based on hepatic artery and portal vein blood supply coefficients calculated from triphasic CT scans. Journal of Digital Imaging, 28: 213-223.
5. **Kanda T, Yoshikawa T and Ohno Y(2012):** Perfusion measurement of the whole upper abdomen of patients with and without liver diseases: initial experience with 320-detector row CT. Eur J Radiol.,81:2470–2475.
6. **Xie Q, Zhang J and Wu PH(2005):** Bladder transitional cell carcinoma: correlation of contrast enhancement on computed tomography with histological grade and tumour angiogenesis. Clin Radiol.,60(2):215–223.
7. **Mahnken AH, Klotz E and Schreiber S(2011):** Volumetric arterial enhancement fraction predicts tumor recurrence after hepatic radiofrequency ablation of liver metastases: initial results. AJR Am J Roentgenol,196(5):W573–W579.