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Original Research Article

Prospective Analysis of Perfusion CT Imaging of Liver Pathology and Histopathological Relation

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Abstract

Background and Aim: The existence and size of tumor vasculature are closely correlated with CT perfusion parameters, which may be used for earlier liver cancer detection and more individualized patient monitoring. The purpose of the current study was to contrast the histological diagnosis with the imaging diagnostic of liver lesions utilising CT perfusion parameters.

Material and Methods: 100 patients who had liver space-occupying lesions by conventional and contrast-enhanced US, CT, or MRI made up the study's population. Prior to participating in the study, all patients were required to give written informed consent. The 16 SLICE CT scanner and syngo® Body Perfusion CT software were used for all CT perfusion tests. The method is based on a continuous accusation of dynamic contrast flow in cine mode.

Results: When perfusion parameters were compared between a few common benign lesions, including liver abscess and hydatid cyst, and normal liver parenchyma, it was discovered that there was a reduction in intralesional BV, BF, PERM, ALP, PVP, and HPI among these benign liver lesions, indicating the cystic content of the lesion. In contrast, there was a relatively higher intralesional BF, ALP, and HP

Conclusion: Using the perfusion parameters, CT perfusion imaging of the liver can be used to distinguish between focal lesions of the liver and functional information about the microcirculation of normal parenchyma. It is an effective method for identifying primary or metastatic tumors.

Keywords: CT perfusion, Liver, Imaging, Tumors

Introduction

A space-occupying lesion in the liver is referred to as a distinct abnormality that arises within the liver. The liver's space-occupying lesions can be categorised as developmental, neoplastic, inflammatory, and other [1]. The best method for imaging the liver for space-occupying lesions is not currently agreed upon. Based on equipment accessibility, radiologists' expertise, and referring doctors' needs, different imaging modalities for the liver are frequently employed [2,3].

For the proper management of liver disease, particularly in cancer patients, accurate imaging of the liver is clinically crucial in the field of gastrointestinal radiology today. This is because the liver is the most common site for metastasis from colorectal cancers and the second most common site for disease metastatic after lymph node metastasis [4,5].

The primary objectives of liver imaging include determining the following: (1) the quantity and size of liver abnormalities; (2) the location of abnormalities in relation to the liver vessels; (3) the nature of the lesions, such as benign versus malignant; (4) the origin of abnormalities, such as primary versus secondary; and (5) the liver parenchyma surrounding the lesions. Ultrasound (US) with or without contrast, computed tomography (CT) with or without contrast, magnetic resonance imaging (MRI) with or without contrast, and US-guided biopsy are the imaging methods most frequently utilised for liver space-occupying lesions [6,7].

Depending on the availability and expertise of the doctors and radiologists, additional techniques may also be employed, including laparoscopy with or without intraoperative US, CT arterioportography (CTAP), CT hepatic arteriography (CTHA), PET, and Positron Emission Tomography (PET). Although there are other imaging modalities of this type, due to its widespread availability, CT is currently the most widely utilised first line imaging modality for staging and monitoring of the disorders. The ability to measure the hepatic and portal blood flow using perfusion computed tomography (CTP) is very promising [8]. Its benefits include quantitatively determining the hemodynamics of the lesion to discriminate between malignant and benign processes and providing morphological information [9,10].

Additionally, some studies have demonstrated that CT perfusion parameters are closely related to the presence and size of tumor vasculature, which may be used for earlier detection of liver malignancies and more individualized patient monitoring during therapy. The purpose of the current study was to contrast the histological diagnosis with the imaging diagnostic of liver lesions utilizing CT perfusion parameters.

Material and Methods

After receiving approval from our institutional ethical committee, this prospective study was carried out, and institutional informed consent policies were followed. During the course of a year, patients who have been referred from the surgical gastroenterology department and who have a suspected liver lesion on US, CT, or MRI and are willing to participate in CT perfusion are included in the study.

Age requirements for inclusion: 10 to 80 years old; both sexes. the presence of a lesion that takes up space in the liver as determined by US/conventional CT/MRI.

Females, who are lactating or pregnant, regardless of gestational age, are excluded. Patients with a blood creatinine level more than 1.3 mg/100 ml, a marker of compromised renal function.

Utilizing the established inclusion/exclusion criteria, the patients were screened. After going over each patient's case sheet and prior medical information, pertinent entries for each patient were recorded in the proforma. 100 patients who had liver space-occupying lesions by conventional and contrast-enhanced US, CT, or MRI made up the study's population. Prior to participating in the study, all patients were required to give written informed consent.

All CT perfusion tests were performed using the 16 SLICE CT scanner and the syngo® Body Perfusion CT software. The approach is founded on a constant accusation of dynamic contrast flow utilised in film. Using the imaging conditions of 80-120 kVp and 50-120 mAs, 24 spiral images were captured. Iohexol 350, a low osmolality non-ionic contrast agent, was given in a 50 ml bolus at a flow rate of 5 ml/s through an 18-gauge cannula positioned in the volar aspect of the cubital vein.

To get arterial input function, a ROI is constructed within the proximal abdominal aorta following motion correction and computerised segmentation. To establish the portal venous input function and address the distinctive nature of the liver's dual blood supply, a second ROI is collected from the portal vein. In order to separate the arterial and portal venous blood flow in the liver, a third ROI is formed across the spleen.

Time-intensity curves are produced from the spleen, portal vein, and abdominal aorta 49. The time-attenuation curves were converted into quantitative parameter images using the perfusion software. Seven different parameter maps were computed for each segment for each patient:

1. Temporal maximum intensity projection (MIP) in Hounsfield units (HU),
2. Blood Volume -BV (ml/100 ml),
3. Blood Flow -BF (ml/100 ml/min)¬
4. Permeability -PERM (ml/100 ml/min)¬
5. Arterial Liver Perfusion -ALP (ml/100 ml/min)
6. Portal Venous Perfusion -PLP (ml/100 ml/min)
7. Hepatic Perfusion Index -HPI in percentage (%)

On the MIP images, ROIs were first created on the lesion's centre (C) and periphery (P), excluding any necrotic or vascular areas. Following an automated copying of the ROIs onto the perfusion maps, the appropriate BV, BF, PERM, ALP, PVP, and HPI values were recorded. Reference ROIs were also created on each patient's neighbouring, healthy liver parenchyma (N), and perfusion parameters were measured to provide control values. All of the patients were monitored, and the pathology department collected histopathological results.

The gathered data were examined using software for statistics SPSS 23.0. Frequency analysis, percentage analysis, and mean & S.D. were employed for categorical variables and continuous variables, respectively, to describe the data using descriptive statistics.

Results

In the current study, benign liver lesions are more prevalent from the second to the fifth decade, whereas malignant liver lesions are more prevalent from the fourth to the eighth decade. Out of 100 patients in this study, 58 patients were men and 42 patients were women. 36 individuals had malignant liver lesions out of 52 total patients, and 16 patients (30.76%) were female. There were 48 patients with benign liver lesions; 22 of them were men and 26 were women.

For statistical analysis, the average parameter value (C+P/2) from the lesion area is taken and compared to a healthy liver. On histology, 52 of the 100 individuals in the study group showed malignant lesions, whereas 48 had benign lesions. Hepatocellular carcinoma and liver abscess were the most frequent tumours in these research groups, respectively.

The mean values of BV, BF, PERM, ALP, PVP & HPI were calculated for the malignant and benign lesions of the Liver On CT perfusion parameters analysis. Comparing the CT perfusion parameters between the malignant and benign liver lesions revealed that the PVP is significantly decreased while the BV, BF, PERM, ALP, and HPI are all significantly higher in the malignant versus benign liver lesions (p =0.0005). (p=0.0005)

Comparing the CT perfusion parameters between the cancer group and the normal liver parenchyma revealed that the intralesional BV, BF PERM, ALP, and HPI were all higher in the malignant liver lesions while PVP was noticeably lower. There is a minor decrease in intralesional BV, BF, PERM, ALP, and PVP among the benign lesion group with a slight increase in the HPI, according to a comparison of the CT perfusion parameters between the benign lesion group and normal liver parenchyma.When the perfusion parameters of a few common malignant lesions, like hepatocellular carcinoma, metastasis, and cholangiocarcinoma, were compared to the normal liver parenchyma, it was discovered that these malignant liver lesions had higher intralesional BV, BF, ALP, and HPI levels while having a lower PVP. When the perfusion parameters of a few common benign lesions, such as liver abscess and hydatid cyst, were compared to normal liver parenchyma, it was found that the intralesional BV, BF, PERM, ALP, PVP, and HPI were reduced in the benign liver lesions, indicating the cystic content of the lesion, while the intralesional BF, ALP, and HPI were relatively higher in the hemangio.

Table 1: Mean value of CT perfusion parameter

Parameters		mean	SD	P value
PERM	Benign	34.8	7.9	0.004
	Malignant	48.6	10.11	
HPI	Benign	39	24.1	0.004
	Malignant	81	8.4	
BF	Benign	26.7	16.7	0.004
	Malignant	51.2	9.2	
ALP	Benign	11.7	8.7	0.004
	Malignant	31.5	6.5	
PVP	Benign	16.2	6.8	0.004
	Malignant	9.6	4.1	
BV	Benign	7.5	5.8	0.004
	Malignant	25.2	7.5	

Discussion

The liver's space-occupying lesions can be divided into developmental, neoplastic, inflammatory, and other lesions. For the proper management of liver illness, accurate imaging of the liver is crucial because it allows for the differentiation of the various liver lesions and the development of tailored treatment regimens [11].

The ability of perfusion computed tomography (CTP) to estimate hepatic and portal blood flow is very promising. It has the advantages of providing morphological information, quantifying the lesion hemodynamics to discriminate between malignant and benign processes [10-12]

In the current investigation, 100 patients were diagnosed using standard and contrast-enhanced US, CT, and MRI with suggested inclusion and exclusion criteria; 52 of these patients had malignant lesions, and 48 had benign lesions, as determined by histology. Patients in the study had their diagnoses made through surgical excision, FNAC, or biopsy. Malignant and benign lesions were evaluated using multiple parameters, including BV, BF, PERM, ALP, PVP, and HPI.

The current study aimed to examine the link between CT perfusion parameter values of normal liver parenchyma and various benign and malignant lesions of the liver, as well as the imaging diagnosis of liver lesions using CT perfusion parameters and the histological diagnosis.

According to the results, it was evident that BV, BF, PERM, ALP, and HPI were significantly above the normal reference levels in patients with malignant lesions and were comparatively below the normal reference values in patients with benign lesions when comparing the two types of liver lesions.

When the perfusion parameters of a few common malignant lesions, including hepatocellular carcinoma, metastasis, and cholangiocarcinoma, were compared to those of normal liver parenchyma, it was discovered that these malignant liver lesions had increased intralesional BV, BF, ALP, and HPI while having a relatively decreased PVP.

When the perfusion parameters of a few common benign lesions, such as liver abscesses and hydatid cysts, were compared to the normal liver parenchyma, it was discovered that the cystic contents of these benign liver lesions were indicated by a reduction in intralesional BV, BF, PERM, ALP, PVP, and HPI.

Ippolito *et al* [13] showed that there is an increase in BV, BF, ALP, HPI, and a decrease in PVP in hepatocellular carcinoma. Increased ALP in liver metastases was seen by Blomley *et al* [14]. using CT perfusion imaging, and this finding was corroborated by further researchers. When compared to the neighboring normal parenchyma, Leggett *et al*. found that patients with liver metastases had considerably higher ALP and lower PVP on CT perfusion imaging.

On CT perfusion pictures, Tsushima *et al* [15] also found that, as compared to liver from patients without metastases and from controls, apparently normal liver tissue with occult metastases had elevated ALP and HPI and decreased PVP. These findings imply that CT perfusion may be used to anticipate the presence of micro-metastases in a liver that otherwise seems normal morphologically, potentially changing how patients are managed.

The current investigation is being supported by all of the studies described above. Hemangiomas were examined using perfusion parameters, and Wang *et al* [16] found that an increase in ALP at the hemangioma's periphery distinguished it from other malignant hepatic lesions.

Conclusion

It is a promising method for identifying primary or metastatic cancers because CT perfusion imaging of the liver gives functional information on the microcirculation of healthy parenchyma and can be utilized to distinguish focal lesions of the liver with perfusion parameters.

References

1. Cullen J. M., Stalker M. J. J. J., Kennedy, P.S.P.O.D.A.V. Liver and biliary system. 2016; 258.
2. Wu J., Liu A., Cui J., Chen A., Song Q., Xie L.J.B.M.I. Radiomics-based classification of hepatocellular carcinoma and hepatic haemangioma on precontrast magnetic resonance images. 2019; 19:1-11.
3. Chen X.P., Liu J., Zhou J., Zho P.C., Shu J., Xu L.L., Li B., Su S. J. B. M. I. Combination of CEUS and MRI for the diagnosis of periampullary space-occupying lesions: a retrospective analysis. 2019; 19: 1-7.
4. Oliva M. R., Saini S. J. C. I. Liver cancer imaging: role of CT, MRI, US and PET. 2004;4:S42.
5. Schima W., Kulinna C., Langenberger H., Ba-Ssalamah A.J.C.I. Liver metastases of colorectal cancer: US, CT or MR?: Wednesday 5 October 2005, 14: 00–16: 00. 2005; 5: S149.
6. Skoczylas K., Pawełas A.J.J.O.U. Ultrasound imaging of the liver and bile ducts–expectations of a clinician. 2015; 15: 292.
7. Assy N., Nasser G., Djibre A., Beniashvili Z., Elias S., Zidan J. J.W.J. O. G. W. Characteristics of common solid

liver lesions and recommendations for diagnostic workup. 2009; 15: 3217.
8. Kontis E.A., Fragulidis G.P. Clinical Implications of Liver Malignancies. In Imaging in Clinical Oncology; Springer, 2018; 391-398.
9. Gadupud V., Ramachandran R., Mohanarangam V.S.P.J.C. The Role of Computed Tomography Perfusion in Various Focal Liver Lesions. 2022, 14.
10. Li J.P., Zhao D.L., Jiang H.J., Huang Y.H., Li D.Q., Wan Y., Liu X.D., Wang J.E.J. H., International P. D. Assessment of tumor vascularization with functional computed tomography perfusion imaging in patients with cirrhotic liver disease. 2011, 10, 43-49.
11. Mortelé K. J., Ros P.R.J.R. Cystic focal liver lesions in the adult: differential CT and MR imaging features. 2001; 21: 895-910.
12. Kambadakone A. R., Sahani D.V.J.R.C. O. N. A. Body perfusion CT: technique, clinical applications, and advances. 2009; 47: 161-178.
13. Ippolito D., Sironi S., Pozzi M., Antolini L., Ratti L., Alberzoni C., Leone E.B., Meloni F., Valsecchi M.G., Fazio,F. J. A. R. Hepatocellular carcinoma in cirrhotic liver disease: functional computed tomography with perfusion imaging in the assessment of tumor vascularization. 2008; 15: 919-927.
14. Blomley M. J., Coulden R., Dawson P., Kormano M., Donlan P., Bufkin C., Lipton M.J.J.J.O.C.A.T. Liver perfusion studied with ultrafast CT. 1995; 19: 424-433.
15. Tsushima Y., Blomley M. J., Yokoyama H., Kusano S., Endo K.J.D.D., sciences. Does the presence of distant and local malignancy alter parenchymal perfusion in apparently disease-free areas of the liver? 2001; 46: 2113-2119.
16. Wang J., Wang S., Chen L., Dong D.J.L.G.B.Z. Application of CT perfusion imaging in discrimination of liver carcinoma and hemangioma. 2006; 22:455-457.