Original research article

Hepatic space-occupying lesions: Perfusion CT imaging's utility, with histological connection

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Abstract

Background: A liver space-occupying lesion is a benign tumour that has grown to occupy a significant amount of the liver's normal tissue. Lesions that occupy space in the liver can be classified as either developmental, neoplastic, inflammatory, or other. Currently, there is no consensus on the optimal method for imaging the liver to identify these types of space-occupying lesions.
Material and Methods: Following approval from our institution's ethical committee, we conducted this prospective study in accordance with our institution's informed consent criteria. 40 participants were analysed in a study conducted at the department of Radiodiagnosis, NRI Medical College & Hospital, Chinakakani, Guntur, and Andhra Pradesh between January 2022 to December 2022.
Results: Hemangiomas are recognised from other benign liver lesions by a relative elevation in intralesional BF, ALP and HPI when compared with normal liver parenchyma, but BV, BF, PERM, ALP, PVP and HPI are all decreased due to the cystic content of these lesions.
Conclusion: In addition to evaluating the efficacy of systemic or local tumour therapy, predicting the early response to anticancer medications, and monitoring the recurrence of tumours, liver CT perfusion imaging is a useful tool.
Keywords: Hepatic space-occupying lesions, perfusion CT, imaging's utility

Introduction

A benign tumour that has grown to occupy a sizable quantity of normally occurring liver tissue is called a space-occupying lesion in the liver. Space-consuming liver lesions might be categorised as developmental, neoplastic, inflammatory or other [1, 2]. There is still no agreement on the best way to image the liver to spot these types of space-occupying lesions. It is up to the referring doctor and the radiologist's discretion whatever imaging technique is chosen to assess the liver [3]. Ultrasound (US) with or without contrast, computed tomography (CT) with or without contrast, magnetic resonance imaging (MRI) with or without contrast and ultrasound-guided biopsy are the most frequently used imaging modalities for liver space occupying lesions. It is up to the discretion of the treating physicians and radiologists to decide between laparoscopy with or without intraoperative US, positron emission tomography (PET), CT arterioportography (CTAP), CT hepatic angiography (CTHA) and other procedures [4-6].

Computed tomography (CT) has become the gold standard for diagnosis and follow-up monitoring of these conditions, however other imaging modalities are useful. Perfusion computed tomography (CTP) [7, 8] allows for a highly accurate assessment of liver and portal blood flow. In addition to giving morphological information, quantitative evaluation of the lesion's hemodynamics helps distinguish between malignant and benign processes. Accurate imaging of the liver is clinically crucial for the effective management of liver disease, especially in cancer patients, because it is the most common site for metastasis from colorectal malignancies and the second most common site for metastatic illness after the lymph nodes [9, 11].

The third leading cause of cancer-related mortality globally [12] is hepatocellular carcinoma, the most frequent primary malignant tumour of the liver. The development of reliable imaging approaches for early diagnosis, disease staging and disease monitoring in these individuals is crucial. Hemangiomas, localised nodular hyperplasia, hepatic adenomas, and rarer diseases such hepatic lipoma, mesenchymal hamartoma, and angiomyolipoma should all be thoroughly evaluated for malignancy [13, 14].

Simple cysts, hydatid cysts, pyogenic or amoebic liver abscesses, biliomas and cholangiomas are all examples of benign liver cysts, while biliary cystadenoma or cyst adenocarcinoma, lymphangioma, and cystic metastases are all examples of malignant liver cysts. Traditional morphologic imaging is still the gold standard for monitoring liver lesions [15], despite the promise of new functional and molecular

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imaging methods using MRI, CT, US, Positron Emission Tomography (PET), and optical based technologies. Analysing blood flow parameters by dynamic CT scans after intravenous infusion of contrast agents, CT perfusion is a simple extension of standard CT imaging. Earlier diagnosis of liver malignancies and more tailored monitoring of patients during therapy may be possible thanks to a correlation between CT perfusion parameters and the presence and extent of tumour vasculature [16].
Combining PET and CT perfusion allows for metabolic and hemodynamic evaluation of liver abnormalities. This article provides a primer on perfusion imaging, a review of the current state of the art in acquisition techniques, and an analysis of the potential applications of perfusion parameters in the interpretation of a lesion. One day, CT perfusion imaging could be used in clinics for screening for hepatic lesions and monitoring their response to treatment. In this article, we discuss some of the problems that have been found with this strategy and some possible solutions [17, 18].

Materials and Methods

Our institution's ethical review board approved this prospective study, and we obtained consent from all participants according to those guidelines. 40 participants were analysed in a study conducted at the department of Radiodiagnosis, NRI Medical College & Hospital, Chinakakani, Guntur, and Andhra Pradesh between January 2022 to December 2022.

Inclusion criteria

1. Both sexes, age between 10 and 80.
2. The presence of a lesion occupying liver.

Exclusion criteria

1. Pregnant or lactating women, regardless matter how far along they are.
2. People with a weakened kidney function.

Statistical Analysis

The data was analyzed using IBM software. The statistical programme SPSS 23-0. For the sake of giving descriptive statistics, we used frequency analysis and percentage analysis for categorical data, and mean and standard deviation for continuous variables.

Results

Age distribution

It was shown that cancerous liver lesions were more common in people in their fourth to eighth decades, while benign liver lesions were more common in people in their second to fifth decades.

Table 1: Dispersion by Age

	Sample (n)	Mean Age
Malignant lesion	20	51
Benign lesion	20	42

Distribution by Gender

The total number of patients in this trial was forty, with twenty male participants and twenty female participants. Within the group of 20 patients who were diagnosed with malignant liver lesion, there were 18 men and 8 females. There were 20 people total, 11 men and 13 females, who had a benign liver lesion. The lesion was found in the liver.

Mean CT Perfusion Parameter Values

Table 2: These are the mean values for the CT perfusion parameters

Parameters		Mean	Standard deviation
BV	Malignant	20.0	4.1
	Benign	6.1	2.3
BF	Malignant	38.2	6.07
	Benign	19.8	13.1
PERM	Malignant	37.6	8.2
	Benign	33.9	7.1
ALP	Malignant	28.7	5.6
	Benign	9.5	7.8
PVP	Malignant	7.3	0.9
	Benign	12.8	2.8
HPI	Malignant	38	4.8
	Benign	35	22.7

Statistical analysis is performed using the mean value of the parameters to compare the lesion area to normal liver. Forty people participated in the study; twenty of them had cancerous lesions and the other twenty had benign ones. The most common malignancies among these patients were hepatocellular carcinoma and liver abscess.

Malignant liver lesions had significantly higher BV, BF, PERM, ALP, and HPI on CT compared to benign liver lesions, while benign lesions had lower PVP. Malignant CT perfusion parameters were shown to be greater than normal liver parenchymal values. CT perfusion metrics in the benign lesion group are slightly lower relative to normal liver parenchyma, whereas the HPI is slightly greater. Hepatocellular carcinoma, metastasis, and cholangiocarcinoma were selected as representative malignant lesions, and their perfusion parameters were compared to those of normal liver parenchyma.

Discussion

Liver lesions are classified as developmental, neoplastic, inflammatory, or other, depending on the cause of liver enlargement. In order to discriminate between the many forms of liver lesions and develop individualized treatment regimens, accurate imaging of the organ is essential for a correct diagnosis of liver disease. Perfusion computed tomography (CTP) provides a highly accurate method of measuring hepatic and portal blood flow. Quantitative examination of the lesion's hemodynamics can distinguish between malignant and benign processes [16-18], in addition to providing morphological information.

Using the established inclusion and exclusion criteria, we analyzed data from 40 patients diagnosed with conventional and contrast-enhanced US/CT/MRI, of whom 20 had malignant lesions and 20 had benign lesions based on histology. Methods of diagnosis used in the study included biopsy, FNAC, and surgical excision. The BV, BF, PERM, ALP, PVP and HPI scores, among others [19], were used to differentiate between cancerous and benign tumours. The purpose of this research was twofold:

1. To evaluate how well CT perfusion parameter values of normal liver parenchyma correlate with different benign and malignant lesions of the liver.
2. To investigate the association between CT perfusion parameter values of normal liver parenchyma and histological diagnosis.

CT perfusion parameters were compared between patients with malignant and benign liver lesions and those with malignant lesions were shown to have significantly greater BV, BF, PERM, ALP, and HPI values than patients with benign lesions. Hepatocellular carcinoma, metastasis, and cholangiocarcinoma (in this study group) all had higher intra lesional BV, BF, ALP and HPI than normal liver parenchyma [20-23].

The cystic contents of benign liver lesions decrease intra lesional BV, BF, PERM, ALP, PVP, and HPI, as shown by a comparison of the perfusion parameters of a few typical benign lesions to those of normal liver parenchyma. Increases in BV, BF, ALP, and HPI and decreases in PVP have all been associated with hepatocellular carcionoma, as described by Ippolito *et al*. Sahani *et al*. and Zhu *et al*. both highlighted how CT perfusion pictures showed that HCC had higher BV, BF, and PERM than the underlying liver parenchyma. Higher ALP and HPI in HCCs are consistent with the formation of new unpaired arterial blood vessels and a blood supply predominantly taken from arterial circulation in HCC nodules, respectively, and so complement the current findings [24-26].

Miles *et al*. first reported on the occurrence of increased ALP in liver metastases, and this has been confirmed using CT perfusion imaging. On CT perfusion imaging, patients with liver metastases had considerably higher ALP and lower PVP than those with normal parenchyma, as shown by Leggett *et al*. and Reiner *et al*. When comparing the livers of patients with no metastases to the livers of controls, Tsushima *et al*. and Shi *et al*. found that presumably normal liver tissue with occult metastases had elevated ALP and HPI with decreased PVP on CT perfusion pictures. These findings support the use of CT perfusion for the prediction of micro-metastases in a morphologically normal-appearing liver, which may lead to a shift in treatment protocols for these patients. All of those other studies back this up, too. ALP and HPI are both increased in HCC compared to normal parenchyma, however HCC has significantly higher total blood flow and ALP than metastasis does. Additionally, notable was the observation of increased BV, BF, ALP, and HPI in this study with hemangioma [32, 33]. Malignant liver lesions exhibit the same phenomenon. However, more research shows that hemangiomas, like hepatocellular carcinoma and metastases, have higher peripheral BV, BF, ALP, and HPI [33-35].

Conclusion

It is challenging to consistently detect hemodynamic changes in normal and diseased liver using standard CT, but these changes can be evaluated using CT perfusion. CT perfusion imaging of the liver provides functional information on the microcirculation of normal parenchyma, allowing for the differentiation of localised lesions of the liver utilising perfusion parameters. Potentially useful for spotting both primary and metastatic cancers. In addition, CT perfusion imaging of the liver can be used to assess the efficacy of systemic or regional tumour treatment, to forecast the early response to anticancer drugs, and to monitor the progression of cancer after it has been treated.

Conflict of Interest: None.

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