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Original Research

A Prospective study to Compare CT and MRI imaging in the diagnosis of hepatocellular carcinoma and analysis of prognostic factors

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Abstract
Value of computed tomography (CT) and magnetic resonance imaging (MRI) in the diagnosis of small hepatocellular carcinoma (HCC), and in analysis of the prognostic factors of primary hepatocellular carcinoma (PHC) were compared. A total of 100 patients with PHC were selected from January 2021 to July 2023. Among them, 50 patients were diagnosed with small HCC. Patients were diagnosed by MRI and CT scans, respectively, and diagnostic efficacy of the methods was compared. A single factor and multivariate analysis of prognostic factors were performed on 200 patients. The sensitivity of MRI screening was 78.82%, specificity was 78.46%, accuracy was 78.67%, positive predictive value was 82.72%, and negative predictive value was 73.91%. CT screening showed a sensitivity of 62.35%, a specificity of 73.85%, an accuracy of 67.33%, a positive predictive value of 75.71%, and a negative predictive value of 60.00%. Differences in sensitivity, accuracy, and negative predictive value between MRI and CT screening were statistically significant ($P<0.05$). There was no statistically significant difference between two groups in specificity and positive predictive value ($P>0.05$). Diagnostic efficiency of MRI is better than that of CT diagnosis. Univariate analysis showed that age, hepatitis B cirrhosis background, tumor stage, and portal vein embolization were prognostic factors for PHC. Cox multivariate regression analysis showed that the background of liver cirrhosis, tumor stage, and portal thrombosis were independent risk factors for poor prognosis for PHC patient and the differences were statistically significant ($P<0.05$). MRI is superior to CT in the sensitivity, specificity and accuracy of the diagnosis of small HCC. Individualized comprehensive treatment plans based on the patient's condition may be effective in prolonging the patient's survival time. Imaging diagnosis can provide survival basis for patients, improve diagnostic accuracy, and help to improve the survival rate.

Introduction

Hepatocellular carcinoma (HCC) is the fifth most common malignant tumor, and its mortality ranks third among all malignancies. HCC affects 620,000 new patients and causes 600,000 deaths every year posing a serious threat to people's health (1). Nearly half of patients with primary hepatocellular carcinoma (PHC) die due to lymph node metastasis (2). At present, 90% of PHC is developed from hepatitis and liver cirrhosis, and the risk of PHC is even greater after infection with hepatitis B and C (3). Cirrhosis also has a 35% risk of malignant transformation (4). Other causes of chronic liver injury include alcoholism, cholestasis, metabolic disorders, autoimmune and steatohepatitis (5,6). Due to the lack of obvious clinical features in early stage of HCC, most patients miss the best treatment time by the time of diagnosis, leading to a poor prognosis because of the high degree of malignancy and metastasis caused by HCC (7).In recent years, imaging techniques have been continuously developed, and it is very important to be familiar with the characteristics and advantages of

different imaging methods. It is of great significance to select appropriate imaging examination methods according to patient's pathological conditions to improve the early diagnosis of HCC and improve patients' survival. Therefore, the diagnosis of small HCC has become a hot topic in recent years (8–11). Small HCC is defined as a single tumor nodule with a diameter ≤3 cm (12,13). The most commonly used imaging methods for diagnosing HCC in clinical practice are computed tomography (CT) and magnetic resonance imaging (MRI) (14). Compared with CT, MRI is more complex. Each sequence has a different organization-contrast mechanism, and each sequence is irreplaceable. MRI can provide liver anatomy images and information about patients' physiological and metabolic function (15,16). However, MRI examinations are expensive, scan time is long and there are contraindications for patients. Therefore, MRI examinations are often used as supplementary means for CT examinations. The purpose of this study was to analyze the diagnostic value of CT and MRI examinations for small HCC in patients, and to analyze the prognostic factors of PHC patients.

Material and methods

General information

This study is a retrospective analysis. A total of 100 patients with HCC who were treated in Ananta Institute of Medical Sciences (Udaipur, Rajasthan, India) from January 2021 to July 2023were selected as the study subjects. There were 74 males and 26 females, and the mean age was 43.46±13.14 years. Among them, 50 were diagnosed as small HCC patients by biopsy or postoperative pathological examinations. Before CT or MRI examination, patients did not receive interventional therapy or related liver surgery. All the patients were excluded from pregnancy, blood system diseases, hypotension drugs, abdominal surgery history, and other types of tumors and metastases. The patients had complete clinical, pathological and surgical records. The study was approved by the Ethics Commitee of our institution. Patients who participated in this research, signed the informed consent and had complete clinical data. General information is listed in

Table I.

General information.

Factors	n	Percentage (%)
Age		
≥43	68	68
<43	32	32
Sex		
Male	74	74
Female	26	26
Tumor stage		
I+II	69	69
III+IV	31	31
Hepatitis B, cirrhosis background		
Yes	66	66
No	34	34

Liver function grading		
A	46	46
B	31	31
C	46	23
Tumor typing		
Massive type	14	14
Nodularity	76	76
Diffuse type	10	10
Portal embolism		
Yes	14	14
No	86	86
Alcohol consumption		
Do not drink	28	28
Occasionally	32	32
Regular drinking	40	40
Tumor distribution		
Left liver lobe	31	31
Right liver lobe	45	45
Left and right liver leaves	24	24

Equipment:CT Machine is 16 slice and The Tesla MRI is Siemens avanto 16 channel 1.5 Tesla

MRI examination: Patients were fasted for more than 4 h before examination. Scanning was performed during inhaling to inspiration. Patients were fixed in supine position. In routine examination, spin-echo sequences were used for transverse axis T1-weighted images, T2-weighted images, diffusion-weighted images, gradient echoes, antiphase, fast volumetric plain scans, respiratory gating and breathhold scans, with a slice thickness of 6 mm. Gd-DTPA was used as a contrast agent during enhanced scan and was injected via forearm superficial vein at a rate of 2.5 ml/sec using a high-pressure syringe. Arterial phase was scanned for 10 sec, portal vein phase was scanned for 5 sec, and equilibrium phase was scanned for 90 sec.

The 64-slice spiral CT examination: Patients were fasted for more than 8 h before examination, and 800–1,000 ml of warm water was used to inflate the intestines 30 min before scan. Breathing was performed and scanning was started after inhaling. Scanning layer's thickness was 5 mm. Iohexol contrast agent was injected at a speed of 3 ml/sec for enhanced scan. Arterial phase scan was performed for 25–30 sec, portal vein phase scan was performed 60–70 sec, balance phase scan was performed for 120–180 sec.

Diagnostic analysis: Image analysis was performed by two radiologists and AFP examination was combined to confirm the diagnosis of small HCC. Diagnostic efficacy of the two imaging methods was evaluated based on sensitivity, specificity, accuracy, positive predictive value, and negative predictive value.

Statistical analysis: SPSS 17.0 (SPSS, Inc., Chicago, IL, USA) was used for statistical analysis. χ^2 test was used for analysis of count data. Kaplan-Meier method was used for univariate survival analysis. Cox proportional hazards model was used for multifactorial analysis. P<0.05 was considered to indicate a statistically significant difference.

Result

Diagnosis analysis: MRI detected 39 cases of true positive small HCC, and the accuracy was 78.67%. In addition, 31 cases of true small HCC were detected by CT and the accuracy rate was 67.33%. CT scan is insensitive for the diagnosis of small HCC, and imaging of adjacent tissues is not clear, which may cause misdiagnosis and diagnostic errors. Thirteen patients were negative by CT screening and were positive after MRI screening and were confirmed as positive by pathological analysis.

Comparison of diagnostic efficacy of MRI and CT on small HCC:MRI screening showed a sensitivity of 78.82%, a specificity of 78.46%, an accuracy of 78.67%, a positive predictive value of 82.72%, and a negative predictive value of 73.91%. CT screening showed a sensitivity of 62.35%, a specificity of 73.85%, an accuracy of 67.33%, a positive predictive value of 75.71%, and a negative predictive value of 60.00%. Differences in sensitivity, accuracy, and negative predictive value between MRI and CT screening were statistically significant (P<0.05). There was no statistically significant differences between two methods in specificity and positive predictive value (P>0.05) (Tables II–III).

Comparison of MRI Scan result with pathological exam results

Table :111

Pathological examination results	Small HCC	Other types	Total
Small HCC	45	5	50
Other types	5	45	50
Total	50	50	100

Comparison of the efficacy of MRI and CT in the diagnosis of small HCC (%).

Groups	n	Sensitivity	Specificity	Accuracy	Positive predictive value	Negative predictive value
MRI	200	78.82	78.46	78.67	82.72	73.91
CT	200	62.35	73.85	67.33	75.71	60
χ^2		11.11	0.763	9.775	2.257	6.433
P-value		0.001	0.383	0.002	0.133	0.011

i] MRI, magnetic resonance imaging; CT, computed tomography; HCC, hepatocellular carcinoma.

Analysis of influencing factors of patient survival time: Univariate analysis of survival factors in 200 patients showed that adverse factors that affect the prognosis of patients with HCC include age, hepatitis B cirrhosis background, tumor stage and portal vein embolism. The differences were statistically significant (P<0.05). Cox multivariate regression analysis showed that the background of liver cirrhosis, tumor stage, and portal thrombosis were independent risk factors for poor prognosis of cancer. The differences were statistically significant (P<0.05) (Tables IV and V).

Results of single factor analysis of prognosis of PHC patients

Items	P-value	HR	95% confidence interval
Sex (male vs. female)	0.485	1.062	0.523–1.946
Age (<43 vs. ≥43 years)	0.043	3.765	2.346–4.427
Hepatitis B cirrhosis background (yes vs. no)	0.013	0.436	0.356–0.821
Liver function grading (A vs. B vs. C)	0.232	3.518	1.265–4.124
Tumor staging (I, II vs. III, IV)	0.024	2.341	1.834–2.701
Tumor tissues (Massive type vs. nodularity vs. diffuse type)	0.064	2.746	1.868–4.103
Portal embolism (yes vs. no)	0.032	0.689	0.535–0.912

[i] PHC, primary hepatocellular carcinoma

Table V.

Results of multivariate analysis of PHC prognosis

Items	P-value	HR	95% confidence interval
Age (<43 vs. ≥43 years)	1.032	4.029	2.306–6.082
Hepatitis B cirrhosis background (yes vs. no)	0.021	0.469	0.314–0.672
Tumor staging (I, II vs. III, IV)	0.016	2.327	1.876–2.728
Portal embolism (yes vs. no)	0.018	0.681	0.512–0.908

[i] PHC, primary hepatocellular carcinoma

The liver's primary roles are blood supply and metabolism. Primary HCC is complicated in both its onset and progression, and early detection is crucial to enhancing patients' quality of life and prognosis (17). In addition to being clinically significant screening tools for liver cancer, MRI and CT scans can offer precise tumor parameters. It has been stated that the detection rate of tiny HCC plays a significant role in the diagnosis and assessment of postoperative clinical efficacy (18). The combination of MRI and CT has not been widely used in

clinical settings due to its high cost. In clinical settings, both MRI and CT offer benefits and drawbacks. Relying solely on one method can lead to incorrect diagnoses or diagnostic mistakes. MRI has a higher diagnosis accuracy than CT scan for screening small HCC (19–21). As a result, to increase the effectiveness of the diagnostic process in the real clinical setting, the patient's conditions should be integrated. Patients who are at risk but do not exhibit overt symptoms ought to undergo routine evaluations in order to boost the rate of early detection and enhance the effectiveness of treatment.According to this study, MRI screening achieved 78.82% screening sensitivity, 78.46% specificity, 78.67% accuracy, 82.72% positive predictive value, and 73.91% negative predictive value. The results of the CT screening were as follows: 62.35% sensitivity, 73.85% specificity, 67.33% accuracy, 75.71% positive predictive value, and 60.00% negative predictive value. There were significantly significant ($P<0.05$) differences in the sensitivity, accuracy, and negative predictive value between CT and MRI screening. According to this study, MRI screening achieved 78.82% screening sensitivity, 78.46% specificity, 78.67% accuracy, 82.72% positive predictive value, and 73.91% negative predictive value. The results of the CT screening were as follows: 62.35% sensitivity, 73.85% specificity, 67.33% accuracy, 75.71% positive predictive value, and 60.00% negative predictive value. There were significantly significant ($P<0.05$) differences in the sensitivity, accuracy, and negative predictive value between CT and MRI screening.

Tumor staging, portal vein embolization, and the history of liver cirrhosis were found to be risk factors for the prognosis of HCC by Cox multivariate regression analysis, and the differences were statistically significant ($P<0.05$). Additionally, according to McNally et al. (24) there is no independent risk factor for a poor prognosis of HCC other than cirrhosis, tumor stage, and portal thrombosis. Liver cirrhosis alters the liver's microenvironment, which leads to the spread of hepatoma cells and the formation of new lesions. Tumor stage is correlated with the quantity, size, level of infiltration, and metastasis of the tumors, all of which affect patient survival. A tumor may spread through the portal pathway if a portal embolism interferes with the liver's regular blood supply (25).In summary, MRI is more diagnostically effective than CT scan screening for the identification of small HCC. When liver tumor lesions cannot be reliably identified by CT screening, MRI can offer a more reliable imaging foundation. The history of hepatitis B liver cirrhosis, tumor stage, and portal vein embolization were found to be independent risk factors for a poor prognosis of hepatocellular carcinoma (HCC) using univariate and Cox multivariate regression analysis. As a result, creating customized, all-inclusive treatment plans based on each patient's unique circumstances, routinely evaluating, and promptly acting upon issues, may help patients live longer. Thus, an MRI diagnosis can offer a crucial foundation and screening technique for the most appropriate treatment of HCC, all within the reasonable range of medical costs.

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Patient consent for publication: Not applicable.

Competing interests: The authors declare that they have no competing interests.

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