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• LIVER CANCER •

Role and limitation of FMPSPGR dynamic contrast scanning in the follow-up of patients with hepatocellular carcinoma treated by TACE

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Abstract

AIM:**To evaluate the role and limitation of fast multiplanar spoiled gradient-recalled (FMPSPGR) MR dynamic contrast scanning in the follow-up of patients with HCC treated by transarterial chemoembolization (TACE).**

METHODS:**Twenty-two patients with 24 HCC lesions confirmed by biopsy or surgical resection underwent MR imaging in 4-9wks after TACE with a superconducting 1.5 T MR scanner, including SE T_1WI, T_2WI and FMPSPGR dynamic contrast scanning. The signal intensities of all lesions on SE T_1WI,T_2WI and the enhancement patterns on FMPSPGR dynamic contrast scanning were observed, and the comparison was made between MRI findings and pathological results in all the cases.**

RESULTS:**Of the 24 lesions, the signal intensities were various on SE T_1WI and T_2WI. On T_1WI, 13 lesions appeared as hyperintense, 4 lesions were isointense and the other 7 lesions were hypointensese. Histologically, hyperintense lesions showed on T_1WI were viable tumor or hemorrhage; isointensities were coagulative necrosis or inflammatory infiltration; hypointensities were tumor, liquified necrosis, coagulative necrosis or inflammatory infiltration. On T_2WI, 15 lesions appeared as hyperintense, 3 lesions were isointense and the other 6 lesions were hypointensese. Hyperintense lesions showed on T_2WI were residuals of viable tumor, hemorrhage, liquefied necrosis or inflammatory infiltration; isointense lesions were residuals of viable tumor or inflammatory infiltration; hypointense lesions were coagulative necrosis. On FMPSPGR dynamic contrast scanning, 18 of the 24 lesions enhanced on early-phase dynamic scanning corresponding to residuals of viable tumor and the other 6 lesions had no enhancement at this phase because complete necrosis were seen in the histologic examination. On delayed-phase dynamic scanning, 6 lesions had permanent enhancement appeared as inhomogeneous hyperintensity and both residuals of viable tumor and inflammatory infiltration were found by histologic examination. 18 lesions were hypointense at this phase and 8 of them coexisted with peripheral ring-like enhancement of the lesions resulting from viable tumors or inflammatory infiltration.**

CONCLUSION: **FMPSPGR MR dynamic contrast scanning can reflect the pathologic changes of HCC treated by TACE. Especially, early-phase dynamic scanning can evaluate accurately residuals of viable tumor and necrosis in HCC lesions. FMPSPGR dynamic contrast scanning is useful in the follow-up of patients with HCC treated by TACE combined with SE T_1WI and T_2WI, but it is difficult to differentiate peripheral viable tumors from inflammatory infiltration.**

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INTRODUCTION

Hepatocellular carcinoma (HCC) is a malignancy prevalent in the Asia countries. Surgical resection is the first choice for the treatment, but this option is not always possible because of coexisting severe cirrhosis, multiple lesions and other conditions not suitable for surgery. In case of unresectable HCC, transarterial chemoembolization (TACE) has been one of the widely used and effective treatment methods and demonstrated great potential in improving survival time, especially, it has been proved to be more effective in combination with percutaneous ethanol injection, Chinese traditional medicine or laser thermal ablation, etc[1-31]. Since TACE is difficult to kill the tumor cells for once completely, the treatment efficacy of TACE was influenced by many factors, such as the size of tumors, blood supply and the ultra- selectivity of the catheter etc. It is very important to assess objectively the viability and necrosis of the tumors after TACE in HCC, and to take further treatment to improve the general therapeutic effects and the survival rate. Magnetic resonance imaging (MRI) has been a useful modality in the diagnosis of HCC, especially fast multiplannar spoiled gradient recalled (FMPSPGR) sequence dynamic contrast scanning could reflect sufficiently the blood supply of HCC[32-39]. The therapeutic effects of TACE in HCC were evaluated with MRI in this study, and the role and limitation of FMPSPGR dynamic contrast scanning in the follow-up of patients with HCC treated by TACE were discussed.

MATERIALS AND METHODS

Twenty-two cases with massive or nodular types of HCC were collected from Sept. 1997 to May 1999. All cases were confirmed by biopsy (n =19) or surgical resection after TACE (n=3).

Transarterial chemoembolization was performed by selectively introducing a catheter into the hepatic artery and injecting antitumor agents (5-FU 1 000 mg, Cisplatin 80 mg

or Biaoroubixing 60-70 mg). Subsequently, the peripheral embolization of the tumors was done with 38 % ultrafluid iodized oil (Lipiodol) (10-25 ml) mixed with Mitomycin 16-20 mg, then the central embolization of the tumors was done with 3-5 strips of gelatine sponge (0.1-0.2 cm×1 cm).

MRI was performed in 4-9 wk after TACE with a superconducting 1.5 T MR scanner (GE Medical Systems Milwaukee, WI) , including T_1WI (TR/TE=500-700 ms/14-16 ms) and T_2WI (TR/TE=2 000-4 000 ms/30-90 ms) and FMPSPGR dynamic contrast MRI (Matrix 256×128, thickness 7 mm, gap 3 mm, TR/TE Flip Angle=100-150 ms/1.6~4.6 ms/60°-90°). Three to four repeated acquisitions were obtained at 25 s, 60 s, 90 s and 180 s respectively following power injection of 15-20 ml (0.15 mmol/kg) of Gd-DTPA (gadopentetic dimeglumine, Magnevist, Shering Pharmaceutical Ltd.) via antecubital vein.

Nineteen cases underwent biopsy with the CT guidance. The other 3 cases underwent surgical resection after TACE. The MRI images of all cases were read and analyzed by 2 experienced radiologists. The comparison of MRI images between before and after TACE was done in 6 cases. The comparison was also done between MRI findings and pathological results in all cases.

RESULTS

A total of 24 lesions were identified in the 22 cases of HCC. The size of the lesions ranged 3.9-8.2 cm in diameter, with average 5.3 cm(Figure 1).

Findings of HCC after TACE on SE sequence were showed in Table 1.

Table 1 Findings of HCC after TACE on SE sequence

SE sequence	signal intensity				
	hyperintensity		isointensity	hypointensity	
	homogeneity	inhomogeneity		homogeneity	inhomogeneity
T_1WI	9	4	4	2	5
T_2WI	3	12	3	3	3

Table 2 Comparison of MR findings on SE sequence with pathology

SE sequence	signal intensity	Pathological changes
	hyperintensity	viable tumors, hemorrhage
	isointensity	viable tumors, coagulative necrosis, inflammatory infiltration
T_1WI	hypointensity	viable tumors, coagulative necrosis, liquefied necrosis, inflammatory infiltration
	hyperintensity	viable tumors, hemorrhage, liquefied necrosis, inflammatory infiltration
T_2WI	isointensity	viable tumors, inflammatory infiltration
	hypointensity	coagulative necrosis

Table 3 Comparison of MR findings on FMPSPGR sequence with pathology

FMPSPGR sequence	enhancement	pathological changes
enhanced early phase	enhanced area	viable tumors
	no enhanced area	necrosis
	enhanced area	viable tumors,inflammatory infiltration
enhanced late phase	no enhanced area	viable tumors, necrosis
	peripheral ring-like enhancement	viable tumors,inflammatory infiltration

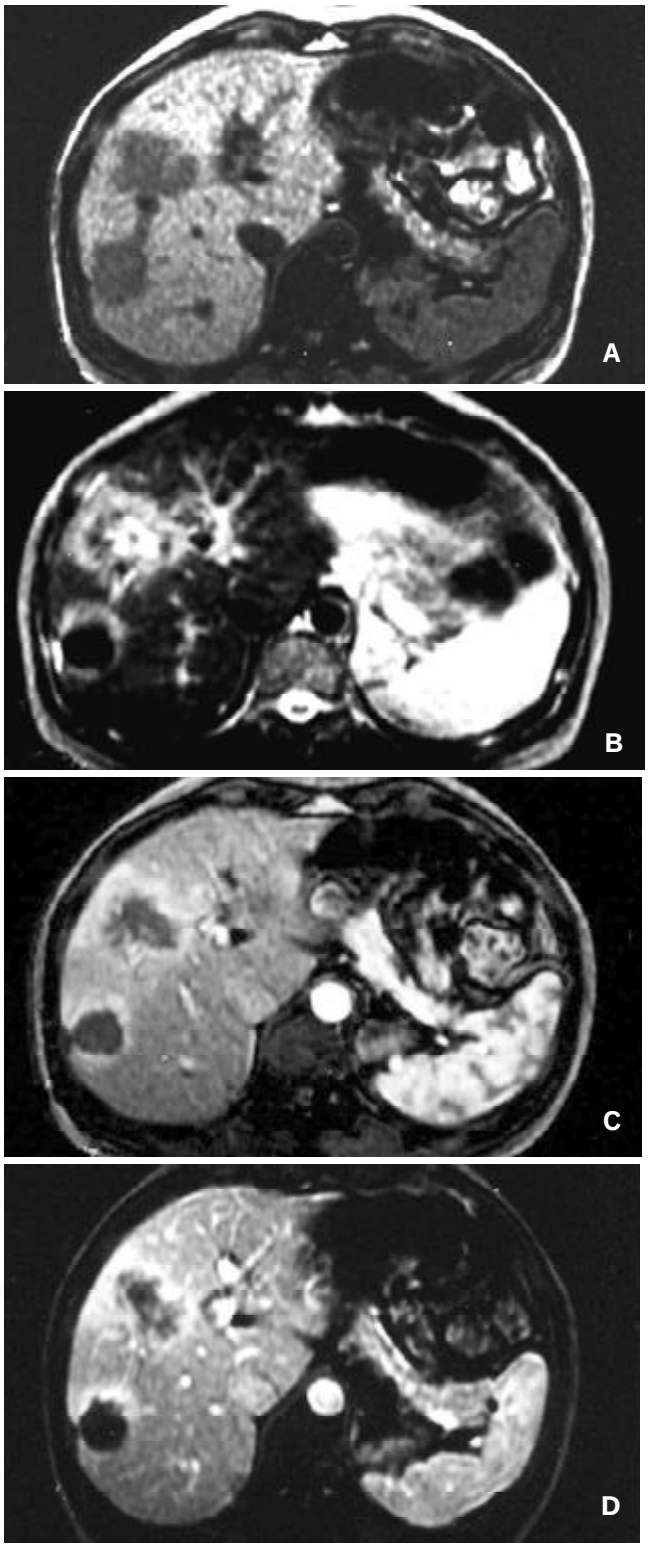

Figure 1 HCC after TACE. A T_1WI shows two hypointense lesions in the right anterior and posterior lobe. B T_2WI shows that the central coagulative necrosis of the right posterior lesion is hypointense and the peripheral residuals of viable tumors is hyperintense. The right anterior lesion is inhomogeneous intensity with liquefied necrosis (central higher hyperintensity), coagulative necrosis(punctual hypointensity)and peripheral residuals of viable tumors (peripheral hyperintensity). C FMPSPGR dynamic contrast early phase scanning shows that both of liquefied necrosis and coagulative necrosis have no enhancement and peripheral residuals of viable tumors enhanced. D The peripheral residuals of viable tumors have permanent enhancement at the dynamic contrast late phase.

Findings of HCC after TACE on FMPSPGR sequence

Eighteen lesions were enhanced at the dynamic early phase, in which one of the lesions revealed homogeneous hyperintensity, and the other 17 were inhomogeneous hyperintense. 6 lesions showed no enhancement on this phase. At the late phase of contrast scanning, 6 lesions were still inhomogeneous hyperintense, 18 hypointense and 10 homogeneous hypointensity, and peripheral ring-like enhancement of the tumors were seen in 8 lesions.

Comparison of MR findings with pathology was showed at Table 2-3

The MRI findings corresponding to the results of pathology showed that complete necrosis was seen in 6 lesions and various degrees of necrosis coexisted with viable tumors were seen in 17 lesions, except one. Peripheral ring-like enhancement of tumors seen on the FMPSPGR dynamic contrast late phase scanning, could be difficult to be differentiated viable tumors from inflammatory infiltration because of the limitation of bioptic spots.

DISCUSSION

TACE has been applied in unresectable HCC as an efficient therapy to improve the survival rate and also as a preoperative modality in some HCC patients to make the tumors diminution and then underwent surgical resection[5-31]. Since TACE is difficult to kill all the tumor cells for once completely, so it is generally used repeatedly. It is needed to evaluate the viability and necrosis of HCC accurately for optimally choosing the further proper managing methods. Angiography is an effective method for evaluating HCC lesions treated with TACE. It could reflect sufficiently the blood supply of viable tumors and demonstrate the blood supply of lateral circulation of HCC. But angiography is an invasive technique and therefore is not suitable for routine follow-up in such patients[40,41]. CT could be considered as a routine modality to judge the efficacy of TACE. It could demonstrate accurately the size, shape, location of the lesions, intrahepatic metastasic nodules and the distribution of lipiodol in the tumors and provide valuable imaging information to determinate the interval of TACE[42-49]. Generally, the homogeneous and complete deposition of lipiodol within the lesions would indicate the high degree necrosis of the tumors, but it is difficult to judge the viability and necrosis of the tumors correctly, due to the inhomogeneous deposition, because lipiodol negative area doesn' t actually represent the viability of the tumors. The necrosis within the lesions before TACE was also lipiodol negative area. On the other hand, the viable tumors could be enhanced on the CT contrast scanning, but the enhancement area within the lesions could also be affected by artifacts of the high concentrations of lipiodol, making it difficult to evaluate the therapeutic efficiency objectively.

Several authors considered that MR was valuable in the evaluation of therapeutic efficiency of TACE, especially on SE T_2WI, most of viable tumors were hyperintense and the coagulative necrosis within the tumors considered as a positive response to TACE were hypointense[50-58]. But this results showed that the signal intensity of the tumors after TACE were variable on the SE T_1WI and T_2WI, but all of viable tumors, hemorrhage, liquefied necrosis and inflammatory infiltration could also result in hyperintensity on the T_2WI. Therefore it was difficult to assess the viable tumors of HCC after TACE by conventional SE imaging. However, it was reliable to judge coagulative necrosis on T_2WI, especially the changes during the process of intratumor hemorrhage after TACE presenting as hyperintensity and then turned in to coagulative necrosis presenting hypointensity. This study also demonstrated that it was significant to compare the signal intensity of HCC on T_2WI before and after TACE to evaluate the degree of coagulative necrosis. The original hyperintensity of HCC turned to hypointensity indicated the presence of coagulative necrosis after TACE.

FMPSPGR dynamic contrast scanning plays a very important role in the detection and characterization of HCC. It is possible to obtain the high quality images of whole liver during a single breath-hold with rapid aquisition. It could demonstrate accurately the blood supply of tumors and reveal the contrast enhancement patterns of HCC. HCC is hypervascular and enhanced rapidly and obviously at the dynamic early phase scanning and declined at the late phase[33-39]. This results showed that FMPSPGR dynamic contrast scanning also had a great value in the evaluation of therapeutic efficacy of TACE. The residual viable tumors were showed as rapid enhanced portions within the lesions, homogeneous or inhomogeneous, when necrotic portions had no enhancement at the contrast early phase scanning. At the late phase scanning, the enhancement of the most lesions became hypointensity, and just a few lesions showed persistent enhancement. Pathologically, both viable tumors and inflammatory infiltration could present such changes, so the contrast early phase scanning was more reliable in the evaluation of viable tumors, combined by with conventional SE sequence, and more accurate to assess the viability and the necrosis of tumors and useful in the followed up of HCC patients after TACE.

This study has some limitation in which all MR images based on histological specimens, but false positivity or false negativity may be present because of the factors in sampling.

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