Utility of diffusion weighted MRI in patients undergoing locoregional treatment of malignant liver tumours

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Background

Imaging of liver tumours following transarterial chemoembolization (TACE) and radio-frequency ablation (RFA) is important for determining the success of treatment and helps decide on further management. Presence of Iodized oil in the lesions following chemoembolization is difficult to assess on CT scans. On gadolinium enhanced MR, enhancing areas in the post RFA lesions and TACE lesions may be viable tumor or inflammatory response and difficult to differentiate.

Purpose

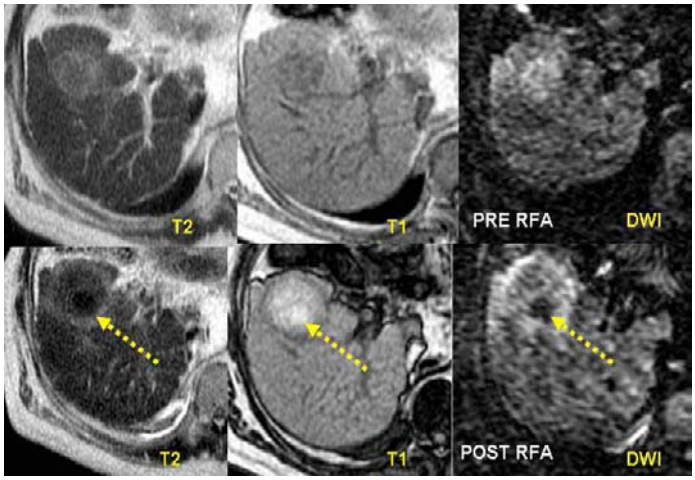
To describe the utility of diffusion weighted MR imaging in patients undergoing locoregional treatment of liver tumours.

Material and methods

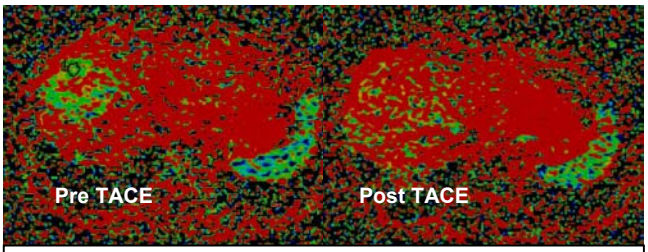
Diffusion-weighted MRI (DWI) was performed before and after transarterial chemoembolization (TACE) (n=22) or radio-frequency ablation (RFA) (n=18) for hepatocellular carcinomas (n=28) and metastatic lesions of liver (n=12). DWI was performed with single shot echo planar sequence (TR/TE = 6000/65) and unidirectional gradient sequences with two b values (0,200 and 0, 500) and apparent diffusion coefficient (ADC) maps generated. The lesion to liver signal intensity ratio and ADC values were calculated. Routine T2-W and T1-W sequences were also obtained. One month follow up DWI was also performed for 9 lesions and three months for 3 lesions.

Results

All hepatic tumours were hyperintense to liver on DWI before TACE and RFA (lesion: liver = 2.2 $\pm$0.43). Post TACE and RFA, the lesions demonstrated a general decrease in signal intensity (1.5 $\pm$ 0.32). RFA lesions were either hypointense with a variable hyperintense rim or mixed-intensity. The post-TACE and RFA lesions demonstrated higher mean ADC values (190 $\pm$ 30; 155 $\pm$ 25) as compared to the tumours prior to treatment (160 $\pm$ 20; 120 $\pm$ 22) (p <0.02). The ADC values increased after 1-month follow-up suggestive of further necrotic changes. In three patients recurrence was noted which appeared hyperintense to the treated lesion with low ADC.



Top row- Hepatocellular carcinoma before RFA treatment. Bottom row -Post RFA appearance (24hours). Note the decreased signal in the center of lesion on DWI representing necrosis and peripheral hyperintensity which represents inflammatory reaction. The ADC value increased from 124$\pm$ 15(before) to 152 $\pm$ 18 (after) signifying RFA induced necrotic changes



Hepatocellular carcinoma demonstrates high ADC following TACE treatment signifying necrotic changes

Discussion

Viable tumor cells have intact cell membranes that restrict water diffusion and necrotic tumours have increased water diffusion due to cell membrane disruption [1]. Chemoembolization and RF treatment causes cell death and cell membrane disruption leading to increased water diffusion in treated lesions. DWI with ADC maps can differentiate necrotic from viable regions of hepatocellular carcinoma [1]. However, the optimum period during which a DWI has to be performed to detect tumour necrosis has not yet been identified. A prospective DWI study with serial imaging may be useful to determine the period.

Conclusion

There is a trend for ADC of the liver lesions to increase following locoregional treatment signifying necrotic changes. DWI with ADC maps may be useful for monitoring response to treatment and detect recurrence.

References

1. Kamel IR, Bluemke DA, Ramsey D, et al. AJR 2003; 18:708-710.