

INTRAVOXEL INCOHERENT MOTION DIFFUSION-WEIGHTED MR IMAGING OF BENIGN MENINGIOMAS IN BRAIN: PRELIMINARY STUDY

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Target Audience: Radiologists, surgeon and neurologists

Purpose: The IVIM MRI based on the DWI had been applied to clinical research with technological development, especially in the body or head and neck. But for the application of domestic benign meningiomas were rarely reported. To evaluate the diagnostic performance of monoexponential model and the biexponential model using IVIM MR imaging for in brain.

Methods: All participants in this study provided written informed consent. The study population consisted of 22 patients (mean age of 50 years) ranging between 32 and 66 years, 7male, 12 female. In light of WHO classification, these cases included fibrillary meningioma (n=12), epithelial meningioma (n=7), angiomatous meningioma (n=3). Both of them were examined on a 3.0T MR scanners (Achieva 3.0T TX, Philips, The Netherlands) and included the plain MR imaging, intravoxel incoherent motion (IVIM)MR imaging and enhanced MR imaging. The IVIM sequence was performed by applying 14b values between 0 and 1000 on 3 orthogonal

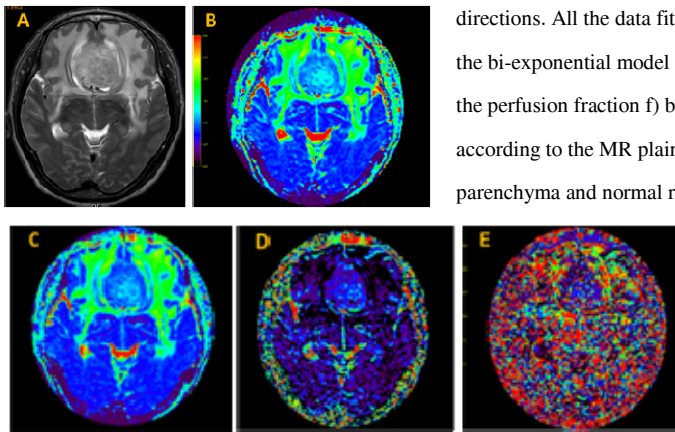


Fig1. 66Y, F. The axial T2WI (A) showed a hyperintense mass with benign meningiomas. The maps (B-E) encoded in a blue-green-red color schema. The ADC map (B) from the monoexponential model showed the mass with the ADC value was $1.01 \mu\text{m}^2/\text{ms}$. The bi-exponential model yielded the diffusion constant D (C), the perfusion fraction f (D) and the pseudodiffusion coefficient of perfusion D* (E). The D, f and D* values were $0.96 \mu\text{m}^2/\text{ms}$, 12.43% and $66.08 \mu\text{m}^2/\text{ms}$.

directions. All the data fitted to a monoexponential model [yielding the apparent diffusion coefficient (ADC)] and the bi-exponential model (yielding the diffusion constant D, the pseudodiffusion coefficient of perfusion D* and the perfusion fraction f) by using postprocessing software. The regions of interest were identified and hand-drawn according to the MR plain scan by a trained neuroradiologist. The significant differences between the tumor parenchyma and normal region were assessed by using the paired *t* tests. The differences of the ADC and the D

values between the benign meningiomas parenchyma were also assessed by using the paired *t* tests.

Results: Signal decay curves were bi-exponential in the benign meningiomas parenchyma. The ADC, D, D* and f values of benign meningiomas were $(0.87 \pm 0.13) \mu\text{m}^2/\text{ms}$, $(0.79 \pm 0.10) \mu\text{m}^2/\text{ms}$, $(58.68 \pm 27.52) \mu\text{m}^2/\text{ms}$, $(7.68 \pm 3.59)\%$ and the normal regions were $(0.74 \pm 0.06) \mu\text{m}^2/\text{ms}$, $(0.69 \pm 0.04) \mu\text{m}^2/\text{ms}$, $(93.43 \pm 31.64) \mu\text{m}^2/\text{ms}$, $(4.48 \pm 2.39)\%$, respectively. (Fig 1.) The differences of the ADC, D, D* and f values between two groups were statistically significant ($t=5.793, 4.384, -3.559, 3.349$, respectively) and the ADC, D and f values of benign meningiomas were increased. The differences of the ADC and the D values between the benign meningiomas parenchyma were statistically significant ($t=0.579, P<0.05$).

Discussion: Our study has suggested that both ADC and D values were significantly larger than the normal regions because that water molecules were easy to spread when tumor parenchyma destroyed the normal cells. Le Bihan and Turner¹ consider that f measures the fractional volume of capillary blood flowing in each voxel. Our study has indicated that the f value may correlate with the amount of normal angiogenesis with intact vessels so f values increased in tumor. But the D* values had slightly worse performance presumably due to their high sensitivity to capillary blood flow and any partial volume effect with CSF-filled or necrotic spaces.²

Conclusion: IVIM imaging was found to be a valid and promising method for non-invasive to quantify perfusion and provided more accurate diffusion in benign meningiomas.

References: 1. Le Bihan D, Turner R. The capillary network: a link between IVIM and classical perfusion. *Magn Reson Med*. 1992; 27(1):171–178.

2. Bisdas S, San Koh T, Roder C, et al. Intravoxel incoherent motion diffusion-weighted MR imaging of gliomas: feasibility of the method and initial results. *Neuroradiology*. 2013; 55(10): 1189–1196.