High resolution DWI for orbital tumors: 3D turbo field echo with diffusion-sensitized driven-equilibrium (DSDE-TFE) preparation technique

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Target audience: Researchers and clinicians who are interested in high-resolution diffusion weighted imaging (DWI) of orbital tumors.

Purpose: DWI is widely used to diagnose tumors, inflammations and vascular diseases in both intracranial and extracranial lesions. However, it is hard to evaluate intraorbital structures with echo planar (EP) imaging, which is the most common imaging techniques for DWI. Compared to EP-DWI, 3D Turbo Field Echo with Diffusion-Sensitized Driven-Equilibrium Preparation Technique (DSDE-TFE) DWI could obtain images with higher spatial resolution and less susceptibility artifacts [1-3]. Therefore, the purpose of this study was to differentiate solid from cystic intraorbital tumors using DSDE-TFE.

Methods: This retrospective study was approved by our institutional review boards, and written informed consent was waived. 26 patients with intraorbital tumors (12 males and 14 females; age range 0 - 78 year old; median 46 year) were studied. MRI was conducted on a 3T clinical scanner (Achieva TX 3.0T, Philips Healthcare, NL) using an 8-channel head coil. For DSDE-TFE, a motion probing gradient was conducted at one direction with b values of 0 and 500 s/mm^2. The other imaging parameters were as follows; TR/TE = 6.2/3.0 ms, FA = 10°, ETL = 75, FOV = 240 mm, voxel size = 1.5x1.5x1.5 mm^3, NEX = 2, imaging time = 5 min 22 s. Additionally, T1WI, fat suppressed T2WI, and fat suppressed postcontrast T1WI were also obtained. The apparent diffusion coefficients (ADCs) of the lesions were measured on axial reformatted images. Signal intensity on T1WI, fat suppressed T2WI, and postcontrast T1WI compared to normal-appearing white matter were also measured. Statistical analysis was performed with Mann-Whitney U test. A p-value less than 0.05 was considered significant.

Results: Intraocular lesions were clearly visualized on DSDE-TFE without obvious geometrical distortion. There were 16 solid (8 cavernous hamangiomas, 6 pleomorphic adenomas, 1 adenocarcinoma, and 1 sebaceous carcinoma) and 10 cystic tumors (7 dermoids, 2 epidermoids, and 1 cystadenoma). All lesions were clearly visualized on DSDE-TFE. ADC of the solid tumors (mean ± SD; 1.43 ± 0.41×10^{-3} mm^2/s) was statistically significantly lower than that of cystic tumors (2.21 ± 0.76×10^{-3} mm^2/s; $P < 0.05$). There were no statistically significant differences on noncontrast conventional MRI ($P > 0.05$).

Discussion: With its insensitivity to field inhomogeneity and high spatial resolution, the 3D DSDE-TFE technique enabled us to discriminate solid tumors from cystic tumors without contrast material.

Conclusion: DSDE-TFE is feasible to assess diffusivity in orbital tumors.

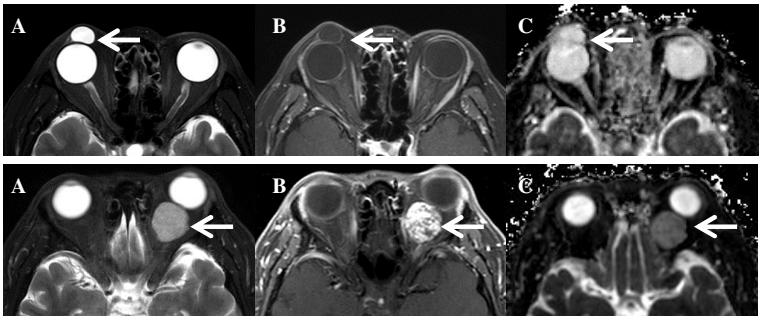

Fig. 1: A 59-year-old female with dermoid cyst in the right orbit. There is a hyperintense mass in the right orbit on fat suppressed T2WI (A). There is no solid enhancement in the lesion (B). ADC map derived from DSDE-TFE (C) shows increased diffusivity in the lesion (3.24×10^{-3} mm^2/s).

Fig. 2: A 32-year-old female with cavernous hemangioma in the left orbit. There is a hyperintense mass in the right orbit on fat suppressed T2WI (A). There is an intense enhancement in the lesion (B). ADC map derived from DSDE-TFE (C) shows low diffusivity in the lesion (1.11×10^{-3} mm^2/s) compared to Fig 1.

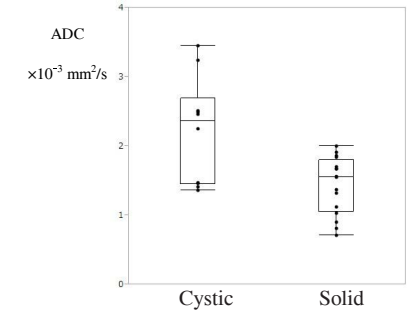

Fig. 3: Graph shows ADC of the solid tumors (mean ± SD; 1.43 ± 0.41×10^{-3} mm^2/s) was statistically significantly lower than that of cystic tumors (2.21 ± 0.76×10^{-3} mm^2/s; $P < 0.05$).

Reference

1. Obara M, et al. Proc. ISMRM. **2.** Hiwatashi A, et al. AJNR. 2014;35:95-8. **3.** Hiwatashi A, et al. Eur Radiol. 2014;24:581-6.