Diagnostic Accuracy of Periodically Rotated Overlapping Parallel Lines with Enhanced Reconstruction (PROPELLER) Diffusion-Weighted MRI in Cholesteatomas

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Target audience: Neuroradiologist, Otologist

Purpose: Conventional diffusion weighted imaging (DWI), as acquired using a single-shot echo planar imaging (ssEPI) sequence, suffers from severe distortion artifacts in areas of high susceptibility such as the temporal bone, thus hindering the diagnosis of middle ear cholesteatoma[1]. The periodically rotated overlapping parallel lines with enhanced reconstruction (PROPELLER) DWI technique, utilizes diffusion lobes and fast spin echo readout, is less prone to the susceptibility effect[2]. This study evaluated the diagnostic value of PROPELLER DWI in detecting middle ear cholesteatoma.

Methods: Twenty-three patients with soft-tissue mass in middle ear underwent a 3T clinical MRI examination (MR750, GE Healthcare). Two techniques of DWI, including conventional ssEPI (TR/TE=6800/74 ms; ASSET factor=2, b=800) and the PROPELLER (TR/TE=6200/118 ms, b=800) were consecutively performed. Two radiologists analyzed unlabeled images for the diagnosis of cholesteatoma. Surgical pathologic findings were used as the reference standard. The respective sensitivity, specificity and accuracy of each DWI techniques were calculated. The severity of the susceptibility artifact and geometry distortion were recorded, and the image quality was scored using a four-point scale, ranging from score 1 of no artifact to score 4 of substantial artifacts. The reader agreement was assessed using Cohen κ statistic test.

Results: The middle ear lesions were proved as cholesteatomas by histology in 14 of our 23 patients. The interobserver agreements were very good (0.84-0.89). Figure shows a patient with cholesteatoma in right middle ear. The ssEPI-DWI suffered from severe susceptibility artifact and geometric distortion, which hindered the detection of the lesion. The evaluation of diagnostic performance and the image quality was summarized in the table. The images by using PROPELLER DWI had significantly lower susceptibility and geometric artifacts (P<0.01), which resulted in higher sensitivity and accuracy when compared with those by using the ssEPI-DWI. Both the two techniques had 100% specificity in diagnosis.

Conclusion: The multishot fast spin-echo PROPELLER DWI reduced susceptibility artifacts and geometric distortion in the area of the temporal bone, resulted in better diagnostic utility in detecting middle ear cholesteatoma compared with conventional EPI-DWI.

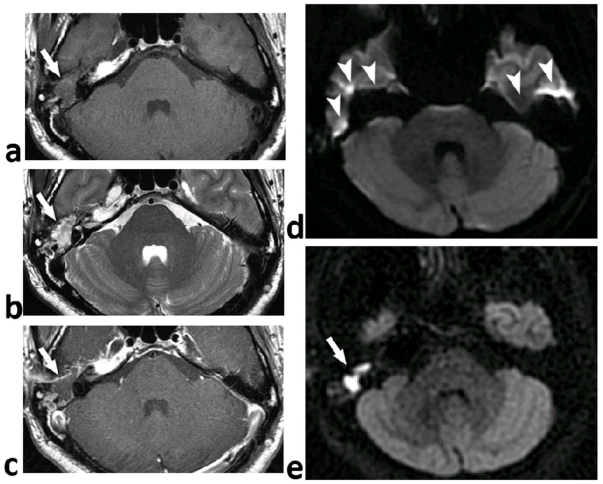

Figure. MRI of a patient with histologically proven cholesteatoma (arrows). (a)T1-weighted image; (b) T2-weighted image; (c)T1-weighted image with gadolinium enhancement; (d) single-shot EPI DWI, arrowheads denote the susceptibility artifacts. (e) PROPELLER DWI.

References: 1. De Foer B, Vercruysse JP, Pilet B, et al. Single-shot, turbo spin-echo, diffusion-weighted imaging versus spin-echo-planar, diffusion-weighted imaging in the detection of acquired middle ear cholesteatoma. *AJNR Am J Neuroradiol.* Aug 2006;27(7):1480-1482. **2.** Pipe JG, Farthing VG, Forbes KP. Multishot diffusion-weighted FSE using PROPELLER MRI. *Magn Reson Med.* Jan 2002;47(1):42-52.

Table. Comparison of diagnostic performance of DWI using SE-EPI and PROPELLER in detecting cholesteatoma and the image quality. *:P<0.01.

	Diagnostic performance			Image quality	
	Sensitivity (%)	Specificity (%)	Accuracy (%)	Susceptibility artifact	Geometric distortion
SE-EPI	10	100	47.6	3.45±0.33	3.27±0.41
PROPELLER	91.67*	100	95.2*	1.45±0.22*	1.33±0.18*