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Intracranial epidermoid cysts: diffusion-weighted, FLAIR and conventional MR findings

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Abstract

Purpose: To compare diffusion-weighted echo-planar imaging (DW) with spin-echo (SE), and fluid-attenuated inversion recovery (FLAIR) sequences in the evaluation of epidermoid cysts (ECs), and to evaluate T2 shine-through effect.
Materials and methods: Fifteen patients were imaged prospectively in two different 1.5 T magnetic resonance (MR) units with standard head coils with SE, FLAIR and DW echo planar imaging sequences. The qualitative and quantitative assessments were performed by two radiologists in consensus. Apparent diffusion coefficient (ADC) values were obtained from all ECs. Exponential DW images are obtained in 11 cases to eliminate T2 shine-through effects. The results are analyzed with variance analysis (ANOVA) and Bonferroni *t* method.
Results: FLAIR sequence was superior to T1- and T2-weighted sequences in showing ECs. In 13 cases, the borders of the lesions could be delineated from the surrounding structures with only DW imaging where ECs were markedly hyperintense. The ADC values of ECs are significantly lower than CSF ($P < 0.001$), and significantly higher than deep white matter ($P < 0.01$). On exponential DW images, ECs had similar intensity with brain parenchyma showing that the real cause of the hyperintensity of the lesions on trace images is the enhanced T2 effect of the tissue.
Conclusion: FLAIR sequence is superior to the conventional MR sequences in demonstrating the ECs and DW imaging is superior to other MR sequences in delineating the borders of the ECs. Exponential DW images had shown that the hyperintensity in the trace images are caused by increased T2 effect of the lesion rather than the decrease in ADC values.

Keywords: Cysts; Epidermoid; Magnetic resonance (MR); Diffusion magnetic resonance imaging

1. Introduction

Intracranial epidermoid cysts (ECs) are rare congenital tumors of ectodermal origin that constitute 0.2–1.8% of all intracranial tumors [1]. They are frequently located at the cerebellopontine angle, and appear as well-defined, homogeneous, lobulated masses with a fibrous capsule filled with cholestrol crystals, keratin, protein, debris and cerebrospinal fluid (CSF) [2–4]. Symptomatic cysts are surgically decompressed and if possible removed with the tumor capsule [5].

Although the outcome of surgical treatment is satisfactory, the diagnosis of ECs by neuroimaging has remained relatively problematic. This is because on conventional CT and MRI, ECs usually exhibit poor contrast from surrounding CSF making identification of their exact extent difficult and they do not enhance after contrast infusion [6,7]. Several imaging techniques have been tried to improve the detection of these tumors, such as CT cisternography, 3D Fourier transform fast MRI with steady state free precession, and magnetic resonance (MR) cisternography [7–9]. The constructive interference in steady state (CISS) sequence provides high-resolution images with good contrast between CSF and solid structures revealing displacement of brainstem and cranial nerves [10].

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Fast fluid-attenuated inversion recovery (FLAIR) sequence imaging is reported to be more sensitive than conventional MRI [5,7,10,11]. The use of diffusion-weighted echo-planar (DW) imaging has been proposed to help in differential diagnosis to differentiate ECs from arachnoid cysts (ACs) by revealing the solid nature of ECs [12–16]. Echo-planar DW imaging results are better than the previous spin-echo DW imaging results since the motion artifacts are reduced. On postoperative conventional MR images, intensities of the resection cavity and residual ECs may be similar. On DW images, the hypointense CSF-containing cavity can easily be differentiated from the residual hyperintense epidermoid tumor [17].

On DW images signal intensity of mobile water molecule decreases as the b factor increases, while that of immobile water molecule does not. As a result, CSF shows low signal intensity on DW images, while solid structures such as ECs show increased signal intensity. The value of DW trace images has been highlighted in the purpose of separating ECs areas appearing bright from CSF appearing dark as well as within normal cisternal spaces and within ACs. Annet et al. speculated that the T2 shine-through may play a role in the mechanism for EC brightness on trace images [16]. To our knowledge, although hypothesized, the origin of this bright signal intensity has not been shown yet.

In this study, our purposes are to investigate the utility of DW echo-planar imaging for initial diagnosis and postoperative assessment of ECs and to show the effect of T2 shine-through on the brightness of ECs.

2. Materials and methods

2.1. Patients

Between July 2000 and August 2003 fifteen consecutive patients with a mean age of 38.7 ± 12.5 years (range, 22–64 years) were enrolled in this prospective study. Ten were female, and five were male patients with lesions ranging from 2 to 13 cm. The clinical diagnosis of the patients were as follows; Eight cases with headache, two cases with headache and ataxia, one vertigo, one case with headache and seizures, one ataxia, one case of trigeminal neuralgia, one case with headache and vertigo. Informed oral consents were obtained from all patients.

Ten lesions were located at the cerebellopontine (CP) angle, two at lateral ventricles, one at peri- and one at premezensephalic cisterns and one at fourth ventricle respectively (Table 1). Nine patients with primary diagnosis of ECs underwent surgery and had histopathologic diagnosis. One lesion is not operated since the size of the lesion was too small to cause symptoms. This case is being followed up (Table 1, case no. 15). Other five patients had postoperative residual tumors, which were located at the CP angle (four cases) and at the lateral ventricle (one case). One residual tumor at the CP angle was reoperated because the symptoms of the pa-

Table 1
The qualitative findings of epidermoid cysts

Case no.	Signal intensity (relative to the CSF) and internal structure						
	Age/sex	Lesion location	Mass effect	T1-weighted SE (600/12)	T2-weighted FSE (4500/82)	FLAIR (9000/124)	Diffusion–trace EPI
1	32/F	Laterale ventricle	Minimal	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
2	36/M	Cerebellopontine angle cistern	Extensive	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
3	44/F	Cerebellopontine angle cistern	Extensive	Inhomogeneous hyperintensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
4	15/F	Cerebellopontine angle cistern	Extensive	Homogeneous isointensity	Homogeneous isointensity	Homogeneous hyperintensity	Hyperintense
5	64/F	Cerebellopontine angle cistern (residue tumor)	Minimal	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
6	34/M	Cerebellopontine angle cistern (residue tumor)	Moderate	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
7	38/F	Cerebellopontine angle cistern	Extensive	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
8	45/M	Fourth ventricle	Extensive	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
9	22/F	Cerebellopontine angle cistern	Minimal	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
10	36/F	Laterale ventricle (residue tumor)	Minimal	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
11	33/F	Perimezensephalic cistern	Moderate	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
12	54/M	Cerebellopontine angle cistern	Moderate	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
13	45/F	Cerebellopontine angle cistern (residue tumor)	Moderate	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
14	30/M	Cerebellopontine angle cistern (residue tumor)	Moderate	Inhomogeneous isointensity	Inhomogeneous isointensity	Inhomogeneous hyperintensity	Hyperintense
15	53/F	Premezensephalic cistern	No	Homogeneous isointensity	Homogeneous isointensity	Homogeneous hyperintensity	Hyperintense