Preoperative Evaluation of Trigeminal Neuralgia Due to Epidermoid Tumor Using a Three Dimensional Fast Advanced Spin Echo -Case Report-

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Abstract: We report preoperative virtual images reconstructed from three-dimensional fast advanced spin echo (3D-FASE) and evaluate the cause of a trigeminal neuralgia due to an epidermoid tumor. A 60-year-old man had a 3-year-history of atypical trigeminal neuralgia in the left V2 region accompanied by a hypesthesia in the cheek. Neuroimaging demonstrated an epidermoid tumor in the left cerebellopontine cistern. As the preoperative virtual images reconstructed from 3D-FASE images indicated that the superior cerebellar artery compressed the trigeminal nerve at the root entry zone, we carried out total removal of the tumor and microvascular decompression of the trigeminal nerve. It was possible to visualize the fine structures around the trigeminal nerve, because an epidermoid tumor shows a high intensity mass on 3D-FASE images. The simulated 3D images were useful in deciding upon the additional microvascular decompression surgery for trigeminal neuralgia after total removal of the epidermoid tumor.

Key words: epidermoid tumor, fast spin echo, three-dimensional image, virtual image.

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Introduction

Epidermoid tumors are uncommon and occur in 0.2 to 1% of all primary intracranial tumors[1]. The symptoms and signs are caused by displacement of the adjacent neural and vascular structures. Even using modern imaging techniques, such as computed tomography (CT) and magnetic resonance imaging (MRI), it has been impossible to evaluate these displacements of nerves and vessels. Recent advances in MR techniques in three-dimensional (3D) data acquisition and post processing technologies have been playing an important role in widening the potential applications of 3D display and preoperative simulation. An effective microsurgical approach can be planned preoperatively to completely remove tumors and can be used to evaluate the relationships between the nerves and vessels. We report a useful MRI technique that uses 3D fast advanced spin echo (3D-FASE) for preoperative evaluation of the cause of the trigeminal neuralgia due to an epidermoid tumor.
Methods

Preoperative MR images were acquired using a 3D-FASE sequence utilizing a 1.5 Tesla MRI system (VISART, Toshiba Corporation, Tokyo). The imaging parameters used for 3D -FASE (repetition time, 6000 ms; echo time, 250 ms) were as follows: echo spacing, 12.5 msec; 1 shot; number of excitations, 2; echo train length, 148; slab thickness, 40 mm; matrix, 256 x 256 x 40. Mid-slice reconstruction post-processing was used to generate images at 0.5 mm intervals. The time required for a single shot was approximately nine minutes. The cross-sectional images data sets were transferred to a Silicon Graphics computer (Mountain View, CA), and the regions predicting compressed cerebellum during the operation were cut on serial 2D images, then the brain surface, cranial nerves and vessels were rendered using Dr. View software (Asahikasei Joho System, Tokyo). Surface rendered images were created as virtual images from superior, right ventral and operator’s views.

Case Report

A 60-year-old man had a 3-year-history of trigeminal neuralgia in the left V2 region. The neuralgia was characterized by shooting pains of 10 to 15 seconds duration in the cheek, lip or oral cavity on the left, when eating, drinking cold liquids, talking or touching his cheek. The pain was not well controlled by stellate ganglion blocks or carbamazepine that had been given by anesthesiologists for three years. The patient was referred to us, when the pain could not be controlled by augmentation of carbamazepine intake and the patient began complaining of dizziness and unsteadiness. The examination showed atypical trigeminal neuralgia in the left V2 region accompanying the trigger area in the infraorbital area and hypesthesia in the cheek. Dilatation of the left cerebello-pontine angle was observed on a CT scan. In the left cerebello-pontine cistern, conventional MRI demonstrated an epidermoid tumor showing low and high intensities on T1- and T2-weighted images, respectively (Fig. 1A, B). MR angiogram showed that the superior cerebellar artery (SCA) was sagging to the trigeminal (Vth) nerve, but could not be identified as the artery responsible for trigeminal neuralgia (Fig. 1C). Thin slice FASE images easily identified the Vth nerve and SCA attached Vth nerve, and the epidermoid tumor showed mix intensity but equal intensity with cerebrospinal fluid (CSF) (Fig. 1D-H). As the preoperative virtual images reconstructed from 3D-FASE images indicated that the SCA compressed the Vth nerve at the root entry zone (REZ), we planned the total removal of the tumor and microvascular decompression of the Vth nerve (Fig. 1I, J, 2A).

The patient underwent surgery through the left suboccipital by the retrosigmoid approach. The cerebello-pontine cistern was completely occupied by a white tumor, and the facial and acoustic nerves were partly observed in the tumor. The lower cranial nerves were seen over
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Fig. 1. Preoperative neuroimaging. MRI demonstrates an epidermoid tumor (small arrows) showing a slightly high intensity on T1-weighted image (A), but iso-intensity on T2-weighted image relative to CSF (B). MR angiogram shows a sagging left superior cerebellar artery (arrowhead) but cannot be confirmed as the artery responsible for trigeminal neuralgia (C). Thin slice serial fast advanced spin echo (FASE) images easily identify the contact (arrow) between the trigeminal nerve and SCA (D–G). Inverse maximum intensity projection of FASE images (H) and surface rendering images (from superior, I; from right ventral, J) show that left SCA indents the trigeminal nerve (arrow) at the root entry zone (REZ).


the tumor. The cistern containing tumoral tissue was demarcated by the arachnoid membrane. At the superior extremity, the arachnoidea was incised and the petrosal vein was dissected from the tumor capsule. A fragile, white tumor content was easily sucked up and removed with pituitary forceps, and the Vth nerve was dislocated ventrally by the tumor. When the tumor in the upper cerebello-pontine cistern was evacuated, a sclerotic posterior cerebral artery and oculomotor nerve were seen on the roof of the cistern in the tentorial hiatus. With the upper cerebellum retracted laterally, the proximal portion of the Vth nerve
was exposed, and at its REZ, the caudal loop of the SCA indented the Vth nerve from above (Fig. 2B). The SCA was completely separated from the Vth nerve by meningeal adhesion.

The SCA was mobilized superlatively with a thin band of Teflon felt with both extremities glued to the petrous dura with Biobond. Gross total removal of the tumor was confirmed with an endoscope. Postoperative chemical meningitis was prevented by the prophylactic administration of steroids. The postoperative course was uneventful and the trigeminal neuralgia disappeared.

**Fig. 2.** Preoperative virtual view from the left ventro-inferior easily identifies the relationship between the trigeminal nerve and left superior cerebellar artery. This simulated operative view (A) reveals good correlation with operative photograph (B). White arrows show responsible site of trigeminal neuralgia. AICA: anterior inferior cerebellar artery, BA: basilar artery, Lt: left, NV: trigeminal nerve, N.VII/VIII: facial and acoustic nerves, SCA: superior cerebellar artery.

**Discussion**

An intracranial epidermoid tumor is slow-growing congenital neoplasm that usually spreads and adheres to critical neurovascular structures along the cistern, particularly the cerebello-pontine angle. The preoperative information of fine structure in the cerebello-pontine angle is needed for safe and effective decompressive surgery. MR cisternography offered the negative configuration of microanatomy without contrast medium, and it was possible to visualize the surface appearance of the fine structures in the cistern and foramen[2–4]. The clinical utilities for lesions in the posterior fossa using 3D-fast spin echo (FSE) have been reported previously[3, 5, 6]. The 3D-FSE techniques allow high-resolution MR cis-
ternograms to be obtained with less than 1 mm slice thickness. Although the images with 3D-FSE (15–27 echo train length) are high quality, the scan time was relatively long, typically around 15 min. In this study, it took only nine minutes of scan time using 3D-FASE that was applied with ultra-long echo train length (148 echo train length) and a half-Fourier imaging technique in 3D-FSE to reduce the scan time. Typical epidermoid tumors were revealed as slightly hyperintense relative to CSF on T1-weighted MR images, hyperintense relative to CSF on proton density-weighted MR images [7]. Our 3D-FASE, which was extreme heavily T2-weighted imaging, showed a high intensity mass with CSF intensity. As the preoperative virtual image reconstructed from 3D-FASE images indicated the operative view after removal of the tumor, the relationship between the Vth nerve and SCA was well evaluated.

Frequently, trigeminal neuralgia is seen in 40–80% of epidermoid tumors within the posterior fossa [8–10]. An epidermoid tumor may cause neuralgia by means of four different mechanisms: direct compressive effect of the nerve at the root entry zone [11–14], pushing the Vth nerve against a blood vessel at the root entry zone [15], a combination of these two mechanisms [16], or local irritation from cholesterol seeping [17]. Hasegawa et al. [18] classified at surgery the anatomical relationships between the Vth cranial nerve, offending arteries and tumors (epidermoid tumor, meningioma, neurinoma) as follows; type A, the nerve was totally encased by the tumor; type B, the axis of the nerve was distorted by the tumor; type C, the nerve was shifted by the tumor and compressed by the artery contralaterally; type D, the nerve was compressed by the artery which was displaced by the tumor. In the past, it had been impossible to classify the anatomical relationship by radiological investigation for epidermoid tumors. In those days it could only be done by intraoperative findings. Using 3D-FASE images, however, the preoperative diagnosis of our case by 3D-FASE image was type D, and the operative finding was the same type. As it was known that the SCA compressed the Vth nerve, we planned total removal of the tumor around the Vth nerve and microvascular decompression for the Vth nerve.

In conclusion, as an epidermoid tumor shows high intensity mass on heavily T2-weighted images, it is possible to visualize the fine structures involved or compressed by tumors. 3D-FASE images, 3D-FSE images or virtual 3D-images may provide in detail more information on the structures around the Vth nerve before operation for trigeminal neuralgia due to an epidermoid tumor.

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類表皮腫による三叉神経痛を3D-FASE 法で術前評価した一例

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要旨：症例は60歳男性。3年前より左顔部の感覚低下を伴う三叉神経痛を自覚し保存的加療にて改善しないため当科を受診した。MRIにて左小脳橋角部から三叉神経にかけて類表皮腫を認めた。Fast spin echo (FSE) に half-Fourier 法を応用した3D-fast advanced spin echo (FASE) にて三叉神経と上小脳動脈、腫瘍の関係を術前に評価し仮想術野を作成した。術中所見でも三叉神経のroot entry zone を上小脳動脈が圧迫しており徐減圧した。症状は消失し経過良好であった。強いT2強調画像であるFASE 画像では類表皮腫は髄液と同様の信号を呈し神経と血管が陰性像として高解像度で描出できる利点があり、類表皮腫の術前評価に非常に有用であったので報告した。

キーワード：類皮腫，高速スピン・エコー法，3次元画像，仮想術野。