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Apparent diffusion coefficient and arterial spin labeling perfusion of conventional chondrosarcoma in the parafalcine region: a case report

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ABSTRACT

Intracranial chondrosarcoma is a very rare malignant tumor of the central nervous system, and is difficult to preoperatively distinguish from other tumors using conventional imaging techniques. Here, we report the case of a 24-year-old woman who presented with mild headache due to chondrosarcoma in the frontal lobe. Preoperative conventional images showed findings typical of an oligodendroglial tumor. However, high apparent diffusion coefficient (ADC) value and extreme hypoperfusion on arterial spin labeling (ASL) were inconsistent with oligodendroglial tumor characteristics. The tumor was completely removed using a standard surgical procedure. Histologic diagnosis was a conventional (classic) chondrosarcoma. High ADC and hypoperfusion on ASL represented low cellularity and low vascularity within conventional chondrosarcoma, respectively. We discuss the utility of ADC and ASL for the preoperative diagnosis of conventional chondrosarcoma.

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Introduction

Intracranial chondrosarcoma is thought to be derived from persistent embryonic cartilage tissues at cartilaginous joints [1]. Intracranial cartilage tumors can be classified as histologically chordoma, chondroma, and chondrosarcoma. There are 2 types of chondrosarcoma variants: conventional (classic) type and mesenchymal type, according to the World Health Organization classification reedited in 2016 [2]. The incidence of all intracranial chondrosarcomas is reportedly less than 0.15% of all intracranial neoplasms [3,4]. Neurosurgeons may see very few cases of this disease during their years in practice, making it difficult to differentially diagnose it from other brain tumors. Most of intracranial chondrosarcomas have been reported to arise from the extra-axial structures such as skull base, the convex dura, falx, and intraventricle [3,5–8]. Thus, its localization often leads to misdiagnosis of meningioma [9,10]. Therefore, selection and interpretation of preoperative neuroimaging are crucial to precisely diagnose intracranial chondrosarcoma. We encountered a case of conventional chondrosarcoma in the left frontal lobe. In addition to conventional magnetic resonance

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imaging (MRI), we performed optional techniques including measurement of apparent diffusion coefficient (ADC) values and arterial spin labeling (ASL) perfusion imaging to preoperatively distinguish chondrosarcoma from other brain tumors. We discuss the utility of using ADC and ASL to preoperatively diagnose intracranial chondrosarcoma.

Case report

Preoperative images

The patient in our case study was a 24-year-old woman who presented with a slight headache for 1 month before admission to our hospital. She had no remarkable medical or family history. Conventional computed tomography (CT) showed multiple calcified lesions within a tumor located in the left frontal lobe (Fig. 1A), and conventional MRI revealed a mass lesion of 4.7 cm in diameter involving the cortex of this lobe. The mass lesion was depicted as hypointense on T1-weighted imaging, hyperintense on T2-weighted imaging, and heterogeneous enhancement on gadolinium-enhanced T1-weighted imaging (Fig. 1B–D). A part of the internal edge of the tumor seemed to perforate the falx. However, both the dura mater and falx adjacent to the tumor only showed slight enhancement, suggesting reactive changes. Based on the age of the patient and the CT and MRI findings such as calcified foci, heterogeneous enhancement, and lack of dural tail, a preoperative diagnosis was an oligodendroglial tumor rather than a meningioma. Then we assessed water molecule diffusion and blood flow within the tumor by ADC and ASL, respectively, using a 3T MR imager (Discovery 750, GE Healthcare, Milwaukee, WI). Diffusion-weighted MR scans to obtain ADC values were performed with the following sequences: repetition time (TR), 8000 ms; echo time (TE), 60 ms; matrix 128×80; field of view, 220×220 mm; 4 mm thickness with 1.5 mm gap; 3 motion-probing gradient directions; and b value, 1000 s/mm^2. We subsequently performed ASL using the same MRI machine as that used to determine ADC values with the following sequences: 3-dimensional fast spin echo, pseudo-continuous ASL (pCASL); TR/TE, 4347/10.5 ms; field of view, 240×240 mm^2; postlabeling delay, 1525 ms. The ADC value was 2.4×10^{-3} mm^2/s in the lesion, which was 3-fold higher than the value of 0.8×10^{-3} mm^2/s measured in the normal region (Fig. 2, left). ASL showed extreme hypoperfusion with 0.2-fold more blood flow than that in the normal brain tissue (Fig. 2, right). These findings were highly inconsistent with the characteristics of oligodendroglial tumors and meningioma.

Surgery, histologic diagnosis, and outcome

A left frontal craniotomy was performed under general anesthesia, and we easily dissected the tumor bulk from the convex dura and falx. We were able to easily remove the tumor edge from the perforating hole at the falx. While dissecting from the

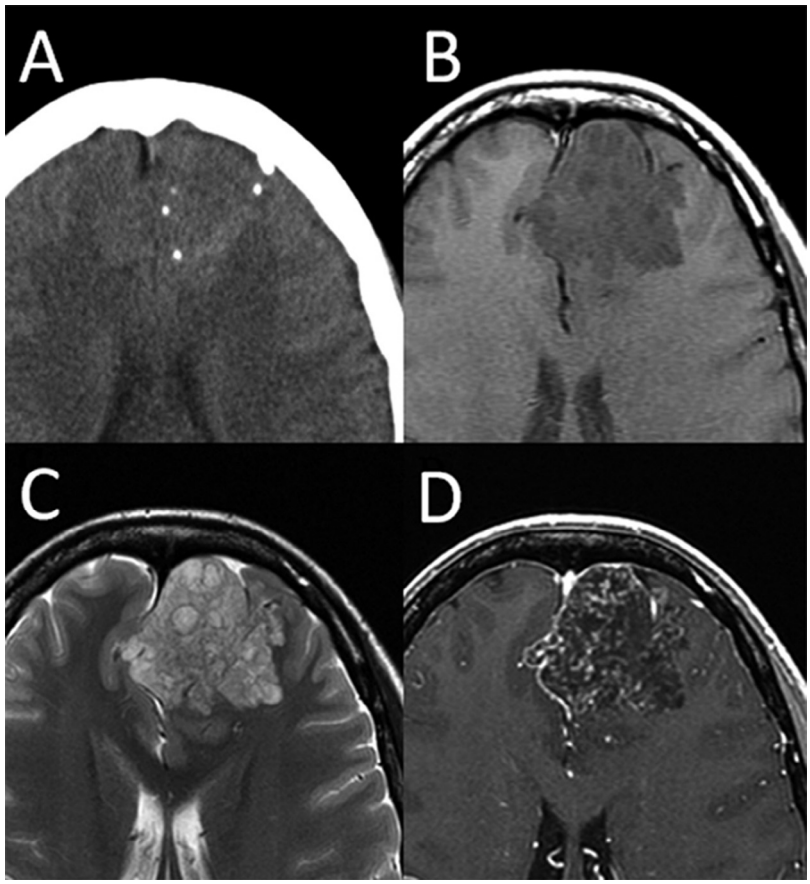

Fig. 1 – Demonstration of conventional imaging. (A) Plain CT; (B) T1WI; (C) T2WI; (D) Gd-T1WI. CT, computed tomography; T1WI, T1-weighted imaging; T2WI, T2-weighted imaging; Gd-T1WI, gadolinium-enhanced T1-weighted imaging.

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