Glioneuronal Tumor with Neuropil-Like Islands in the Cerebellum: A Case Report
소뇌에서 발생한 신경그물 섬을 동반한 신경아교신경원 종양: 증례 보고

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Glioneuronal tumor with neuropil-like islands (GTNI) is a rare and novel mixed neuronal-glial tumor that typically affects the supratentorial cerebral hemispheres of adult patients. It is extremely rare for GTNIs to be in the spine of pediatric and adolescent patients, and there have been no reports of infratentorial GTNIs. We report a case of an elderly patient with an anaplastic, infratentorial GTNI that occurred in the cerebellum, including describing MRI features of our case.

Index terms
Cerebellar Neoplasms
Neuropil
Magnetic Resonance Imaging

INTRODUCTION

Glioneuronal tumor with neuropil-like islands (GTNI) is a rare, mixed neuronal-glial tumor of the central nervous system that was recently recognized as a distinct tumor in the 2007 World Health Organization (WHO) classification of brain tumors (1, 2). Approximately 35 cases of GTNI have been reported in the English literature since the first report in 1999 (3, 4). Most cases in the literature have been located in the cerebrum, and it has been rare for GTNIs to be found in the spine (5, 6). Physicians have limited experience with these tumors in the elderly and in the posterior fossa. Herein, we present the first case of an anaplastic GTNI in the cerebellum. We also describe the MRI features of this case, which could reflect the aggressive nature of GTNIs.

CASE REPORT

A 75-year-old female patient presented with whirling dizziness for 3 days before admission. Her medical history was unremarkable except for hypertension, and a neurological examination at presentation was unremarkable. Non-enhanced CT revealed an ill-defined, hypoattenuated area in the left cerebellar hemisphere without internal calcification (Fig. 1A). A brain MRI revealed a well-defined, 3.1 × 3.3 × 4.2 cm tumor in the left cerebellar hemisphere that extended to the cerebellar vermis and displaced the 4th ventricle anteriorly (Fig. 1B). The mass showed hyper-intensity on a T2-weighted image with mild peritumoral edema and heterogeneous, strong enhancement after intravenous injection of gadolinium. We observed no intratumoral hemorrhage on susceptibility-weighted imaging. A diffusion-weighted image showed iso- or low signal intensity without diffusion restriction, while the same lesion was increased.
Fig. 1. A 75-year-old woman with anaplastic glioneuronal tumor with neuropil-like islands.

A. Unenhanced axial CT scan demonstrates ill-defined hypodensity in the left cerebellar hemisphere.

B. The mass exhibits hyper-intensity on axial T2-weighted image (upper left panel) with minimal peritumoral edema and heterogeneously strong enhancement on axial post-contrast T1-weighted image (upper central panel). On diffusion images, the mass exhibits a mainly hypo-intense signal on diffusion weighted image (upper right panel) without diffusion restriction and a higher apparent diffusion coefficient (lower left panel) relative to brain parenchyma. Axial post-contrast T1-weighted image on first day after gross total resection (lower central panel) reveals residual enhancement along the margin of the resection cavity. The three-months postoperative MR image (lower right panel) reveals widespread enhancement with distinct margin in the surgical bed.
apparent diffusion coefficient (ADC) relative to brain parenchyma. Perfusion MRI showed decreased cerebral blood volume (CBV) within the tumors on a CBV map (Fig. 1C). MR spectroscopy showed a marked increase in choline and reduced N-acetylaspartate peaks (Fig. 1D). There was also no large lipid peak. The patient underwent suboccipital craniotomy, and the cerebellum showed mild bulging; a yellowish mass with moderate vascularity was identified via supracerebellar approach. Within the surgical field, there was poor demarcation between the mass and the surrounding normal tissue. Histopathological analysis revealed a biphasic pattern of astrocytic cells and well-delineated micronodular neuropil-like islands with angiocentricity (Fig. 1E). Glial tumor cells revealed moderately increased cellularity with large, dark, atypical, pleomorphic nuclei. There was no evidence of mitosis, necrosis, or vascular endothelial proliferation. Immunohistochemical analyses were focally positive for glial-fibrillary acid protein and synaptophysin (Fig. 1F) with a Ki-67 labeling index of 30%, which represented a mixture of neuronal and glial components and a high proliferative index. The combined diagnostic findings indicated an anaplastic GTNI of WHO grade 3. Despite aggressive management, follow-up MRI 3 months after surgery disclosed a large mass in

**Fig. 1. A 75-year-old woman with anaplastic glioneuronal tumor with neuropil-like islands.**

C. The CBV map reveals low CBV within the lesion.

D. Single-voxel intermediate echo time (135 ms) MR spectroscopy demonstrates elevated choline/creatine and choline/N-acetylaspartate peaks.

E. Photomicrograph of hematoxylin and eosin stained slide (magnification × 100) reveals spindled or elongated astrocytic cells with well-delineated micronodular, neuropil-like islands and central capillaries.

CBV = cerebral blood volume
DISCUSSION

Mixed glioneuronal tumors comprise a heterogeneous group of primary central nervous system lesions that arise from neoplastic cells and that can be differentiated along both glial and neuronal cell lines. They include both well-defined entities such as gangliogliomas and papillary glioneuronal tumors and newly described mixed lesions that were previously classified as histopathological variants of ganglioglioma. GTNIs are diffusely infiltrating tumors that exhibit predominantly fibrillary, gemistocytic, or protoplasmatic astroglial elements and that correspond to WHO grades 2 to 3 but that contain distinctive neuropil-like islands (3). Although they are rare, at least 35 cases of GTNIs that affected the cerebral hemispheres have been described so far (4). Without exception, GTNIs typically arise in the cerebral hemispheres in middle-aged patients, although there have been a few reports of GTNIs in the spines of pediatric and adolescent patients (4); in contrast to previous reports, our case of GTNI occurred in the cerebellar hemisphere in an elderly (75-year-old) patient. The diagnosis of anaplastic GTNI is based on typical pathological findings of a mixture of neuronal and glial components with neuropil islands and a high Ki-67 proliferative index (30%). According to the literature, the radiological appearances of GTNIs vary, including poorly demarcated lesions with nonspecific signal intensities (low intensity on T1WI and high intensity on T2WI), variable mass effects, and edema. Intratumoral calcification or hemorrhage has not been reported. Contrast enhancement is usually minimal at diagnosis (7). In our case, unlike with a previously reported intracranial case of GTNI, the contrast enhancement was heterogeneously diffuse and strong, which may be associated with moderate tumor vascularity and changes in the permeability of the blood-brain barrier. Cerebellar solid tumors in adults are less common than in children. The differential diagnoses of solid cerebellar tumors include solid hemangioblastoma, metastatic tumor, malignant astrocytoma, medulloblastoma, and lymphoma, in adults. With gliomas, lower ADC values and higher rCBV have been reported more frequently in higher-grade gliomas than in lower-grade gliomas (8). Unlike typical higher-grade gliomas, our case showed a high ADC value and decreased rCBV within the tumor despite its anaplastic nature. The low rCBV with avid contrast enhancement in our case could have been attributable to the angiocentric growth pattern, revealed at histologic examination and a massive leakage of contrast media into the interstitial space. In a region of severe blood-brain barrier breakdown, unwanted T1 effects caused by extravasated gadolinium counteract the T2 signal-lowering effects of gadolinium, resulting in falsely low rCBV values (9). Unfortunately, we did not perform the perfusion study with leakage correction algorithm. This low CBV coupled with avid enhancement may play an important role in differentiating anaplastic GTNI from other frequently encountered differential diagnoses including hemangioblastoma, glioblastoma multiforme, medulloblastoma, and metastases, all of which show significantly higher rCBV values.

Fig. 1. A 75-year-old woman with anaplastic glioneuronal tumor with neuropil-like islands. F. Positive glial-fibrillary acid protein stain (left panel, magnification × 100) indicates a glial component. Synaptophysin stain (right panel, magnification × 100) revealed positive staining in part of the tumor, indicating a neuronal component.
The high ADC in our case could have been attributable to the presence of large extracellular spaces and their cellularity, which helped us to rule out lymphoma, which shows significantly low ADCs. On MR spectroscopy in our case, we noted a high choline/creatinine level. Although this might not help differentiate anaplastic GTNI from glioblastoma multiforme and metastases, it may help in differentiating anaplastic GTNI from other low-grade gliomas.

In summary, we reported a case of an anaplastic GTNI in the cerebellar hemisphere of an elderly patient. The tumor appeared not to be confined to the cerebrum and showed avid contrast enhancement with progression. Our case supports the finding that unlike typical mixed glioneuronal tumors, which have favorable clinical courses, GTNIs have been found to have poor prognostic outcomes and behave like diffuse astrocytomas. Although GTNI is an uncommon neoplasm, its diagnosis should be considered when an enhanced solid tumor in the cerebellum is encountered in an adult.

REFERENCES