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Case Report

MRI Finding of Residual Tumor of Giant Oligodendroglioma in Pediatric: A Case Report ☆

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ABSTRACT

Oligodendroglioma is a rare brain tumor. Although it commonly originates in the cerebral hemisphere in adults, in the pediatric population, the location of oligodendroglioma varies and includes the cerebellum, midbrain, and spinal cord. The MRI characteristic of oligodendroglioma is also different between adults and pediatrics. Oligodendroglioma of >3 cm in pediatrics is associated with a poorer prognosis. Surgery and radiotherapy are the modality of choice for such patients. In this case, we present a 12-year-old girl with huge oligodendroglioma (WHO grade II). MRI showed an isointense-inhomogeneous signal on T1W1 and isointense with some region of hyperintense inhomogeneous on T2W1. After a 26-times-radiotherapy regimen, the patient was followed up for MRI evaluation and which revealed a marked reduction of tumor volume. The patient also reported no symptoms and overall clinical improvement.

Introduction

Oligodendroglioma (OG) is the third most common glioma, accounting for 2%-5% of primary brain tumors and 5%-18% of all glial neoplasms [1]. OG is most commonly detected in the fourth and fifth decades of life and is rarely seen in children. OG mostly originates in the cerebral hemispheres, mainly in the frontal or temporal lobes. The definitive diagnosis of OG is established based on the histological appearance of the tumor. OGs are generally present as low-grade, WHO grade II neoplasms, that are slow-growing tumors and have a favorable treatment response when compared to other gliomas. The combination of surgery, chemotherapy, and radiotherapy yields an average survival of 10-20 years for well-differentiated (WHO grade II) oligodendrogliomas or 5-10 years for anaplastic (WHO grade III) oligodendrogliomas [2]. The role of imaging in patients with oligodendroglioma falls into 3 main categories: (1) diagnostic work-up; (2) surgical and radiotherapy guidance; and (3) follow-up and treatment monitoring. Structural MRI is the modality of choice for all of those indications [3]. In this case report, we present a rare case of pediatric oligodendroglioma evaluated by MRI for post-radiation evaluation in Dr. Hasan Sadikin General Hospital, Bandung, Indonesia.

☆ Competing Interests: None.

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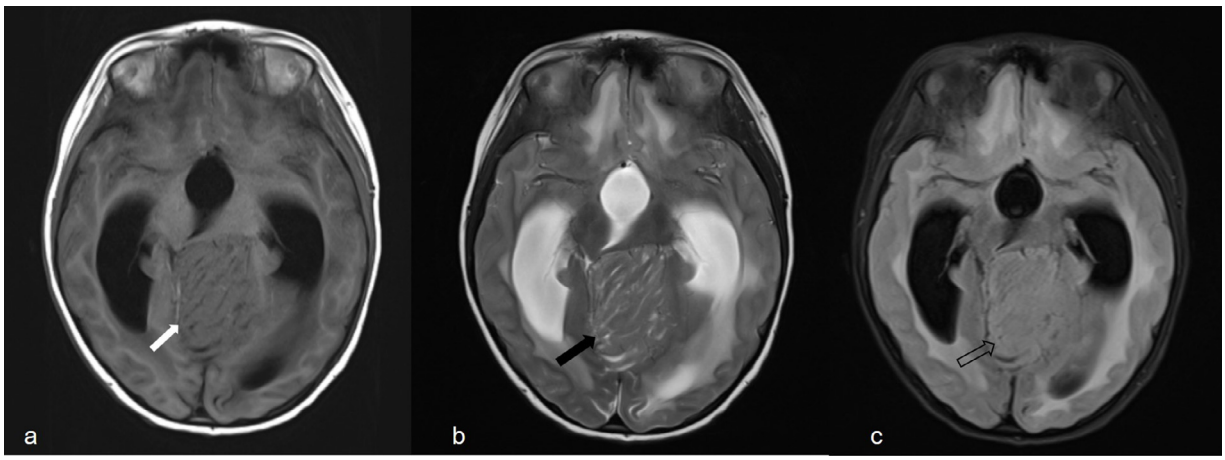

Fig. 1 – (a) It showed inhomogeneous isointense signal lesion on T1WI on left cerebellar hemisphere (white arrow); (b, c) showing isointense signal with slightly inhomogeneous hyperintense signal on T2WI (black arrow) and T2 Flair image (blank arrow).

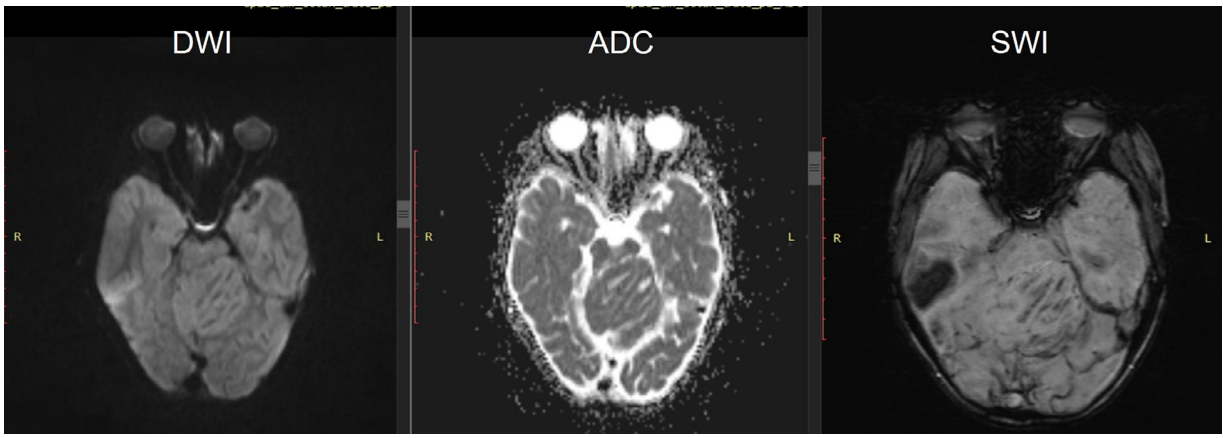

Fig. 2 – (a) (DWI) and (b) (ADC) showed restricted area image with ADC value of 787 x 10^6 mm^2/s was found on (black arrow). (c) (SWI) showed blooming artifact.

Case presentation

The patient was diagnosed for oligodendroglioma in 2021 when she felt sudden blurred vision associated with balance difficulty, headache, and vomit. MRI was conducted and it revealed space-occupying lesion. MRI finding showed irregular, well-defined lesion with the size of 6.7 × 7.3 × 7.4 cm from the left cerebellum to the right cerebellum. The midline was displaced 1.21 cm anteriorly to the midbrain and infiltrated the left cerebellar peduncle, causing left cerebellum tonsillar herniation and narrowing the fourth ventricle. The narrow fourth ventricle resulted in ventricle obstruction (Fig. 1).

Restricted area image with ADC value of 787 × 10^6 mm^2/s was found on DWI-ADC and blooming artifact was found on SWI (Fig. 2). Post-contrast scanning showed inhomogeneous minimal enhancement lesion (Figs. 3a and b). The lesion also affected other region in the brain; the third ventricle was found to be enlarged with transependymal edema, thus sella tursica and juxtasella was compressed by the third ventricle. VP shunt placement was conducted to treat the hydrocephalus due to ventricle obstruction. During the procedure, tumor biopsy was also conducted to confirm the diagnosis. A 12.8-g mass was extracted and sent for pathology evaluation. The mass was consisted of oval, hyperplastic, solidifying cells with round nucleus and some prenuclear halo. Branching capillary was found within the connective tissue stroma. Rosette or perivascular psudorosette was not found indicating oligodendroglioma (WHO grade II).

After the surgery, patient was scheduled for a 26 times radiotherapy regiment. Four months after completing the radiotherapy regiment, the patient underwent follow-up MRI. The MRI revealed marked reduction of tumor volume after radiotherapy. The residual lesions were well-defined, irregular edges measuring 4.41 × 4.98 × 4.41 cm which appeared to originate from the vermis of the cerebellum compressing the right cerebellum. The lesion also gave pressure to the pons and midbrain anteriorly. On T1WI and T2WI, the lesion showed an inhomogeneous isointense signal intensity (Figs. 4a-c) and on T2 FLAIR, it showed a hyperintense signal.

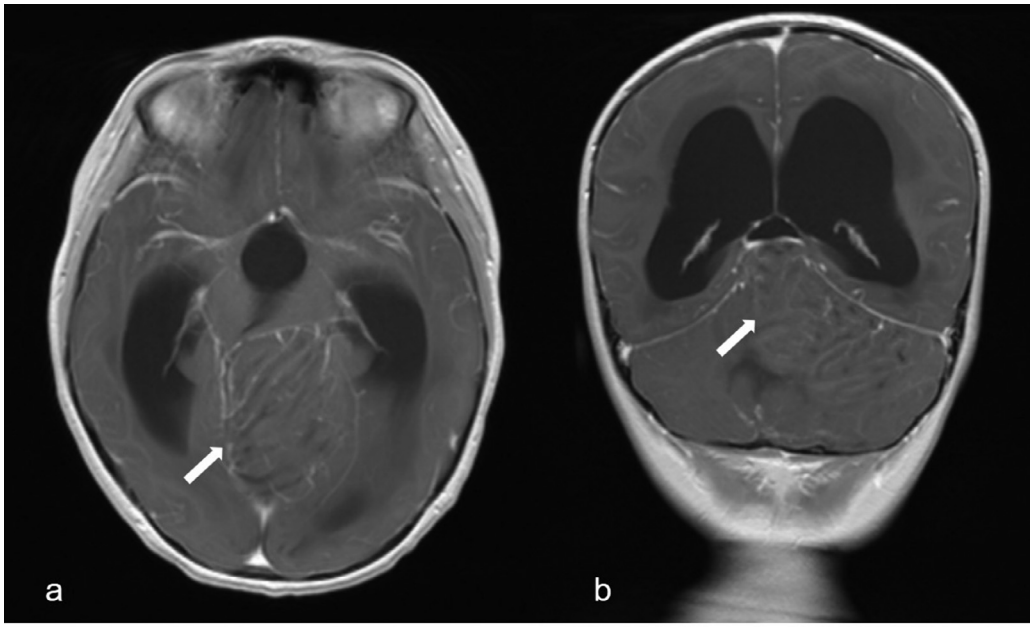

Fig. 3 – (a) (T1W1 contrast axial) and (b) (T1W1 contrast coronal) were post-contrast scanning showing inhomogeneous minimal enhancement lesion (white arrow).

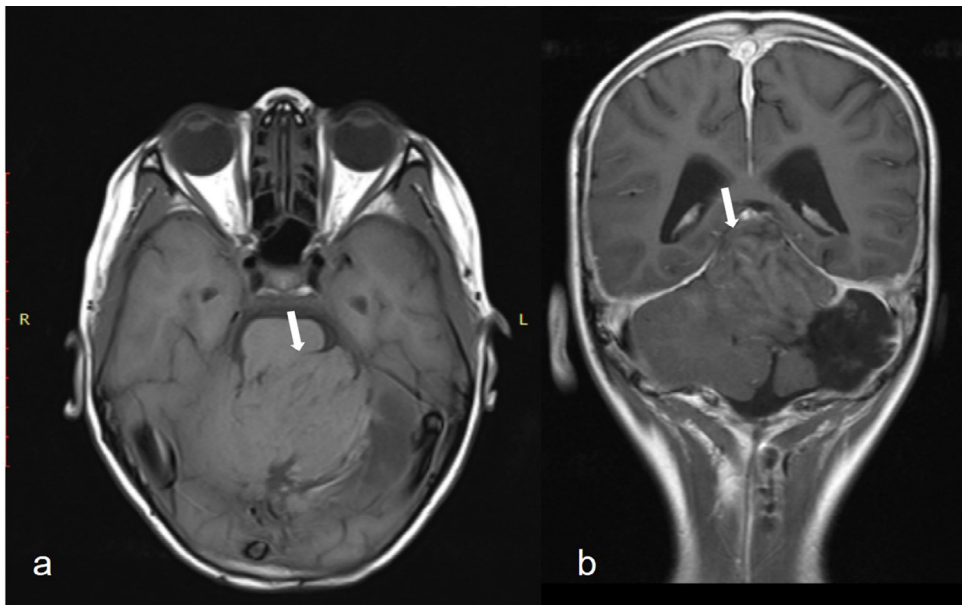

Fig. 4 – (a) (T1W1 axial) and (b) (T1W1 coronal showed an inhomogeneous isointense signal intensity (white arrow).

The lesion showed isointense signals with slightly inhomogeneous hyperintense, with a few restricted area in DWI-ADC (Figs. 5a and b), forming a "blooming artifacts" on SWI (Fig. 5c). The post-contrast provides minimal enhancement (Fig. 6). When compared with the previous head MRI, the size of the lesion appeared to be smaller. After she finished the radiation regiment, she felt no symptom and physical examinations were within normal limit. The patient was considered as good responder to radiotherapy and further treatment was not given.

Discussion

OGs are found predominantly in the cerebral hemisphere' white matter (80%-90% supratentorial), most commonly in the frontal lobes, but temporal and parietal lobe involvement is not uncommon. However, in pediatric population, these tumors arise in locations that are unusual for adult OGs, that is, brainstem, pineal region, cerebellum, or spinal cord [4]. In children, only 22% of tumors originate in the frontal lobe,

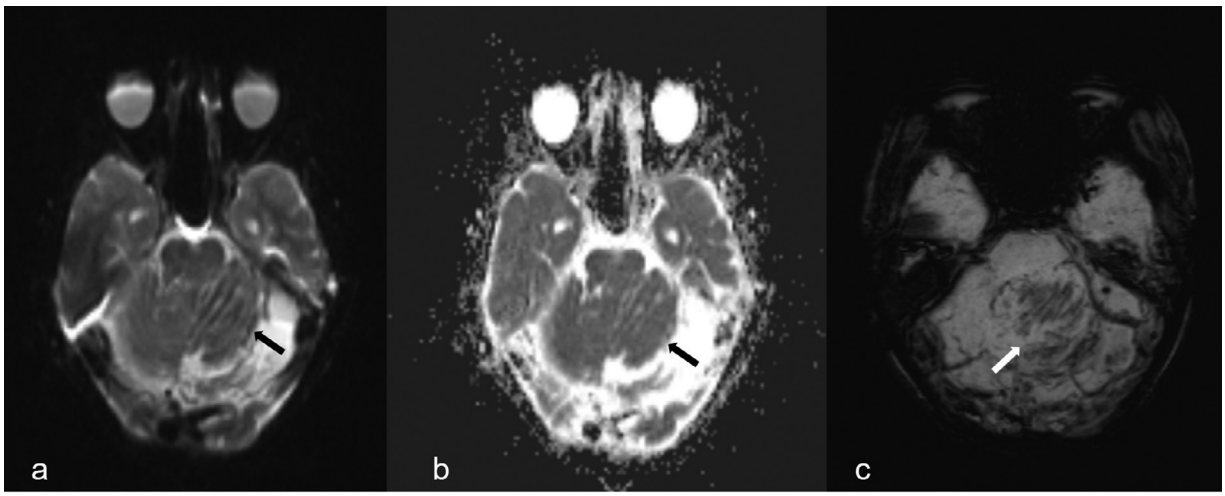

Fig. 5 – (a) (DWI) and (b) (ADC) showed isointense signals with slightly inhomogeneous hyperintense, with a few restricted area in DWI-ADC (black arrow), forming a "blooming artifacts" (white arrow) on (c) (SWI).

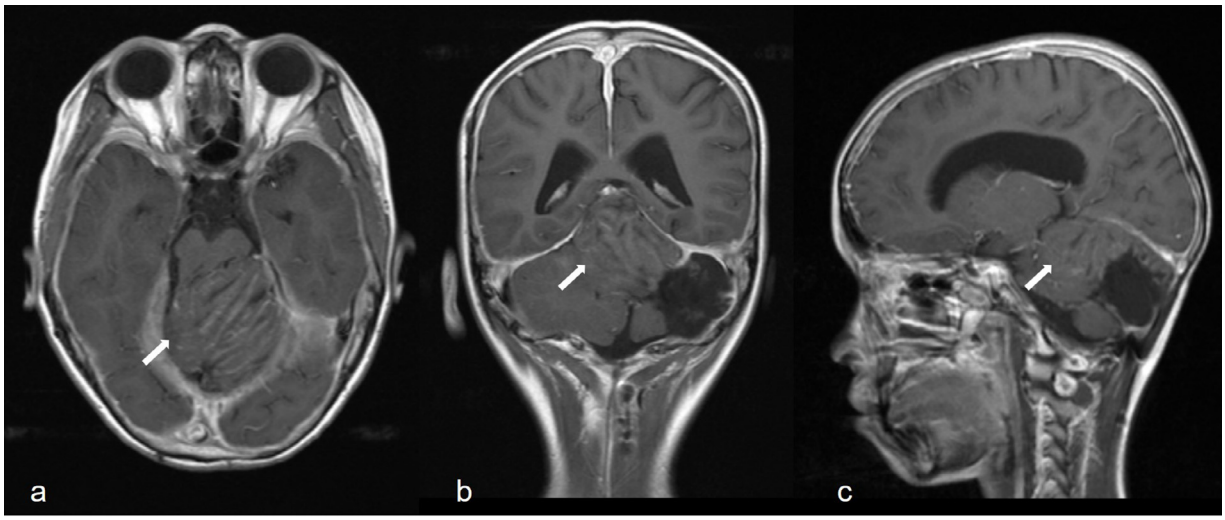

Fig. 6 – (a) (Post-contrast axial), (b) (post-contrast coronal), and (c) (post-contrast sagittal) showed minimal enhancement (white arrow).

whereas the temporal lobe (32 vs 18% in adults) and extracortical regions of the cerebrum (19 vs 5% in adults) are much more common locations of tumor origin. The standard of care for pediatric OG includes surgical resection, radiation, and a regimen of chemotherapy that differs across institutions and clinical trials. Because of its locally aggressive nature, oligodendroglioma is rarely cured by standard therapy and lengthy clinical course [5]. Only 45% of pediatric tumors were >3 cm in size at the time of diagnosis compared with 76% of adult tumors, while in this case, the size was relatively bigger (6.7 × 7.3 × 7.4 cm).

Smits et al. described MRI characteristic of oligodendroglioma in adult. Small oligodendroglioma may not be visible on CT, and MRI is superior to CT in delineating the tumor. Signal intensity on MRI is generally lower than that of the gray matter on T1-weighted sequences. On T2-weighted imaging, the tumor is hyperintense with commonly marked heterogeneity. Cystic degeneration and hemorrhage may occur, but these are not frequent findings. Peritumoral edema is also not common. After intravenous contrast administration, oligodendroglioma generally do not enhance. Minimal to moderate patchy, multifocal enhancement with a dot-like or lacy pattern is, however, reported in up to 50% of cases. This distinguishes oligodendroglioma from other low-grade gliomas that do not enhance and has been suggested to be more common in mixed oligoastrocytoma than in oligodendroglioma. Care needs to be taken, however, not to falsely diagnose contrast enhancement on MRI, as spontaneous hyperintensity on T1-weighted may be present in the context of calcification or hemorrhage. The non-enhanced T1-weighted images therefore need to be carefully scrutinized before contrast enhancement can be determined with certainty. Although anaplastic tumors tend to enhance somewhat more frequently, the presence of contrast enhancement is not a reliable imaging feature

to grade oligodendroglioma. In one study, the presence of contrast enhancement only had 63% sensitivity and 50% specificity to differentiate high- from low-grade tumors [3]. In this patient, we found a mass with isointense-inhomogeneous signal on T1W1 and isointense with some region of hyperintense inhomogeneous on T2W1 and T2Flair. Post-contrast scanning showed inhomogeneous minimal enhancement.

Study by Rodriguez et al. evaluated oligodendroglioma in 50 children and found that most tumors appeared infiltrative but circumscribed, some cystic or cyst-like with T1 hypointensity and T2/FLAIR hyperintensity (4 cases), and several showed small central cystic areas. Not infrequently there was evidence of remodeling of adjacent calvarium. In the majority of cases (13/18), the tumor was predominantly cortically based and showed both gray and white matter involvement with mild parenchymal expansion; in 2 cases only, subcortical white matter was involved and in 1 only gray matter. Associated mass effect was most often minimal to mild, occasionally with mild adjacent vasogenic edema. In 3 cases calcification was present within the tumor (1 evident on computed tomography and 2 evident on MRI). Eight of 17 cases showed gadolinium contrast enhancement: 4/11 of grade II oligodendrogliomas showed enhancement, typically mild or minimal, compared with 4/5 grade III tumors showing enhancement, ranging from punctate, rim, to heterogeneous, solid, and intense enhancement [4]. While in this case, the mass was shown as isointense-inhomogeneous signal on T1W1 and isointense with some region of hyperintense inhomogeneous on T2W1 and T2Flair.

In this case, restricted area image with ADC value of 787×10^6 mm^2/s was found on DWI-ADC and blooming artifact was found on SWI. DWI measures and quantifies the diffusion of water molecules, or Brownian motion, in tissue. Barriers such as cell membranes, with which the water molecules collide, hinder diffusion. Compared with the normal free diffusion, a lower apparent diffusion coefficient (ADC) is measured in tissue. The ADC increases with tissue damage and with the presence of increased extracellular fluid, such as in vasogenic edema. Conversely, the ADC is decreased (often called “diffusion restriction”) with reduction of the extracellular space. In the context of brain tumor imaging, tortuosity of the interstitial space is presumed to underlie the inverse relationship of ADC with cellular density. Diffusion restriction is typically absent in oligodendroglioma. Although average ADC values are reported to be lower in high-grade than in low-grade glioma, overlap of values is such that DWI cannot reliably distinguish oligodendroglioma from anaplastic oligodendroglioma. This is at least in part due to the fact that in high-grade tumor vasogenic edema and necrosis, both resulting in high ADC, and vital tumor, with high cellularity and thus lower ADC, coexist [3].

In this case, after patient was operated and received 26 times radiotherapy regiment, the size of the tumor was decreased by approximately one third of the initial size. Study by Goel et al. mentioned that patterns of treatment were found to differ significantly among pediatric and adult patients. Pediatric patients were much less likely to receive radiotherapy than adults (21 vs 51%) but more likely to undergo gross total resection of their tumor—as opposed to partial tumor resection or no surgery—compared with adults (50 vs 36%). In the pediatric, the 5-year survival rate was 85%, and the 10-year survival rate was 81%. For adults, the mean overall survival was 129.5 ± 1.4 months, the 5-year survival rate was 67%, and the 10-year survival rate was 51% [5]. Among pediatric patients, tumor size was a strong prognostic factor. Patients with tumors >3 cm fared significantly worse and were especially prone to death within 5 years of diagnosis. In contrast, in adult patients, tumor size showed no association with survival within the first 5 years, but did influence survival at 10 and 20 years after diagnosis. Although there exists no clear standard chemotherapeutic regimen in oligodendroglioma, these tumors are generally found to be much more sensitive to chemotherapy than most other primary brain tumors. Chemotherapy is thus an important part of oligodendroglioma treatment and potentially drives some differences in outcomes among oligodendroglioma cases [5].

Conclusion

Oligodendrogliomas are commonly occur in cerebral hemisphere in adult, however, in pediatric population location may vary including the cerebellum, midbrain, and spinal cord. Tumor size > 3 cm is associated with poorer prognosis. In this case the patient had pediatric oligodendroglioma with minimal residual mass after 26 times radiotherapy regiment. Further treatment and follow up is required to ensure complete remission of the tumor.

Research support

This case received no external financial or non-financial support.

Relationship

There are no additional relationships to disclose.

Patents and intellectual property

There are no patents to disclose.

Other activities

There are no additional activities to disclose.

Patient consent

The patient has seen a version of the manuscript to be submitted/published (including any pictures) and she gave her consent for her image or other information relating to her to be

reported in the above named manuscript for consideration of publication in the *Radiology Case Report*.

The patient understands that protected health information such as identification number, billing information, address, will not be published and that efforts will be made to conceal her identity, however. Images, including distinctive body markings and/or diagnostic images, may be published.

The patient understands that the material may be published in the *Radiology Case Report* Journal. As a result, she understands that the material may be seen by the general public. She understands that she may revoke consent at any time before publication, but once the information has been published revocation of the consent is no longer possible.

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