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## Neuroradiology

# Pineal gliosarcoma in a 5-year-old girl

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### ABSTRACT

The purpose of this paper is to report a rare case of a pediatric pineal gliosarcoma. Gliomas on the pineal region are uncommon, representing 0.4%-1% of all brain tumors. Furthermore, pediatric gliosarcomas are a very rare entity. We present a case of a 5-year-old girl, with a history of headache, vomiting, diplopia, and gait disturbances. A pineal tumor was found with pathology results consistent with a gliosarcoma. A total of 25 cases of pediatric gliosarcomas have been reported, none of them in pineal topography. Only 3 gliosarcomas were found in the pineal region, but these were found in adults. To our knowledge, this is the first pediatric pineal gliosarcoma reported in the literature.

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## Introduction

The pineal region is limited superiorly by the corpus callosum and choroid plexus of the third ventricle; anteriorly by the third ventricle; inferiorly by the quadrigeminal plate and cerebellum; and laterally by the thalamus and cerebral hemispheres. Pineal tumors represent 0.4%-1% of all cerebral tumors, and germinal cell tumors are the most frequent type of neoplasm in this topography, accounting for 50%-75% of overall cases; gliomas are very rare in this area [1–3].

The gliosarcomas are a sarcomatous variant of glioblastomas, accounting for 1.8%-2.8% of all cases of high-grade glioma, with predominance in the fifth and sixth decades of life. A literature review by Mallick et al. found a total of 25 reported cases of nonpineal pediatric gliosarcoma [4].

We present a case of a 5-year-old girl with a history of headache, vomiting, diplopia, and gait disturbances. A pineal tumor was found with pathology results consistent with a gliosarcoma.

## Case report

A 5-year-old girl was transferred to our institution with a history of 2 weeks of severe headache that woke her up during the night, associated with several episodes of vomiting, double vision, left gaze deviation, and gait disturbances. During the physical examination, she was alert, with 15/15 Glasgow scale, mydriatic 4-mm hyporeactive pupils, and with III and IV cranial nerves paralysis found and funduscopy that revealed papilledema.

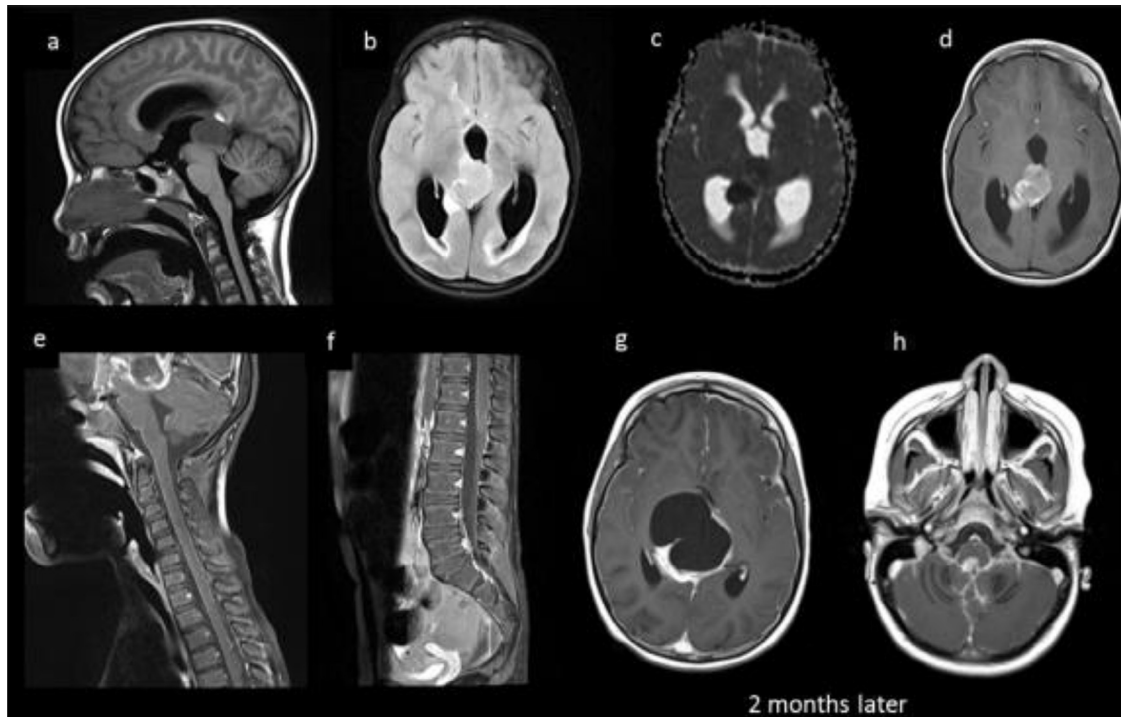
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**Fig. 1** – Brain MRI sagittal T1 weighted image (A), axial FLAIR image (B), axial DWI (C), axial T1 contrast-enhanced image (D), cervical sagittal T1 contrast-enhanced image (E), lumbar sagittal T1 contrast-enhanced image (F), and brain MRI axial T1 contrast-enhanced image (G and H). Brain MRI revealed a mass type lesion in the topography of pineal gland, hypointense on T1, restricted on DWI, and with heterogenous contrast enhancing. Cervical and lumbar MRI showed diffuse meningeal and filum terminale roots enhancement. Two months later, a brain MRI revealed an increase in the cystic component and a nodular lesion in the medulla. DWI, diffusion-weighted imaging; FLAIR, fluid-attenuated inversion recovery; MRI, magnetic resonance imaging.

A computed tomography (CT) scan showed a mass lesion in the pineal gland region, causing hydrocephalus and mesencephalic compression. Subsequently, a brain magnetic resonance imaging (MRI) demonstrated a mass lesion was found, hypointense on T1, hyperintense on T2 with strongly heterogeneous contrast enhancing. Associated with these findings, ventricular system dilatation and transependymal edema were also observed. A diagnosis of germinal cell tumor, followed by pineal parenchymal or glial cell tumor, was suspected (Fig. 1). An endoscopy biopsy through the third ventricle and external ventricular drain was made. Histopathologic results showed a high-grade glial cell lesion, immunohistochemistry revealed vimentin positive cells, Glial Fibrillary Acidic Protein positive, and KI67 of 90%, consistent with grade IV gliosarcoma.

The patient presented with an episode of acute elevated intracranial pressure with altered mental status and mydriasis with slow pupillary response despite a ventriculostomy. A follow-up CT scan revealed a bleeding mass in the pineal region with ventricular system dissemination and an increase in the residual tumor size. Based on this, an intratumoral mass resection with Sonoca ultrasonic aspirator via frontoparietal craniotomy with an anterior trans-splenic interhemispheric approach and a ventriculoperitoneal shunt was performed.

After this surgical approach, the patient improved her clinical status and an oncological evaluation was performed. Further assessment included a bone gammagraphy and follow-up brain and spine MRI; at this point no metastases were found. An im-

planted port was inserted to initiate chemotherapy along with adjuvant therapy with temozolomide and radiotherapy.

Two months later, neurologic symptoms such as nystagmus, hemiparesis, gait disturbance, tremor, and myoclonic type seizures persisted. A brain CT scan showed increased tumor size with ventricular system bleeding. A spine MRI was also taken, and meningeal enhancement of filum terminale roots was found, and metastatic dissemination was suspected. All these findings were taken into consideration for the therapeutic plan. Therefore, surgical resection was ruled out. Because of poor therapeutic response and prognosis, the oncology group decided to discontinue chemotherapy with concomitant radiotherapy and to start palliative management of symptoms.

## Discussion

Pineal tumors are infrequent and correspond to 0.4%-1% of all cases of intracranial tumors [1,2], a diverse group of tumor types that originates from the pineal gland [3]. Germinal cell tumors are the most frequent type of pineal tumor; gliomas are very rare in this area [3]. During childhood, pineal tumors are more common, corresponding to 3%-11% of all pediatric central nervous system tumors. However, only 25 cases of pediatric nonpineal gliosarcoma had been reported, none of them in pineal topography [4,5].

In some instances, the diagnostic approach of tumoral lesions is not straightforward. Germ cell tumors, pineal parenchymal neoplasm, and glial neoplasm have no pathognomonic imaging findings; however, some characteristics, in combination with clinical and laboratory assessments, help to narrow the differential diagnosis.

High-grade gliomas, such as gliosarcoma, present with adjacent tissue invasion, mass effect, and bleeding. High-grade gliomas generate pineal apoplexy, Parinaud syndrome, and Sylvian aqueduct obstruction, causing secondary hydrocephalus. Pineocytoma is a benign type of pineal parenchymal neoplasm that was ruled out because of imaging inconsistencies. The pineocytoma imaging features are characterized by a homogeneous contrast-enhancing lesion, with a cystic component. Pineoblastoma is a grade IV type of tumor, which is very difficult to distinguish from a glial cell malignant tumor. Therefore, pathology diagnosis is required to dismiss this type

of neoplasm. Pineal parenchymal tumors of intermediate differentiation share similar histologic characteristics with pineocytoma and pineoblastoma. In addition, no specific MRI findings distinguish pineal parenchymal tumors of intermediate differentiation from pineocytoma and pineoblastoma [6]. All these types of tumors had similar imaging findings, and it is not possible to determine the class of tumor only by MRI. Therefore, the diagnoses must be histologic, to initiate early and specific treatment.

Regarding the symptoms in patients with pineal tumors, the most frequent are the ocular movement disturbances, headaches, nausea, and vomiting [5]. Secondary to these is the compression of adjacent structures, including ventricular system, producing hydrocephalus. The current case referred had similar symptoms, and hydrocephalus was confirmed by a CT scan. The presence of these symptoms must suggest a pineal mass lesion.

**Table 1 – Comparison of reported pineal gliosarcoma cases**

Reference and year	Age/sex	Symptoms	Imaging	Treatment	Outcome	Survival time
Banczerowski et al. 2012 [9]	35/M	Headache and diplopia	MRI showed in T1 a hyperintense mass after contrast administration in the region of corpus pineale.	Radiotherapy 50 Gy and 2 cycles of TMZ	Residual tumor with left cerebellar metastasis was found 3 mo later	6 mo
Sugita et al. 2016 [8]	52/F	Headache	MRI showed a mass lesion in the pineal region was isointense on T1, hyperintense to normal on T2, and became well-enhanced after the administration of contrast.	Third ventriculostomy and biopsy TMZ at a dose of 75 mg/m <sup>2</sup> /day concomitant with a dose of 60 Gy of radiation therapy in 30 fractions	Recurrence at 12 mo; partial removal of the tumor was accomplished and 2 courses of ifosfamide, cisplatin, and etoposide chemotherapy and 20 Gy of radiation were given	24 mo
Sugita et al. 2016 [8]	18/M	Headache and memory loss	MRI showed an enhanced mass lesion in the pineal region with contrast that was obstructing the CSF pathway.	A ventricular drainage and partial removal of the tumor were performed. The patient was treated with TMZ at a dose of 75 mg/m <sup>2</sup> /day concomitant with a dose of 60 Gy of radiation therapy in 30 fractions.	Patient complained of quadriplegia 7 mo after the operation, and MRI revealed dissemination of the tumor in the pons and thoracic spinal cord.	13 mo
Granados et al. 2017 (this issue)	5/F	Headache, vomiting, gait, and visual disturbances	MRI showed a mass lesion, hypointense in T1, hyperintense in T2 with heterogeneous enhancement after contrast administration located in the pineal region. Spinal MRI showed meningeal enhancement in filum terminal roots, suggesting spinal cord dissemination.	Endoscopic biopsy through the third ventricle was done. Radiotherapy and chemotherapy with TMZ were indicated.	Patient presented new neurologic abnormalities 2 mo later. A brain MRI revealed an increase in the cystic component and a nodular lesion in the medulla. Palliative care was initiated.	3 mo—patient is currently alive

CSF, cerebrospinal fluid; Gy, gray; MRI, magnetic resonance imaging; TMZ, temozolomide.

Gliosarcoma is a glioblastoma variant, with sarcomatous and glial components [7]. Sugita et al. performed a literature review in 2016, searching for reported cases of pineal gliosarcoma; they found 1 case, and they reported 2 additional cases [8,9]. Therefore, including the current case, a total of 4 cases had been reported. A comparison was made, including clinical, imaging, pathology, and therapeutic and outcome data (Table 1). The imaging findings in these cases were similar and consistent with a glial cell tumor. The hallmarks were a mass type lesion, hypointense or isointense on T1 images secondary to necrosis, and hyperintense on T2 with heterogeneous enhancement after contrast administration [1]. Also, edema and tumor infiltration were common. The presence of these features must be taken into account in the differential diagnosis and suggest a glial cell tumor.

Additionally, metastatic dissemination was found on 3 cases, 1 of them on the cerebellum and the other 2 in the spinal cord. Gliosarcoma metastasis is more common than glioblastoma metastasis, usually affects the spinal cord, lung, pleura, bone marrow, and liver [10].

The treatment plan in the 3 cases was chemotherapy with concomitant radiotherapy; 1 case received only radiotherapy. Temozolomide was used as the chemotherapy agent. The case who received only radiotherapy had a shorter survival time. Chemoradiotherapy is the treatment of choice in this type of tumor; however, despite the use of multimodal therapies, survival continues to be poor.

In general, the survival time for high-grade glial tumors is very low; 12 months is the median survival time for glioblastoma [2,3]. The leading cause of mortality for this type of patients seems to be related to invasion of thalamus, mid-brain, as well as leptomeningeal and ventricular dissemination [1]. Poor prognosis is expected in this case, due to spinal roots and leptomeningeal spread.

To conclude, gliosarcomas are sporadic and aggressive tumors that are associated with a poor survival time. In addition, to our knowledge, only 4 cases of pineal gliosarcoma had been reported.

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