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Case Report

Giant intracranial congenital hemangiopericytoma/solitary fibrous tumor: A case report and literature review

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ABSTRACT

Background: Hemangiopericytoma and solitary fibrous tumor (HPC/SFT) are considered to be one category according to the WHO 2016 classification of central nervous system tumors. HPC/SFT are subdivided into infantile (congenital) and adult type. Both are extremely rare entities, with little knowledge about etiology, prognosis, and optimal therapeutic strategy.

Case Description: A 10-day-old girl was referred to our neurosurgical department due to hypotonia, palsy of the right oculomotor nerve, and prominent frontal fontanel. Imaging studies revealed a large occupying mass in the right middle cerebral fossa and the suprasellar cisterns. Only a subtotal resection of the tumor was possible, and postoperatively, she underwent chemotherapy (CHx). After a 3-year follow-up, the girl has minimum neurologic signs and receives no medications, and she can walk when she is supported.

Conclusion: Congenital HPC/SFT is considered to have a benign behavior with a good prognosis. Treatment with gross total resection, when it is feasible, is the key to a good prognosis and low rates of recurrence. However, there is no consensus on the therapeutic strategy of a HPC/SFT, which is difficult to be completely resected. Literature lacks a therapeutic algorithm for these tumors, and thus, more clinical studies are needed to reach a consensus.

Keywords: Congenital, hemangiopericytoma, intracranial, solitary fibrous tumor

INTRODUCTION

It is known that congenital brain tumors are very rare with an incidence of 1.1–3.6/100,000 newborns.[13,14,19,24,38] They make up 0.5%–1.5% of brain tumors that are diagnosed during infancy.[20] These neoplasms consist of teratomas, which are the most commonly found medulloblastomas, astrocytomas, choroid plexus papillomas, ependymomas, and hemangiopericytoma (HPC).[24] The latter is subcategorized to the adult type and the infantile (congenital) form, which is very rare, and only a few cases have been reported in the literature.[1,11,12,17,23,35] It usually has more benign characteristics than that of adults,[9] more often is highly responsive to CHx and has a better prognosis.[2,10] The latest WHO Classification of Tumors of the Central

Nervous System (CNS) considers HPC a member of a group of lesions designated with the combined term hemangiopericytoma/solitary fibrous tumor (HPC/SFT),[4,21] which are usually located on brain surface. We present a case of an infantile anaplastic HPC/SFT.

CASE REPORT

A 10-day-old girl was referred to our neurosurgical department from the neonatal intensive care unit where it was being treated since her 3rd day after birth due to jaundice. She presented with hypotonia, palsy of the right oculomotor nerve, and prominent frontal fontanel; a cerebral ultrasound and subsequently a computed tomography (CT) scan were performed and revealed a large hyperdense space-occupying mass in the right middle cerebral fossa and the suprasellar cisterns. Magnetic resonance imaging (MRI) demonstrated a tumor with marked inhomogeneous enhancement, with mixed cystic and solid components with dimensions of 6.7 cm × 6.2 cm × 6.1 cm [Figure 1]. The tumor was occupying the right anterior frontal and medial cranial fossa along the entire right temporal lobe, extending to the frontal and parietal lobes, crossing the midline, infiltrating the cavernous sinuses bilaterally, and compressing the brain stem. Microsurgical resection of the tumor was performed on the 10th day of her life through a right temporal craniotomy. Only a subtotal resection of the tumor was possible due to the size and the position of the tumor, the age of the patient, and the hemorrhagic tendency of the tissues involved. Histology report of the tumor revealed heterogeneous cellular density with cellular heterogeneity and regions with high mitotic activity 12–40/10HPF×40 (WHO Grade III) as well as regions with ischemic and apoptotic necrosis. The tumor was in continuity with the meninges with perivascular growth of neoplastic cells without neoplastic emboli. Gomori staining revealed HPC growth pattern. Molecular analysis by reverse transcription-polymerase chain reaction for hybrid gene ETS variant 6/neurotrophic tyrosine kinase, receptor, type 3 t(12;15)(p13;q25) was negative. In the immediate postoperative period, the baby presented with an increased tone of the left upper limp and nonreactive pupil. In the late postoperative period, she had an increase in her head circumference and a bulging frontal fontanel. A CT was performed, which revealed obstructive hydrocephalus [Figure 2]. A ventriculoperitoneal shunt was inserted. In the immediate postoperative period, she presented with an improvement in the muscle tone of the upper limbs. Afterward, the child was referred to the oncology department and underwent CHx according to CWS guidance (version 1.5 from July 01, 2009) and received twelve cycles of Vincristine, Actinomycin D, and Cyclophosphamide, without any complications. Postoperative MRI scan after completion of CHx revealed regression of tumor to 3.5 cm × 3.5 cm × 3.8 cm [Figure 3]. After a 3-year follow-up, the girl has no muscle weakness, normal tendon reflexes, and no Babinski sign. However, she continues to have a third nerve palsy. She crawls and can walk when she is supported, she can eat by herself, and she receives no antiepileptic treatment.

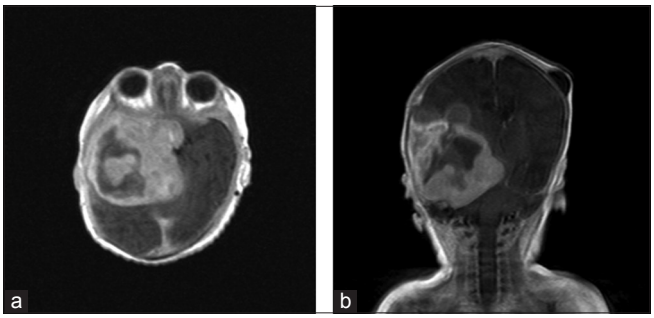

Figure 1: (a and b) Hemangiopericytoma and solitary fibrous tumor (HPC/SFT) in a 10-day-old girl. Left: Magnetic resonance imaging (MRI) axial postcontrast T1-weighted image of HPC/SFT, Right: MRI coronal of HPC/SFT. Postcontrast T1-weighted image.

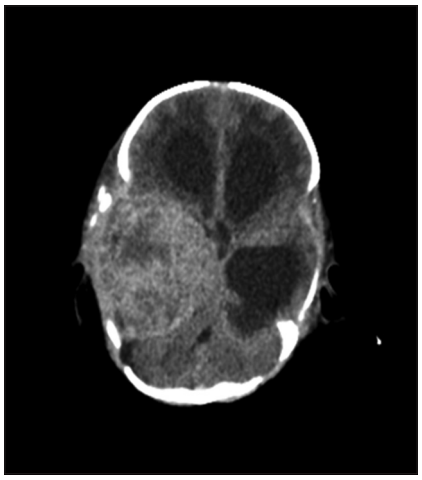

Figure 2: Postoperative computed tomography scan with obstructive hydrocephalus after subtotal resection.

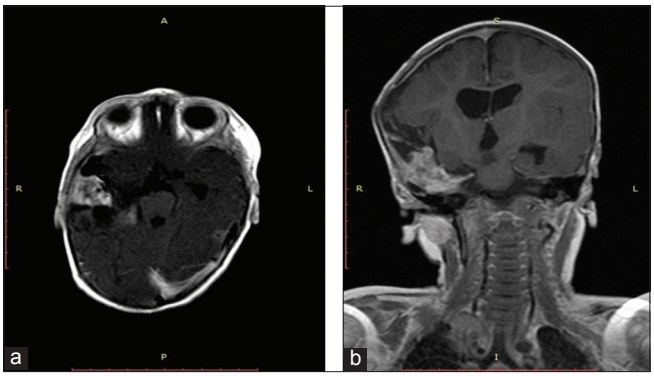

Figure 3: (a and b) Postoperative magnetic resonance imaging postcontrast T1-weighted image axial (left) and coronal (right) after completion of chemotherapy.

DISCUSSION

The incidence of congenital tumors is 0.34 per one million births, and infantile HPCs are extremely rare with an incidence of <1% of all CNS tumors.[29] Literature currently reports

Table 1: Summarized congenital HPC at age of intervention. Sex, size pathology, complications, and follow-up are recorded.

Authors	Age	Sex	Localization	Size/volume	Pathology	Treatment	Complications	Follow-up
Our case	10 days old	F	Right middle cerebral fossa and the suprasellar cisterns	6.7×6.2×6.1 cm	High mitotic activity, CD34 (+), SMA (+), WT-1 (+), Factor XIIIa (+), Cytokeratin 8.18 (+), no expression of CD31, ERG, Glut-1, Desmin S-100, GFAP, Synaptophysin Neurofilaments 2F11 and CD99/MIC-2, Ki-67/ MIB-1 15-30%	STR	Obstructive hydrocephalus	3-year follow-up residual right eye findings, difficulty in walking
Aouad *et al.*[1]	5 days old	M	Supratentorial	200 g	Strong cytoplasmic staining/absence of nuclear staining. EMA (−), GFAP (−), S 100 Protein (−), NSE (−).	GTR	None	Uneventful at 5 months
Cavalheiro *et al.*[5]	6 h old	M	Supratentorial	N/A	MIB-1 (7%), epithelial membrane antigen (−) and CD34 (+)	GTR	None	Uneventful at 2 years
Blank *et al.*[3]	9 months old	F	Anterior portion of the middle fossa	4-cm diameter	Proliferation of round-, oval-, or spindle-shaped cells of rather uniform size, surrounded by reticulin fibrils and arranged around blood vessels lined by a single layer of endothelial cells	STR	Mild hydrocephalus	Slowed mentality and mild right spastic hemiparesis, recurrence at 20 months.
Herzog *et al.*[11]	(1) 1 month old, (2) 14 days old	(1) M, (2) M	(1) Right parasagittal tumor, (2) anterior left temporal fossa	N/A	(1) Highly cellular proliferation/closely surrounding thin-walled capillaries. Mitotic activity. Foci of necrosis were seen with markedly enlarged and pleomorphic nuclei. (2) extensive tumor necrosis. Vimentin (+), Ag factor-VIIl (+), EMA (−), GFAP. (−), S 100 Protein (−), MSA (−), neurofilament protein (−)	(1) GTR, (2) Partial resection	(1) Intracranial hemorrhage, (2) Intratumoral hemorrhage	(1) Uneventful at 5 years, (2) Residual left eye findings at 27 months
Peace *et al.*[26]	2 days old	M	Right cerebrum	N/A	No mitosis	None	N/A	Died 3 days
McHugH *et al.*[22]	2 months old	M	Left frontal extra-axial	2.8×2.2×3.0 cm	Highly vascularized, CD34 (+), MSA (+), SMA (+), CD31 (+) in vascular cells. CD45, CD99, EMA, GFAP, glut-1, keratin AE1/AE3, Mak-6, NSE, and S100 were negative.	GTR	None	Developmental delay at 28 months
Cole and Naul[6]	6 weeks old	M	Right parieto-occipital	5×2 cm	EMA (−), GFAP (−), keratin (−), reticulin (+), vimentin (+)	GTR	None	None at 1 month
Laviv *et al.*[18]	1 month old	N/A	Posterior fossa	6 cm diameter	Highly mitotic activity and extensive necrotic areas. CD34 and FV111 and vimentin (+). Ki-67 30-35%.	GTR	Obstructive hydrocephalus	None at 7 years
Voth *et al.*[37]	14 days old	M	Right temporo-parieto -occipital	4.9–7.1–8.5 cm	Capillary-rich parts of the tumor. Locally enlarged sinusoidal and reticularly connected with one another. Very dense tumor cells between the vessel lumens. The core-plasma-relation is shifted to the cores. High mitotic rate.	STR	Hemorrhage	Died in post-operative period

(*Contd...*)

Table 1: *(Continued)*

Authors	Age	Sex	Localization	Size/volume	Pathology	Treatment	Complications	Follow-up
Sobel *et al.*[31]	33 weeks old	M	Posterior fossa	9×8 cm	High mitotic rate/necrotic areas. GFAP (×), NSE (−), synaptophysin (−), S-100 (−), cytokeratins (AE1/AE3, CK7, 8, 19 and 20) (−), EMA (−), and desmin (−). Vimentin (+), CD34 (+), factor VIII-related antigen and CD31 stained the vessel endothelium only. Ki67 40–50%	Biopsy	Brainstem compression	Died on his 11th day of life.
Kerl *et al.*[16]	18 months	F	Occipitomedial in the left hemisphere	4×3 × 4 cm	Low mitotic activity and a Ki67/MIB1 proliferation index of 4%.	Open biopsy, Chemotherapy, GTR	Aplasia due to CHx. No neurosurgical complications	After the 5th course of CHx regression of the tumor GTR. Unremarkable course at 18 months and after 8 cycles of CHx.
Semerci *et al.*[30]	2 h old	F	Left frontoparietal	5.5×5.5×5 cm	High mitotic activity, necrosis, moderate nuclear atypia, high cellularity and hemorrhage. reticulin (+), SMA and FXIIIa (+). BCI-2 staining was weak and CD34 and S100 (−). Ki-67 40%. Vimentin (+), EMA (−), GFAP (−), pancytokeratin (−), NSE (−), synaptophysin (−), CD56 (−), HMB45 (−), inhibin (−).	GTR	Cardiac arrest due to prolonged seizures, pericardial effusion	Neurologically intact at 6 months. On phenytoin and phenobarbital
Wyler *et al.*[39]	3 months old	F	Left parieto-occipital mass	30 ml	Well-defined reticulin sheaths peripheral to the endothelial capillary walls and strands of reticulin branching to surround adjacent cells. Low mitotic activity. Leptomeningeal invasion	GTR and RTx with cobalt	None	Unremarkable at 14 months
Solitaire and Krigman[32]	32 weeks old	F	Right middle fossa	3.5×2 × 4 cm	Mixed HPC and meningeal fibroma	None	None	Died

HPC: Hemangiopericytoma, CHx: Chemotherapy, EMA: Epithelial membrane antigen, GFAP: Glial fibrillary acidic protein, GTR: Gross-total resection, MSA: Muscle-specific actin, N/A: Not available, NSE: Neuron-specific enolase, SMA: Smooth-muscle actin, STR: Subtotal resection, RTx: Radiotherapy

<20 cases[1,3,5,6,9,11,16,22,26,31,32,39] and differential diagnosis includes ependymoma, subependymoma, hemangioblastomas, fibrous tumors, or choroid plexus papilloma. Histological features place the diagnosis, where it should be stated that a cellular SFT is virtually indistinguishable from a HPC. For that reason, the two entities (HPC and SFT) are referred as one category in the latest CNS tumor classification of the WHO in 2016.[21]

In our case, the neoplasm shows morphological heterogeneity and is composed of cellular areas of the short bundles of spindle, stellate, and ovoid cells with eosinophilic cytoplasm and a round nucleus with fine chromatin without nucleolus and with mild-to-moderate nuclear atypia. A moderate-to-brisk mitotic activity of 12–40 mitoses/10 high-power fields (hpf) × 40 and 2–6 mitoses/hpf × 40 was recognized [Figure 4a and b]. Moreover, areas of moderate cellularity and areas composed of dissecting bundles of spindle cells with limited cytoplasm and limited mitotic activity along with wavy and storiform patterns are featuring. Furthermore, the focal myogenic morphology of the spindle cell bundles with focal nodular configuration and the presence of medium-sized veins with an epithelioid configuration of their wall must be delineated. Finally, spindle cells appeared to be either focal cleared or vacuolated, while epithelioid cells appeared with round morphology. Nevertheless, there was an extensive ischemic necrosis of up to 30% along with the presence of focal geographic apoptotic necrosis. Further immunohistochemical studies revealed that there was an expression of cytoplasmic/membranous cluster of differentiation (CD)34 in the stellate/spindle cells [Figure 4c]. A heterogeneous expression of smooth muscle actin was also seen in bundles of spindle cells and areas with myogenic differentiation [Figure 4d]. Diffuse expression of WT-1 protein along with heterogeneous expression of Factor XIIIa and focal expression of Cytokeratin 8.18 was also observed. However, there was no expression of CD31, erythroblast transformation-specific, human erythrocyte-type glucose transporter protein, Desmin S-100, glial fibrillary acidic protein, Synaptophysin Neurofilaments 2F11, and CD99/MIC-2. Proliferative index Ki-67/MIB-1 was detected in 15–30%, while INI-1/SMARCB1 expression was retained in >99% of the nuclei of the neoplastic cells. HPC/SFT share inversions at chromosome 12q13 and fused NAB2 and STAT6 genes. The latter fusion leads to the nuclear expression of STAT6 protein, which can be detected by immunohistochemistry. Considering mitotic activity, necrosis, and cellularity which are necessary criteria, our case was diagnosed with anaplastic HPC/SFT.

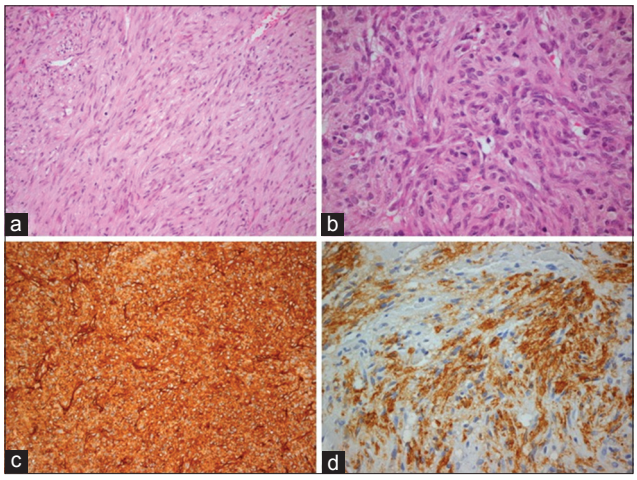

Figure 4: (a) Cellular areas of short bundles of spindle cells with an eosinophilic cytoplasm and a round nucleus with fine chromatin without nucleolus and with mild-to-moderate nuclear atypia. (b) Heterogeneous cellular density with cellular heterogeneity and obvious mitoses in a cellular area of the neoplasm. (c) Immunohistochemical expression of CD34 in the neoplastic cells mainly membranous and cytoplasmic. (d) A heterogeneous expression of smooth muscle actin in bundles of spindle cells.

In Table 1, sixteen cases of HPC/SFT are recorded. The oldest publication is in 1954 from Peace, and since then, only a few cases have been added. Moreover, since then, the pathology has evolved and now plays a critical role in diagnosing HPC. The mainstay of treatment of HPC/SFT is considered to be complete excision, whenever it is possible.[10,27] In cases where complete excision was feasible, there was no evidence of recurrence after a follow-up of 1 month–5 years.[1,5,6,11,16,39] In case a gross total resection (GTR) cannot be performed, some have undergone CHx given the fact that infantile HPC/SFT is chemoresponsive.[8,25,34,36] CHx has been introduced as either initial treatment, to offer a chance for a GTR, or as a therapy in case of recurrence or incomplete resection.[8,16] Regiments used include combinations of vincristine, etoposide, doxorubicin, cisplatin, methotrexate, cyclophosphamide, actinomycin-D, and ifosfamide.[10] Radiotherapy (RTx) is also an option for primary or adjuvant therapy of infantile HPC/SFT.[25,33,39] Nevertheless, the effectiveness of RTx has been questioned as well as the long-term safety of the radiation dose. A recent study has found that there is no statistical significance in prognosis between GTR alone and GTR with RTx.[28] Moreover, a radiation dose of >50 Gray (Gy) has not been related to a good prognosis in HPC/SFT RTx, in contrast to the radiation dose of ≤50 Gy.[7,15,25,28,33] In general, the prognosis of infantile HPC/SFT is considered to be favorable,[2,10,27] and literature reports a 5-year overall survival of 80% for patients <1 year and 10-year overall survival of 62% for older patients.[10]

CONCLUSIONS

Infantile HPC/SFT is considered to have a benign behavior with a good prognosis. Treatment with GTR is the key to a good prognosis and low rates of recurrence. Nevertheless, GTR is not always feasible. There is no consensus on the therapeutic strategy of a HPC/SFT, which is difficult to be completely resected. CHx before surgery has been proven useful, to make the tumor operable. Moreover, it has been successfully applied as an adjuvant therapy after surgery, or in case of recurrence. RTx has also been used in treating these tumors, but there have been studies that support its ineffectiveness. Literature lacks a therapeutic algorithm for

these tumors, and thus, more clinical studies are needed to reach a consensus. In our case, a subtotal resection was performed, which was postoperatively complicated with obstructive hydrocephalus. After a ventriculoperitoneal shunt operation, the patient received CHx.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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