

Intracranial hemangiopericytoma in a 15 year-old child: neuroimaging features and management therapy.

Abstract:

Intracranial hemangiopericytoma (HPR) is a highly vascular tumors which is exceptional in children. We report the case of a 15 year-old female presented with symptoms of increased intracranial pressure. Physical examination featured a frontal syndrome, a Broca's aphasia, a grade 3 papilledema and a decreased visual acuity in her left eye. Radiological investigation including cranial CT scan and MRI displayed a large dural-based heterogeneous hemorrhagic tumor of the left frontal convexity. The patient underwent a total-gross resection of an extra-parenchymal hemorrhagic tumor through a large frontal craniotomy with no postoperative complications. Pathologic examination of the specimen and immuno-histochemistry concluded to an anaplastic HPR. Postoperative radiotherapy was performed without incidents. A local recurrence was diagnosed four months postoperatively and remained stable after additional radiotherapy.

Key words: Hemangiopericytoma, child, surgery, radiotherapy, intracranial, MRI

Introduction:

Meningeal HPR is a highly cellular mesenchymal tumor which arises from pericytes and accounts for less than 1% of primary central nervous system tumors (1). Intracranial HPR is uncommon in children, only a few cases have been reported in the literature (2-8). This tumor has a more aggressive course than meningiomas with variable clinical behavior and prognosis, depending on patients' age (9). Management requires a multidisciplinary approach including surgery with often

24 preoperative embolisation and complementary chemotherapy or radiotherapy.
25 We present the case of an intracranial anaplastic HPR managed in our department
26 emphasizing on its radiological and anatomopathological features.

27 **Case presentation:**

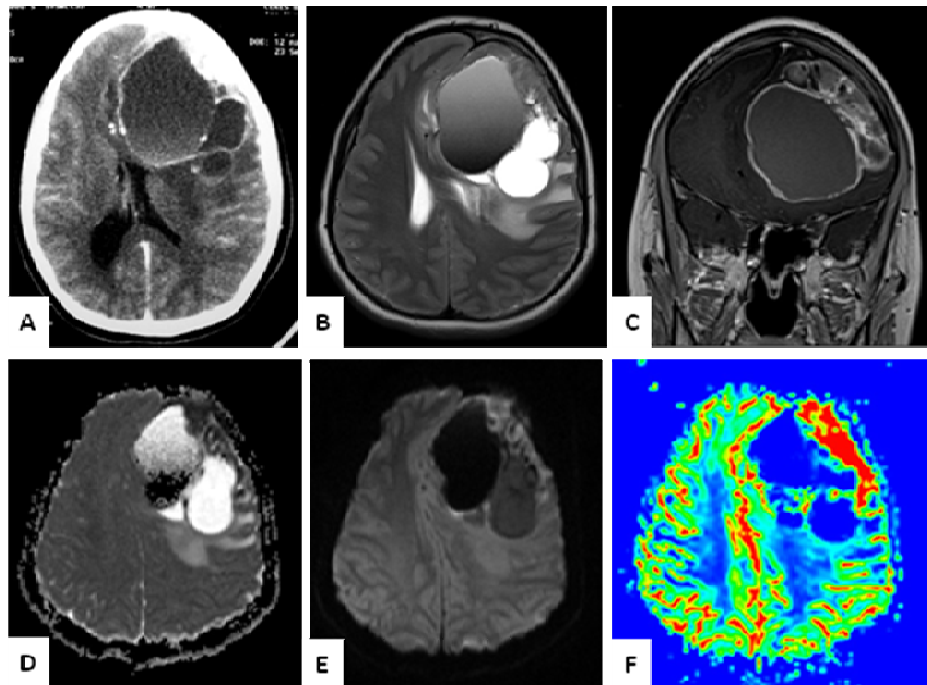
28 A 15 year-old female, without medical history, was referred with a 2-month history of
29 symptoms of increased intracranial pressure. Neurological examination featured a
30 conscious right handed patient who was apathetic with reduced verbal fluency, a
31 frontal syndrome, Broca's aphasia and right lively reflexes without motor deficit.
32 Ophthalmologic examination showed bilateral grade 3 papilledema and decreased
33 visual acuteness (5/10) in the left eye. No other abnormalities were present on
34 clinical examination.

35 Computerized tomography (CT) scan showed a large multicystic mass, which
36 measures 12 x 8 cm, with peripheral enhancement located in the left frontal
37 parasagittal convexity (figure n°1A). The mass showed mixed low and isoattenuation
38 with moderate surrounding edema. Notable mass effect was associated, with left-to-
39 right midline shift, subfalcine and uncal herniations

40 On Magnetic resonance image (MRI), the mass appeared heterogeneous on T1 and
41 T2 weighted-images (WI), with solid and cystic components. It showed a dural-base
42 on the left-frontal convexity. The largest cystic component appeared hyperintense on
43 T1-WI, hypointense on T2-WI in relation to hemorrhagic content. The solid
44 component presented a narrow-based dural attachment and a "dural tail" sign. It
45 appeared isointense to grey matter on T1 and T2-WI, enhanced markedly and
46 heterogeneously after gadolinium administration and contained multiple signal
47 intensity flow voids (figures n°1B & 1C).

48 On diffusion-WI, the solid portion appeared hyperintense with a corresponding
49 hypointensity on the ADC map; diffusion was restricted compared to normal white
50 matter (figures n°1D & E).

51 Perfusion-WI showed a fivefold increase in relative regional cerebral blood volume in
52 the solid component (figure n°1F). MR spectroscopic imaging was not performed
53 because of the presence of the large hemorrhagic component.

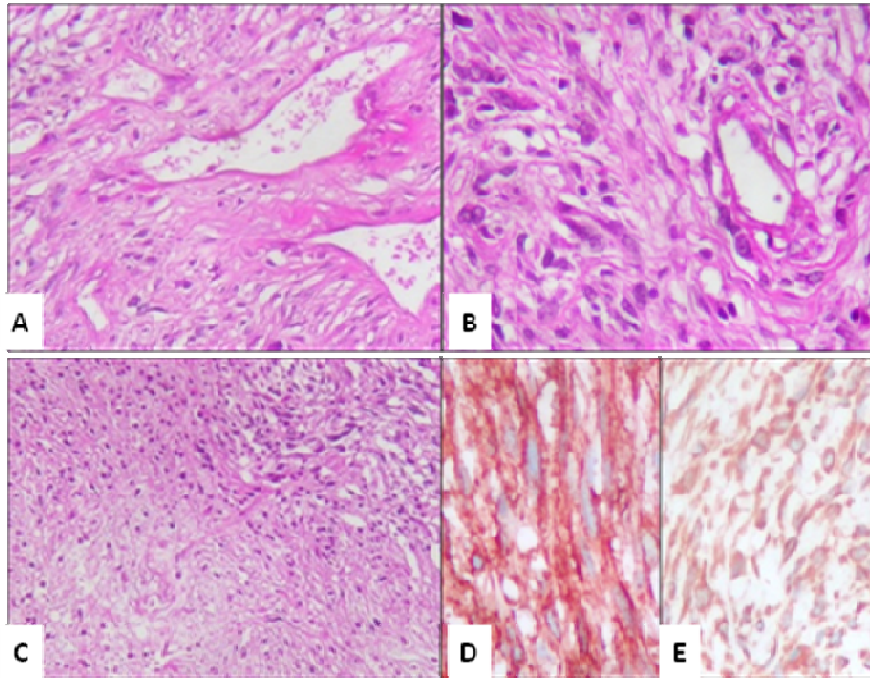


55 Figure 1: A, cranial axial computed tomography with contrast enhancement shows a a left frontal large
56 multicystic mass with peripheral enhancement. B, A, axial T2-WI displays an heterogeneous signal of
57 this lesion. The largest cystic component appeared hypointense whereas the solid component
58 appeared isointense to grey matter. C, post-enhanced coronal T1-WI revealing an intense and
59 heterogeneous contrast enhancement of the solid component of this intracranial mass. D & E,
60 diffusion-WI shows a hyperintense signal with a corresponding hypointensity on the ADC of the solid
61 portion. F, perfusion-WI showed an increase in relative regional cerebral blood volume in this solid
62 component.

64 The patient underwent a total-gross resection of the tumor through a large frontal
65 craniotomy. The lesion was, indeed, extra-parenchymal and hemorrhagic with
66 modest blood spoliation. Dura was thick, vascularized and invaded by the tumor.
67 Arachnoid sheet was present in places between the tumor and the parenchyma.
68 Duraplasty using the galea aponeurotica was performed at the end of the procedure.
69 The postoperative course was uneventful and the patient was discharged on the 5th
70 postoperative day.

71 Pathologic gross examination of a piecemeal lesion displayed elastic whitish portions
72 with reddish hemorrhagic foci. The smears featured a very cellular tumor, with round
73 to oval cells. Cells were arranged around thin-walled vascular spaces lined by a non-
74 neoplastic endothelium. They were large, with finely granular cytoplasm and round-
75 shaped hyperchromatic nuclei. Mitotic atypia with a high mitotic index, vascular
76 thrombosis, hemorrhage, hemosiderin deposits and necrosis areas were noted.

77 Immuno-histochemistry showed diffuse positivity for vimentin, CD99, and bcl-2 and
78 variable positivity for CD34 (figure n°2). The diagnosis of anaplastic
79 hemangiopericytoma was made.



80

81 Figure n°2: Histopathological and immunohistochemical evidence displaying a highly cellular and
 82 vascularized mesenchymal tumor with dilated, staghorn-type vessels (A), High nuclear atypia (B) and
 83 necrosis (C). Ki67 index was 25%. The tumor cells were immune-positive for vimentin (D) and
 84 CD 34 (E).

85

86 One month postoperatively, the child started whole-brain radiotherapy. She received
 87 54 Gy without incidents. On the fifth postoperative month, physical examination
 88 showed improvement of Broca's aphasia but persistent decreased visual acuity in her
 89 left eye. However, MRI revealed a local recurrence (figure n°3B). Therefore, an
 90 additional radiation dose of 10 Gy was delivered. After 1-year follow-up, the
 91 recurrence remained unchanged on MRI (figure n°3C) and No metastases were
 92 found on body scan.

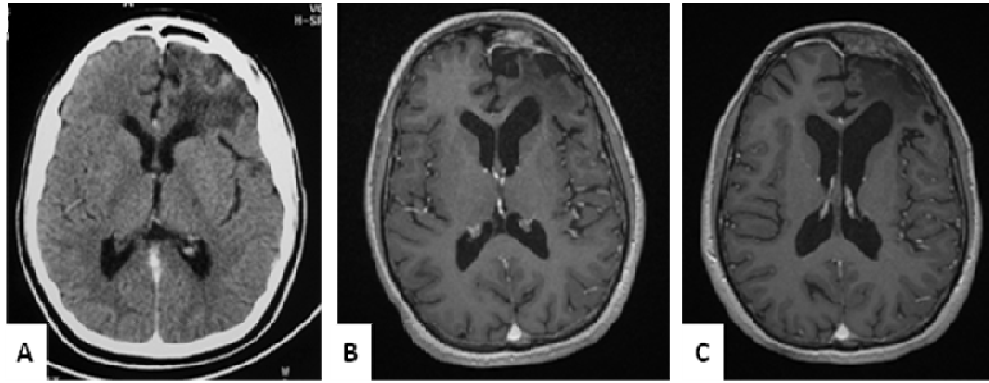


Figure 3: A, cranial axial CT scan with contrast enhancement on the first postoperative month shows a total gross resection of the HPR. B, post-enhanced axial T1-WI revealing a local recurrence of the tumor 3 months after radiotherapy. C, after an additional radiation dose of 10 Gy The recurrence remained unchanged on the 1-year follow-up post-enhanced axial T1-WI.

Discussion:

HPRs were first described by Stout and Murrey in 1942 (3). Initially, they were considered variants of angioblastic meningiomas, hemangiopericytic type. The 2007 WHO classification divided HPRs into two categories: grade II HPR, the more common type, and grade III HPR or anaplastic HPR (10).

HPRs are quite uncommon in all age groups, representing less than 1% of all CNS tumors, with only 10% of cases occurring in children (1). They represent less than 3% of dural-based lesions (1). The peak age ranges within the third and fourth decades (10) with a slight male predominance. HPR is extremely rare among children and most of them occur within the first year of life (3-6, 11). This infantile form of HPR is associated with a more benign course. The behavior of HPR in children older than 1 year is similar to that of adult HPR (9).

Intracranial HPRs are almost invariably solitary, attached to the cranial dura and to the venous sinuses, rarely the skull base dura. HPR may develop into the parenchyma, the ventricles, the sella, the pineal gland or the orbit (12-16). The spectrum of clinical signs and symptoms mirrors that described for meningiomas.

Neuro-imaging features of intracranial HPRs are non-specific but show differences with regard to meningiomas.

Indeed, intracranial HPRs are multilobulated, and their location is similar to that of meningiomas. However, HPRs present a narrow base of dural attachment in one third of cases, which is not typically seen in meningiomas (17). They usually are large, even in children, with a mean diameter of 75 mm (18). On CT-scan, HPRs are heterogeneous, hyperdense and typically show heterogeneous enhancement. They also show bony erosion, frequently seen in most anaplastic form but they lack calcifications and hyperostosis, usually observed in meningiomas (17, 19, 20). MRI findings show that intracranial HPR are heterogeneous, isointense on T1 and T2-WI with signal flow voids and enhance heterogeneously (17, 19, 20). In some cases, the serpentine signal intensity voids in vessels are numerous and large, giving an AVM-like appearance on MRI, which is suggestive of HPR (18). According to Zhou et al., pronounced lobulation, necrosis, cystic properties and damage of adjacent skull on MRI findings are more common in anaplastic form of HPR (21). On magnetic resonance spectroscopy, Barba et al. noted that elevated myoinositol using short TE (20 msec) may help differentiate HPR from meningioma (22).

Tumors showing increased mitotic activity and/or necrosis as well as hemorrhage have been defined as anaplastic grade III HPR (10, 11) and have been reported to be associated with malignant behavior (23). Histological distinction between the benign and the malignant forms of HPR in children cannot be made (11).

Meningeal HPR shows diffuse positivity for vimentin, CD99, and bcl-2 (24) and more variable positivity for CD34 (33–100%) which is generally patchy as opposed to the diffuse positivity typical of solitary fibrous tumor (25).

Treatment strategies for the management of intracranial HPR in children remain non-uniform. Surgical resection is the treatment of choice for intracranial HPR (26). However, it has been proven very difficult to cure the disease with surgical resection alone (27, 28).

Gross-total resection at first operation was strongly correlated with prolongation of time to recurrence and extension of survival duration (29, 30). HPR are hypervascular tumors causing intra-operative hemorrhage (27, 31), as in our case. Surgical mortality rate is about 9–24%. Hence, some authors recommend prior embolization (32).

The effect of adjuvant radiotherapy the treatment of HPR is discussed. Several studies have shown that that postoperative radiotherapy decreases the local recurrence rate (28, 33, 34) and improved survival outcome (34) . However, these results are not accepted by all authors. Indeed, HPR may be a relatively radioresistant lesion and the addition of postoperative radiation does not confer a survival benefit compared with gross-total resection (30).

Stereotactic radiosurgery may be an effective therapeutic mean to treat recurrent intracranial HPR in adult after surgical resection followed or not by radiotherapy (27, 35). Given the rarity of HPR in children, using stereotactic radiosurgery has not yet been worked out.

The role of chemotherapy is more debatable (9). For adult HPR, chemotherapy efficacy is limited (36). However, the use of chemotherapy for congenital and infantile HPR has proven to be successful in many cases combined with surgery (7, 8, 11).

Local aggressiveness, high rate of recurrence and extra-neural metastasis are the characteristics of intracranial HPR (8). Anaplastic HPR recurs locally earlier than low-grade HPR. Consequently, clinical control and annual MRI follow up are necessary.

Conclusion:

Management of intracranial HPR in children older than 1 year does not differ from adult HPR. Imaging diagnosis of HPR is not always straightforward, because it mimics meningioma. Anaplastic HPR are recognized for their aggressive clinical behavior, high recurrence rates, Microneurosurgery with adjuvant radiotherapy is the main treatment. Long-term follow-up is mandatory because this tumor had tendency for recurrence and metastasis even after complete macroscopic resection.

References:

1. Alen JF, Lobato RD, Gomez PA, Boto GR, Lagares A, Ramos A, et al. Intracranial hemangiopericytoma: study of 12 cases. *Acta Neurochir (Wien)*. 2001;143(6):575-86.
2. Huisman TAGM, Brandner S, Niggli F, Kacel G, Willi UV, Martin E. Meningeal hemangiopericytoma in childhood. *Eur Radiol*. 2000;10:1073-5.
3. Cole JC, Naul LG. Intracranial infantile hemangiopericytoma. *Pediatr Radiol*. 2000;30(4):271-3.
4. Herzog CE, Leeds NE, Bruner JM, Baumgartner JE. Intracranial hemangiopericytomas in children. *Pediatr Neurosurg*. 1995;22(5):274-9.
5. Aouad N, Vital C, Rivel J, Ramsoubramanian K, Santosh S, Chwdry O. Giant supratentorial meningeal hemangiopericytoma in a new born. *Acta Neurochir (Wien)*. 1991;112(3-4):154-6.
6. Laviv Y, Michowitz S, Schwartz M. Neonatal intracranial hemangiopericytoma: a 7-year follow-up. *Acta Neurochir (Wien)*. 2011;154:637-8.
7. Sulit DJ, Tom WL, Willert JR, Nespeca MP, Friedlander SF. Multicentric infantile hemangiopericytoma: case report and review of the literature. *J Pediatr Hematol Oncol*. 2011;33(4):e166-70.
8. Fernandez-Pineda I, Parida L, Jenkins JJ, Davidoff AM, Rao BN, Rodriguez-Galindo C. Childhood hemangiopericytoma: review of St Jude Children's Research Hospital. *J Pediatr Hematol Oncol*. 2011;33(5):356-9.
9. Rodriguez-Galindo C, Ramsey K, Jenkins JJ, Kaste SC, Merchant TE, Rao BN, et al. hemangiopericytoma in children and infants. *Cancer* 2000;88:198-204.
10. D N Louis, H Ohgaki, O D Wiestler, W K Cavenee, P C Burger, A Jouvett, et al. WHO classification of tumours of the central nervous system. *Acta Neuropathol*. 2007;114:97-109.

11. Kerl K, Strater R, Hasselblatt M, Brentrup A, Fruhwald MC. Role of neoadjuvant chemotherapy in congenital intracranial haemangiopericytoma. *Pediatr Blood Cancer*. 2011;56(1):161-3.
12. Shetty PM, Moiyadi AV, Sridhar E. Primary CNS hemangiopericytoma presenting as an intraparenchymal mass--case report and review of literature. *Clin Neurol Neurosurg*. 2010;112(3):261-4.
13. Sumi K, Watanabe T, Ohta T, Fukushima T, Kano T, Yoshino A, et al. Hemangiopericytoma arising in the body of the lateral ventricle. *Acta Neurochir (Wien)*. 2010;152(1):145-9.
14. Jalali R, Srinivas C, Nadkarni TD, Rajasekharan P. Suprasellar haemangiopericytoma--challenges in diagnosis and treatment. *Acta Neurochir (Wien)*. 2008;150(1):67-71.
15. Jian BJ, Han SJ, Yang I, Waldron JS, Tihan T, Parsa AT. Surgical resection and adjuvant radiotherapy for a large pineal hemangiopericytoma. *J Clin Neurosci*. 2010;17(9):1209-11.
16. Shinder R, Jackson TL, Araujo D, Prieto VG, Guadagnolo BA, Esmaeli B. Preoperative radiation therapy in the management of recurrent orbital hemangiopericytoma. *Ophthalm Plast Reconstr Surg*. 2011;27(5):e126-8.
17. Chiechi MV, Smirniotopoulos JG, Mena H. Intracranial hemangiopericytomas: MR and CT features. *AJNR Am J Neuroradiol*. 1996;17(7):1365-71.
18. Chen Q, Chen X Z, Wang J M, Li S W, Jiang T, P. DJ. Intracranial meningeal hemangiopericytomas in children and adolescents: CT and MR imaging findings. *AJNR Am J Neuroradiol*. 2012;33(1):195-9.
19. Akiyama M, Sakai H, Onoue H, Miyazaki Y, Abe T. Imaging intracranial haemangiopericytomas: study of seven cases. *Neuroradiology*. 2004;46(3):194-7.
20. Sibtain NA, Butt S, Connor SE. Imaging features of central nervous system haemangiopericytomas. *Eur Radiol*. 2007;17(7):1685-93.
21. Zhou J L, Liu J L, Zhang J, M. Z. Thirty-nine cases of intracranial hemangiopericytoma and anaplastic hemangiopericytoma: a retrospective review of MRI features and pathological findings. *Eur J Radiol*. 2012;81(11):3504-10.
22. Barba I, Moreno A, Martinez-Pérez I, Tate AR, Cabañas ME, Baquero M, et al. Magnetic resonance spectroscopy of brain hemangiopericytomas: high myoinositol concentrations and discrimination from meningiomas. *J Neurosurg*. 2001;94(1):55-60.
23. Mena H, Ribas JL, Pezeshkpour GH, Cowan DN, Parisi JE. Hemangiopericytoma of the central nervous system: a review of 94 cases. *Hum Pathol*. 1991;22(1):84-91.
24. Rajaram V, Brat DJ, Perry A. Anaplastic meningioma versus meningeal hemangiopericytoma: immunohistochemical and genetic markers. *Hum Pathol*. 2004;35(11):1413-8.
25. Hayashi Y, Uchiyama N, Nakada M, Iwato M, Kita D, Higashi R, et al. A reevaluation of the primary diagnosis of hemangiopericytoma and the clinical importance of differential diagnosis from solitary fibrous tumor of the central nervous system. *Clin Neurol Neurosurg*. 2009;111(1):34-8.
26. Wu W, Shi JX, Cheng HL, Wang HD, Hang CH, Shi QL, et al. Hemangiopericytomas in the central nervous system. *J Clin Neurosci*. 2009;16(4):519-23.
27. Payne BR, Prasad D, Steiner M, Steiner L. Gamma surgery for hemangiopericytomas. *Acta Neurochir (Wien)*. 2000;142(5):527-36; discussion 36-7.
28. Soyuer S, Chang EL, Selek U, McCutcheon IE, Maor MH. Intracranial meningeal hemangiopericytoma: the role of radiotherapy: report of 29 cases and review of the literature. *Cancer*. 2004;100(7):1491-7.
29. Kim JH, Jung HW, Kim YS, Kim CJ, Hwang SK, Paek SH, et al. Meningeal hemangiopericytomas: long-term outcome and biological behavior. *Surg Neurol*. 2003;59(1):47-53; discussion -4.
30. Rutkowski MJ, Sughrue ME, Kane AJ, Aranda D, Mills SA, Barani IJ, et al. Predictors of mortality following treatment of intracranial hemangiopericytoma. *J Neurosurg*. 2010;113(2):333-9.
31. Sheehan J, Kondziolka D, Flickinger J, Lunsford LD. Radiosurgery for treatment of recurrent intracranial hemangiopericytomas. *Neurosurgery*. 2002;51(4):905-10; discussion 10-1.

- 245 32. Fountas KN, Kapsalaki E, Kassam M, Feltes CH, Dimopoulos VG, Robinson JS, et al.
246 Management of intracranial meningeal hemangiopericytomas: outcome and experience. *Neurosurg*
247 *Rev.* 2006;29(2):145-53.
- 248 33. Dufour H, Metellus P, Fuentes S, Murracchiole X, Regis J, Figarella-Branger D, et al. Meningeal
249 hemangiopericytoma: a retrospective study of 21 patients with special review of postoperative
250 external radiotherapy. *Neurosurgery.* 2001;48(4):756-62; discussion 62-3.
- 251 34. Ghia A J, Allen P K, Mahajan A, Penas-Prado M, McCutcheon I E, D. BP. Intracranial
252 hemangiopericytoma and the role of radiation therapy: a population based analysis. *Neurosurgery.*
253 2013;72(2):203-9.
- 254 35. Kim JW, Kim DG, Chung HT, Paek SH, Kim YH, Han JH, et al. Gamma Knife stereotactic
255 radiosurgery for intracranial hemangiopericytomas. *J Neurooncol.* 2010;99(1):115-22.
- 256 36. Chamberlain MC, Glantz MJ. Sequential salvage chemotherapy for recurrent intracranial
257 hemangiopericytoma. *Neurosurgery.* 2008;63(4):720-6; author reply 6-7.

258