

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

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Abstract:

Intracranial hemangiopericytoma (HPR) is a highly vascular tumors which exeptionnal 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 papillary edema 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. We discuss the clinical, radiological, histological features and management of an intracranial anaplastic hemangiopericytoma in a 15 year-old child through a literature review.

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

Case presentation:

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

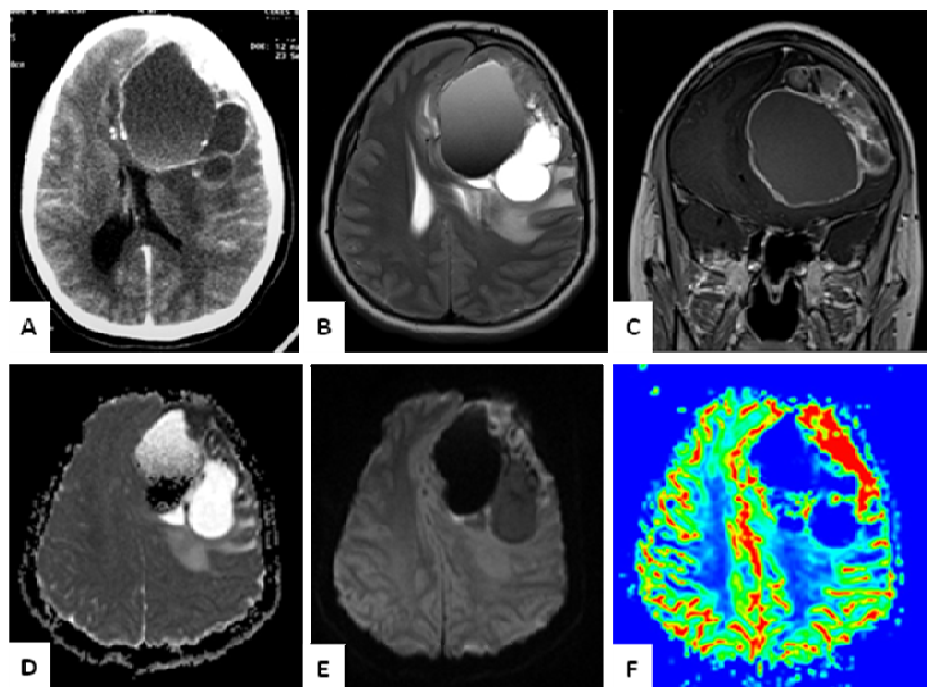
Computerized tomography (CT) scan showed a large multicystic mass with peripheral enhancement located in the left frontal parasagittal convexity (figure n°1A).. The mass showed mixed low and isoattenuation with moderate surrounding edema. Notable mass effect was associated, with left-to-right midline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

On Magnetic resonance image (MRI), the mass appeared heterogeneous on T1 and T2 weighted-images (WI), with solid and cystic components. It showed a dural-base on the left-frontal convexity. The largest cystic component appeared hyperintense on T1-WI, hypointense on T2-WI in relation to hemorrhagic content. The solid component presented a narrow-based dural attachement and a "dural tail" sign. It

47 appeared isointense to grey matter on T1 and T2-WI, enhanced markedly and
48 heterogeneously after gadolinium administration and contained multiple signal
49 intensity flow voids (figures n°1B & 1C).

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

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



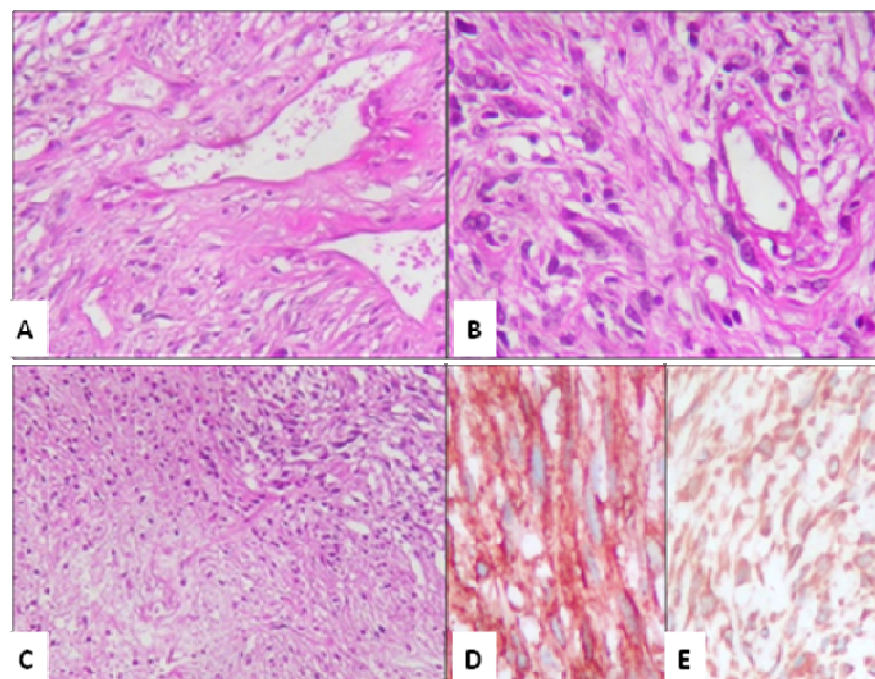
57 Figure 1: A, cranial axial computed tomography with contrast enhancement shows a a left frontal large
58 multicystic mass with peripheral enhancement. B, A, axial T2-WI displays an heterogeneous signal of
59 this lesion. The largest cystic component appeared hypointense whereas the solid component
60 appeared isointense to grey matter. C, post-enhanced coronal T1-WI revealing an intense and
61 heterogeneous contrast enhancement of the solid component of this intracranial mass. D & E,

62 diffusion-WI shows a hyperintense signal with a corresponding hypointensity on the ADC of the solid
63 portion. F, perfusion-WI showed an increase in relative regional cerebral blood volume in this solid
64 component.

65

66 The patient underwent a total-gross resection of the tumor through a large frontal
67 craniotomy. The lesion was, indeed, extra-parenchymal and hemorrhagic with
68 modest blood spoliation. Duraplasty using the galea aponeurotica was performed at
69 the end of the procedure. The postoperative course was uneventful and the patient
70 was discharged on the 5th postoperative day.

71 Pathologic gross examination displayed elastic whitish portions with reddish
72 hemorrhagic foci. Histologically, the smears featured a high cell-density tumor. The
73 cells were clustered in layers. They were large, little abundant with finely granular
74 cytoplasm and round-shaped hyperchromatic nuclei. There were numerous mitotic
75 atypia with a high mitotic index. Vascular thrombosis, hemorrhage, hemosiderin
76 deposits and necrosis areas were noted. Immuno-histochemistry showed diffuse
77 positivity for vimentin, CD99, and bcl-2 and variable positivity for CD34 (figure n°2).
78 The diagnosis of anaplastic hemangiopericytoma was made.

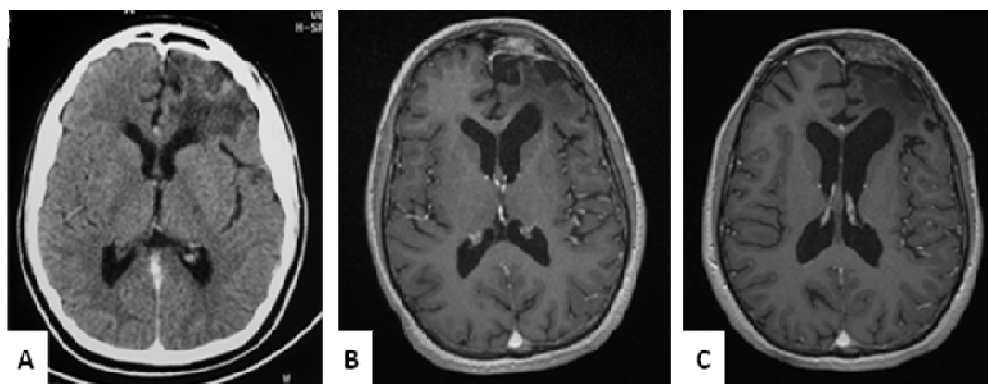


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80 Figure n°2: Histopathological and immunohistochemical evidence displaying a highly cellular and
 81 vascularized mesenchymal tumor with dilated, staghorn-type vessels (A), High nuclear atypia (B) and
 82 necrosis (C). The tumor cells were immune-positive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

83

84 One month postoperatively, the child started whole-brain radiotherapy. She received
 85 54 Gy without incidents. On the fourth postoperative month, physical examination
 86 showed improvement of Broca's aphasia but persistent decreased visual acuity in her
 87 left eye. However, MRI revealed a local recurrence (figure n°3B). Therefore, an
 88 additional radiation dose of 10 Gy was delivered. The recurrence remained
 89 unchanged on the 1-year follow-up MRI (figure n°3C).



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

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96 Discussion:

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

101 HPRs are quite uncommon in all age groups, representing less than 1% of all CNS
 102 tumors, with only 10% of cases occurring in children (1). They represent less than 3%
 103 of dural-based lesions (1). The peak age ranges within the third and fourth decades
 104 (10) with a slight male predominance. HPR is extremely rare among children and
 105 most of them occur within the first year of life (3-6, 11). This infantile form of HPR is
 106 associated with a more benign course. The behavior of HPR in children older than 1
 107 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). HPR are hypervascular tumors causing intra-operative hemorrhage (27, 30), as in our case. Surgical mortality rate is about 9–24%. Hence, some authors recommend prior embolization (31).

Adjuvant radiotherapy has a definite role in the treatment of HPR (9). It has been proven that postoperative radiotherapy decreases the local recurrence rate (28, 32, 33) and improved survival outcome (34). Several studies showed that 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.

158 **Conclusion:**

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

165 **References:**

- 166 1. Alen JF, Lobato RD, Gomez PA, Boto GR, Lagares A, Ramos A, et al. Intracranial
 167 hemangiopericytoma: study of 12 cases. *Acta Neurochir (Wien)*. 2001;143(6):575-86.
- 168 2. Huisman TAGM, Brandner S, Niggli F, Kacel G, Willi UV, Martin E. Meningeal
 169 hemangiopericytoma in childhood. *Eur Radiol*. 2000;10:1073-5.
- 170 3. Cole JC, Naul LG. Intracranial infantile hemangiopericytoma. *Pediatr Radiol*. 2000
 171 Apr;30(4):271-3.
- 172 4. Herzog CE, Leeds NE, Bruner JM, Baumgartner JE. Intracranial hemangiopericytomas in
 173 children. *Pediatr Neurosurg*. 1995;22(5):274-9.
- 174 5. Aouad N, Vital C, Rivel J, Ramsoubramanian K, Santosh S, Chwdry O. Giant supratentorial
 175 meningeal hemangiopericytoma in a new born. *Acta Neurochir (Wien)*. 1991;112(3-4):154-6.
- 176 6. Laviv Y, Michowitz S, Schwartz M. Neonatal intracranial hemangiopericytoma: a 7-year
 177 follow-up. *Acta Neurochir (Wien)*. 2011;154:637-8.
- 178 7. Sulit DJ, Tom WL, Willert JR, Nespeca MP, Friedlander SF. Multicentric infantile
 179 hemangiopericytoma: case report and review of the literature. *J Pediatr Hematol Oncol*. 2011
 180 May;33(4):e166-70.
- 181 8. Fernandez-Pineda I, Parida L, Jenkins JJ, Davidoff AM, Rao BN, Rodriguez-Galindo C.
 182 Childhood hemangiopericytoma: review of St Jude Children's Research Hospital. *J Pediatr Hematol*
 183 *Oncol*. 2011 Jul;33(5):356-9.
- 184 9. Rodriguez-Galindo C, Ramsey K, Jenkins JJ, Kaste SC, Merchant TE, Rao BN, et al.
 185 hemangiopericytoma in children and infants. *Cancer* 2000;88:198-204.
- 186 10. David N Louis, Hiroko Ohgaki, · ODW, Webster K Cavenee, Peter C Burger, Anne Jouvett, et al.
 187 WHO classification of tumours of the central nervous system. *Acta Neuropathol*. 2007;114:97-109.
- 188 11. Kerl K, Strater R, Hasselblatt M, Brentrup A, Fruhwald MC. Role of neoadjuvant
 189 chemotherapy in congenital intracranial haemangiopericytoma. *Pediatr Blood Cancer*. 2011
 190 Jan;56(1):161-3.
- 191 12. Shetty PM, Moiyadi AV, Sridhar E. Primary CNS hemangiopericytoma presenting as an
 192 intraparenchymal mass--case report and review of literature. *Clin Neurol Neurosurg*. 2010
 193 Apr;112(3):261-4.
- 194 13. Sumi K, Watanabe T, Ohta T, Fukushima T, Kano T, Yoshino A, et al. Hemangiopericytoma
 195 arising in the body of the lateral ventricle. *Acta Neurochir (Wien)*. 2010;152(1):145-9.
- 196 14. Jalali R, Srinivas C, Nadkarni TD, Rajasekharan P. Suprasellar haemangiopericytoma--
 197 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. *Ophthal 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 Aug;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 Mar;46(3):194-7.
20. Sibtain NA, Butt S, Connor SE. Imaging features of central nervous system haemangiopericytomas. *Eur Radiol*. 2007 Jul;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 Jan;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 Apr 1;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 Jan;59(1):47-53; discussion -4.
30. Sheehan J, Kondziolka D, Flickinger J, Lunsford LD. Radiosurgery for treatment of recurrent intracranial hemangiopericytomas. *Neurosurgery*. 2002 Oct;51(4):905-10; discussion 10-1.
31. Fountas KN, Kapsalaki E, Kassam M, Feltes CH, Dimopoulos VG, Robinson JS, et al. Management of intracranial meningeal hemangiopericytomas: outcome and experience. *Neurosurg Rev*. 2006 Apr;29(2):145-53.
32. Dufour H, Metellus P, Fuentes S, Murracchiole X, Regis J, Figarella-Branger D, et al. Meningeal hemangiopericytoma: a retrospective study of 21 patients with special review of postoperative external radiotherapy. *Neurosurgery*. 2001 Apr;48(4):756-62; discussion 62-3.
33. Ghia A J, Allen P K, Mahajan A, Penas-Prado M, McCutcheon I E, D. BP. Intracranial hemangiopericytoma and the role of radiation therapy: a population based analysis. *Neurosurgery*. 2013;72(2):203-9.
34. Ghia A J, Allen P K, Mahajan A, Penas-Prado M, McCutcheon I E, D. BP. Intracranial hemangiopericytoma and the role of radiation therapy: a population based analysis. *Neurosurgery*. 2013;72(2):203-9.

- 249 35. Kim JW, Kim DG, Chung HT, Paek SH, Kim YH, Han JH, et al. Gamma Knife stereotactic
250 radiosurgery for intracranial hemangiopericytomas. *J Neurooncol*. 2010 Aug;99(1):115-22.
251 36. Chamberlain MC, Glantz MJ. Sequential salvage chemotherapy for recurrent intracranial
252 hemangiopericytoma. *Neurosurgery*. 2008 Oct;63(4):720-6; author reply 6-7.
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