

Case Report

Rupture of hemangioblastoma in the posterior part of the fourth ventricle is manifested as a ventricular system hemorrhage: a case report and literature review

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Abstract: The rupture of hemangioblastoma with a hemorrhage, especially a ventricular system hemorrhage caused by the rupture of a hemangioblastoma located in the posterior part of the fourth ventricle, is very rare. This study reports a case of this rare disease. The patient was a 38-year-old male with onset after a sudden headache. Computed tomography examination after onset revealed a hemorrhage in the fourth ventricle, third ventricle, and lateral ventricles that resembled a simple intraventricular hemorrhage. Further imaging via computed tomographic angiography (CTA) and digital subtraction angiography (DSA) indicated that the blood supply for the tumor was from the posterior inferior cerebellar artery. The CTA and DSA examinations clarified that the hemorrhage in the fourth ventricle was caused by a lesion in the posterior part of the fourth ventricle instead of a simple intraventricular hemorrhage. Surgical treatment was provided. The lesion located at the inferior medullary velum and the median aperture of the fourth ventricle was intraoperatively observed to have a blood supply from the distal branch of the posterior inferior cerebellar artery. The lesion was fully resected and was postoperatively confirmed by pathology to be a hemangioblastoma. Therefore, the rupture of an infratentorial hemangioblastoma might also occur under extremely rare conditions. When the tumor is located in the posterior part of the fourth ventricle, the hemorrhage can enter the fourth ventricle and cause ventricular system hemorrhage. The hemorrhage might cover the tumor, and the condition may then manifest as a simple intraventricular hemorrhage such that the diagnosis would be easily missed, resulting in misdiagnosis.

Keywords: Hemangioblastoma, the fourth ventricle, hemorrhage

Introduction

Hemangioblastoma, a benign tumor of the nervous system, often occurs in the infratentorial space. Infratentorial hemangioblastomas are usually located in the cerebellar hemisphere or involve the brainstem [1]. Those located at the inferior medullary velum and median aperture in the posterior part of the fourth ventricle are rare. Hemangioblastoma usually presents with a mass effect, which manifests as increased intracranial pressure or symptoms of neurological deficit. Ruptures of hemangioblastomas with a hemorrhage causing hemorrhagic stroke are extremely rare [2, 3]. This study reported a rare case of hemangioblastoma in the posterior part of the fourth ventricle that manifested as an intraventricular hemorrhage after rupture. The hemorrhage covered the tumor, which was

discovered upon further angiographic examination. A satisfactory outcome was obtained after tumor removal. Herein, a case is reported, and the relevant literature is reviewed.

Case presentation

A male patient, 38 years old, was admitted because of "sudden severe headache and dizziness, with nausea and vomiting for six hours". The patient was previously in good health. He denied any familial history of cerebral hemorrhage, as well as histories of hypertension and diabetes. Physical examination showed that the patient's vital signs were stable, and his blood pressure was 135/80 mmHg. The patient was conscious, answered questions accurately, and could move his limbs upon command; he had neck stiffness, was Kernig positive, and had

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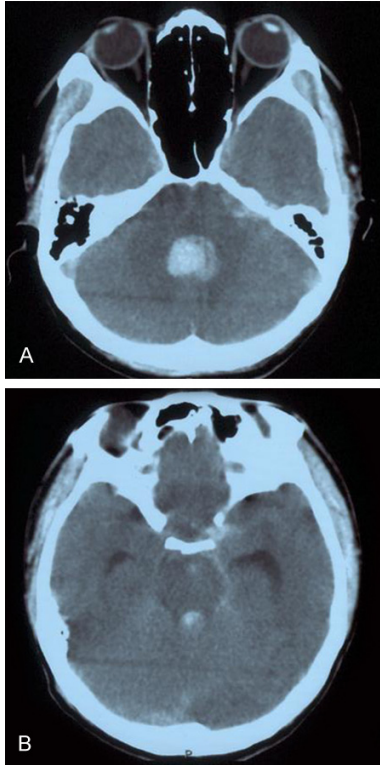


Figure 1. Head CT imaging. A: The hemorrhage in the fourth ventricle fully occupied the fourth ventricle; B: The hemorrhage entered the ambient cistern and extended toward the left suprasellar cistern and sylvian fissure cistern; C: The hemorrhage entered the third ventricle and the lateral ventricles. The size of the supratentorial ventricular system was essentially normal.

negative Babinski signs in both lower extremities. Head computed tomography (CT) revealed that a hemorrhage of the fourth ventricle had entered the third ventricle and the lateral ventricles. The size of the supratentorial ventricular system was essentially normal, and the hemorrhage entered the ambient cistern and extended toward the left suprasellar cistern and sylvian fissure cistern (**Figure 1**). Meanwhile, a computed tomographic angiography (CTA) examination revealed an enhanced irregular image in the posterior part of the fourth ventricle, with a diameter of approximately 1 cm and a blood supply from the posterior inferior cerebellar artery (**Figure 2A, 2B**). Further digital subtraction angiography (DSA) showed that the lesion's blood supply was from the posterior inferior cerebellar artery, and a stained lesion was observed in the advanced stage, with no clear drainage vein (**Figure 2C, 2D**). Based on the imaging study, the diagnosis was a lesion in the posterior part of the fourth ventricle, with a hemorrhage in the ventricular system. Surgery for lesion resection was performed via a median suboccipital approach. The rear edge of the foramen magnum and the posterior arch of the atlas were partially grinded, and the dura mater was then cut to expose the lesion located below

the cerebellar tonsil in the posterior part of the fourth ventricle, which occupied the inferior medullary velum and the median aperture of the posterior part of the fourth ventricle. The lesion was purple with blood clots underneath, and the lesion's blood supply originated from the distal branch of the posterior inferior cerebellar artery. After transecting multiple arteries for blood supply by coagulation, the lesion was resected, and the hematoma in the fourth ventricle was removed (**Figure 3**). The dura mater was then sutured, the bone chips were removed, and the occipital muscles were sutured in layers. The excised lesion specimen was submitted for pathological examination. The patient was awake after the surgery, and the physical

examinations showed unrestricted limb movement, without pathological reflexes in either lower extremity. The postoperative-day-7 CT revealed that the intraventricular hematoma was absorbed, with no hydrocephalus images. The patient was discharged after recovery, with no positive nervous system signs. The results of the pathological examination revealed that the tumor was formed from large mesenchymal cells with lipid-rich cytoplasm and an abundant capillary network. The mesenchymal cell nuclei varied in size. Vasodilatation in the tumor occurred and was accompanied by hemorrhage and cystic change. The diagnosis was hemangioblastoma (World Health Organization [WHO] grade I) (**Figure 4**). Six months after discharge, the patient returned to work, and his health situation returned to the level he experienced before onset. A follow-up head CT revealed that the tumor had been fully removed with no residual tissue and that the size of the ventricular system had returned to normal (**Figure 5**).

Discussion

Hemangioblastoma is a benign tumor of the nervous system (WHO grade I), with an inci-

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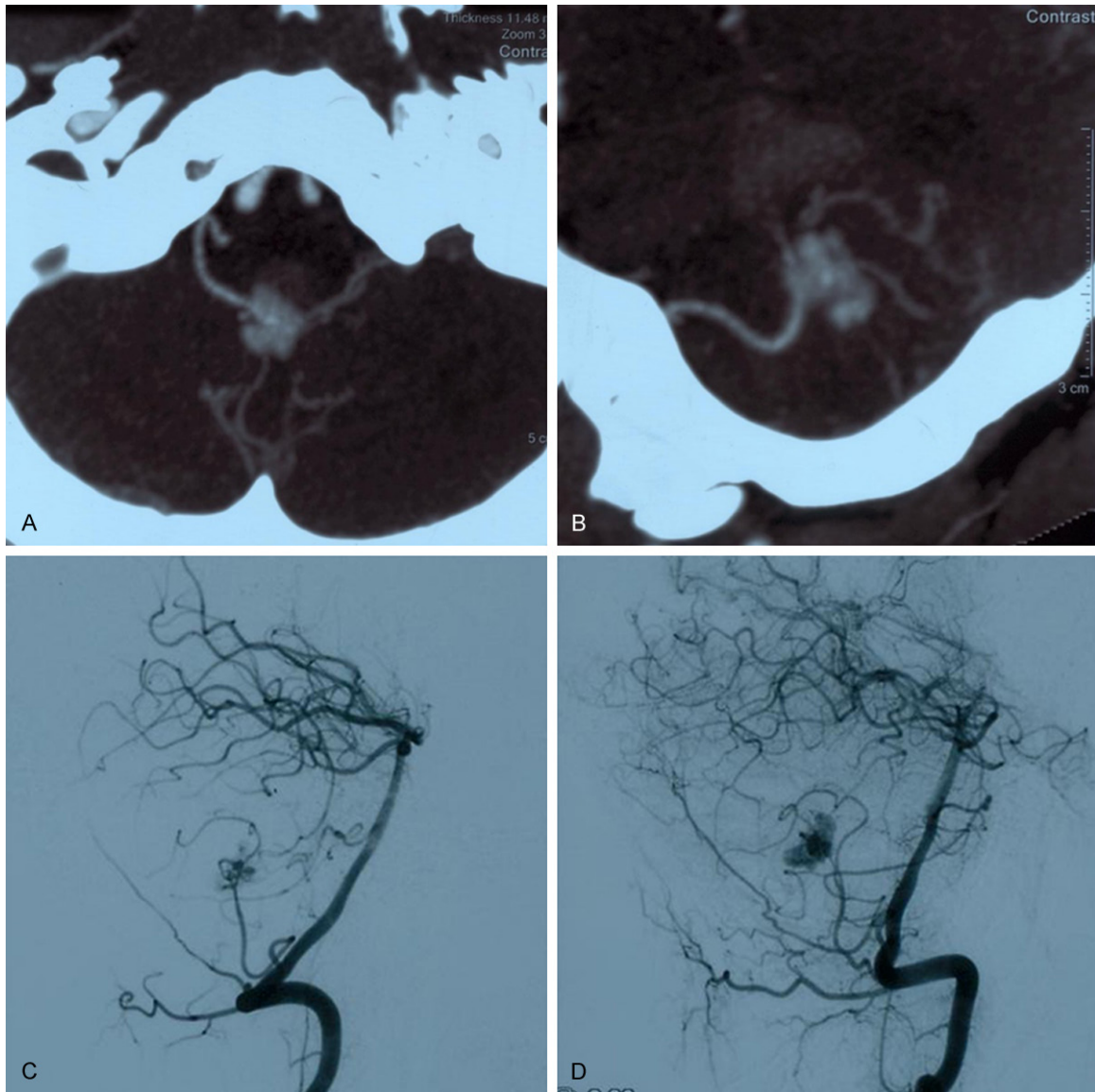


Figure 2. Vascular imaging study. (A, B) CTA examination revealed an enhanced irregular image in the posterior part of the fourth ventricle, with a diameter of approximately 1 cm and a blood supply from the posterior inferior cerebellar artery; (C, D) DSA imaging identified the lesion in the arterial early stage and advanced stage, with the lesion's blood supply from the posterior inferior cerebellar artery. (A) Stained lesion was observed in the advanced stage. (A) Indicates the early arterial stage, while (B) indicates the advanced arterial stage, with no clear drainage vein.

dence accounting for approximately 2% of all intracranial tumors [4]. Hemangioblastoma can present as a sporadic event, and 20-30% of cases are linked to von Hippel-Lindau (VHL) disease, an autosomal dominant inherited disorder. VHL mostly manifests as tumors or cysts in multiple organs, which may be associated with diseases such as retinal hemangioma, renal cell carcinoma, and pheochromocytoma [5]. Hemangioblastoma is prone to occur in the infratentorial brain tissue but is relatively rare

in the supratentorial brain tissue [6]. Hemangioblastomas that occur in the infratentorial cerebellar tissue are mostly cystic, containing tumor nodules; their typical characteristics on magnetic resonance imaging (MRI) include changes in large cysts and small nodules [7]. Some supratentorial hemangioblastomas are also solid, have a larger tumor volume and involve the brain stem, making their surgical treatment is very difficult [8]. Solid hemangioblastomas can be manifested as an even den-

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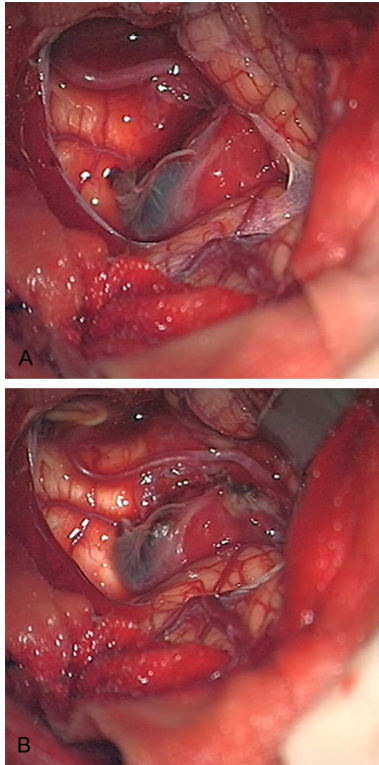


Figure 3. Imaging of the lesion during the resection. A: The lesion was located below the cerebellar tonsil in the posterior part of the fourth ventricle and was purple with blood clots underneath; B: The lesion's blood supply was from the distal branch of the posterior inferior cerebellar artery; C: After the lesion was resected and the hematoma was removed, the fourth ventricle was exposed. The tumor occupied the inferior medullary velum and median aperture of the posterior part of the fourth ventricle.

cerebral hemorrhage. For example, Hashimoto et al reported one case of cerebellar hemangioblastoma in 1995, which manifested as a cerebellar hemisphere hematoma after hemorrhage; the diagnosis could not be confirmed until the pathological examination of the surgical specimen [10]. In some cases, even after the hematomas were removed, diagnoses of hemangioblastoma still could not be confirmed. For example, Lee et al reported a case of cerebellar hemisphere hemorrhage in 2007, and only the hematoma was removed after the hemorrhage. Four years after the surgery, a large hemangioblastoma was found on the site of the previous hemorrhage; consequently, it was finally diagnosed that the previous hemorrhage was

caused by the hemangioblastoma [11]. In 2005, Glacker et al reported that the probability of spontaneous hemorrhage from hemangioblastomas is very low (0.024%/person/year) and that lesions smaller than 1.5 cm present no risk of spontaneous hemorrhage [3]. Recently, Ene et al retrospectively analyzed 55 cases of hemangioblastomas in 2015. Of the 55 cases, only three patients showed hemorrhage, with an incidence of 5.5%, and the sizes of two of the hemorrhagic tumors were smaller than 1.5 cm, contradicting the results of previous studies in which authors proposed that hemangioblastomas less than 1.5 cm in size have essentially no risk of hemorrhage [9]. The case reported in this study supported the opinion of Lee. The size of the hemangioblastoma with hemorrhage was only approximately 1 cm; therefore, a small hemangioblastoma may also rupture and cause hemorrhage.

sity on CT, with a small internal cystic change to cause the uneven density. These hemangioblastomas can be significantly strengthened after enhancement; solid hemangioblastomas can be manifested as flow voids on MRI that are similar to arteriovenous malformations and can be characterized as high-flow lesions on CTA or DSA, with definite feeding arteries and draining veins, similar to arteriovenous malformations [1]. Hemangioblastomas mostly develop with a mass effect, resulting in increased intracranial pressure, and neurological deficit symptoms may occur with hemangioblastomas involving the brainstem [4]. Few hemangioblastomas cause hemorrhagic stroke, which may be misdiagnosed as a simple cerebral hemorrhage [9]. We reported a case of infratentorial hemangioblastoma with hemorrhage onset, showing no symptoms of VHL disease. After onset, the hemorrhage entered the fourth ventricle, followed by the third ventricle and the lateral ventricles, which is extremely rare.

Because the hemangioblastoma blood supply is very rich, a hemorrhage can have serious consequences. If the amount of bleeding is large, the tumor can be immersed in the hematoma, resulting in a misdiagnosis as a simple

Hemangioblastomas mostly occur in the cerebellar hemispheres and are cystic, but these tumors can also be solid and involve the brainstem [12]. The hemangioblastoma of the case reported in this study involved the inferior medullary velum and the median aperture of the posterior part of the fourth ventricle, a location

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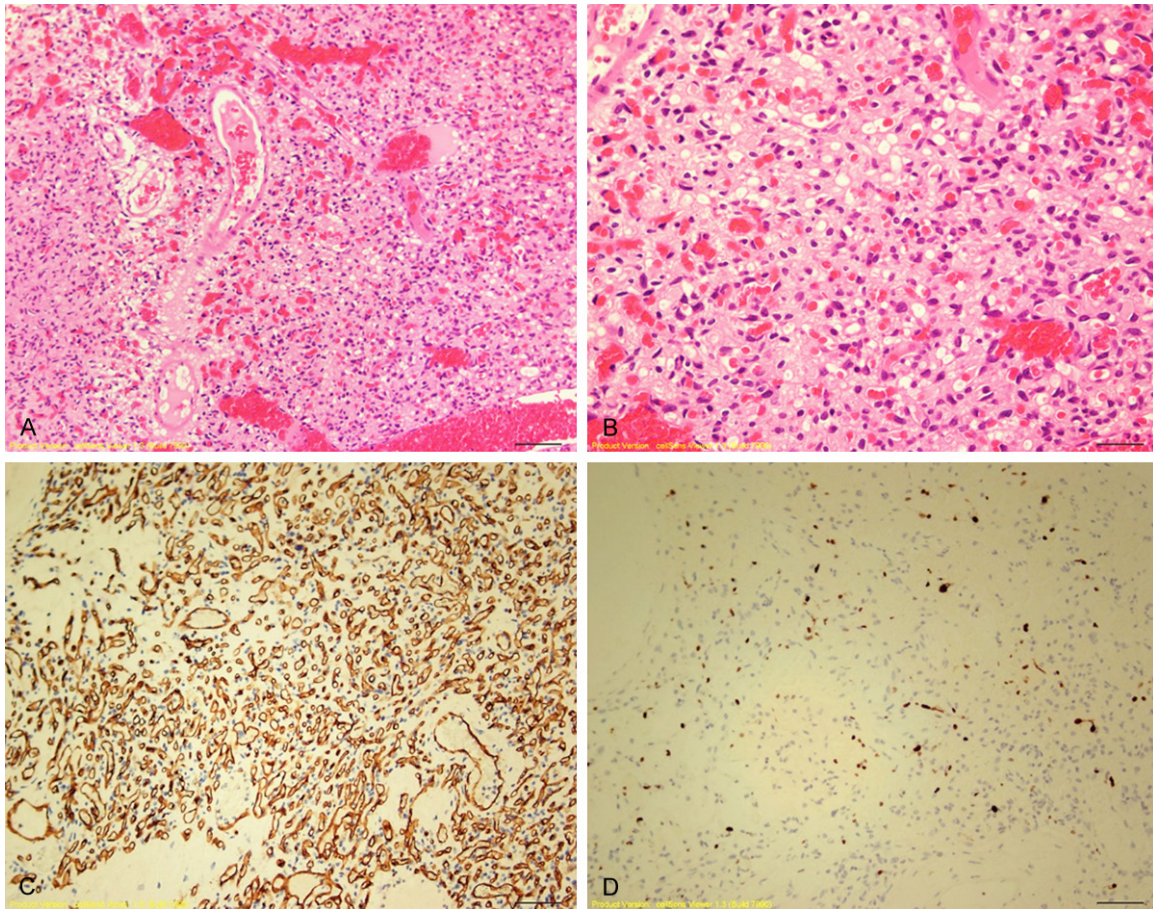


Figure 4. Pathological examination results. A: $\times 200$, the tumor had formed from two portions of large mesenchymal cells with lipid-rich cytoplasm and an abundant capillary network. Vasodilation was observed in some blood vessels, and the tumor was accompanied by hemorrhage and cystic changes. B: $\times 400$, the nuclei of the mesenchymal cells varied in size, and conventional staining of the lipid vacuoles in the cytoplasm revealed typical “clear cells”; C: CD34 staining was positive, showing the vascular structure; D: Ki67 staining, with a Ki67 proliferation index of less than 1%, was diagnosed as WHO grade I.

that has been rarely reported in the literature. Because the inferior medullary velum of the posterior part of the fourth ventricle is thin and located in the median aperture (**Figure 3**), when the hemangioblastoma ruptured and caused a hemorrhage, the hematoma might have punctured the inferior medullary velum and median aperture to enter the fourth ventricle. Because the blood supply of the hemangioblastoma was rich, the blood pressure of the hemorrhage was high. After filling up the fourth ventricle, the hemorrhage could enter the third ventricle and the lateral ventricles through the midbrain aqueduct, and part of the hemorrhage might also have directly entered the subarachnoid space (**Figure 1**). As the tumor volume was not large, the hemorrhage in the fourth ventricle likely directly surrounded

the hemangioblastoma so that the tumor was not observed by CT imaging. Further CTA and DSA imaging identified tumor-like changes in the posterior part of the fourth ventricle, thus avoiding misdiagnosis. Therefore, for unexplained hemorrhages, vascular examination is necessary. The vascular imaging of hemangioblastoma has certain characteristics. CTA can reveal hemangioblastoma staining [13]. For the case described in this study, CTA examination was also performed to obtain a tumor image; however, CTA is for static imaging and is not comparable to DSA. DSA is an effective method of assessment in which brush-like tumor staining can be observed; drainage veins can also be shown to distinguish this tumor type from an arteriovenous malformation [14]. In this study, DSA examination of the hemangio-

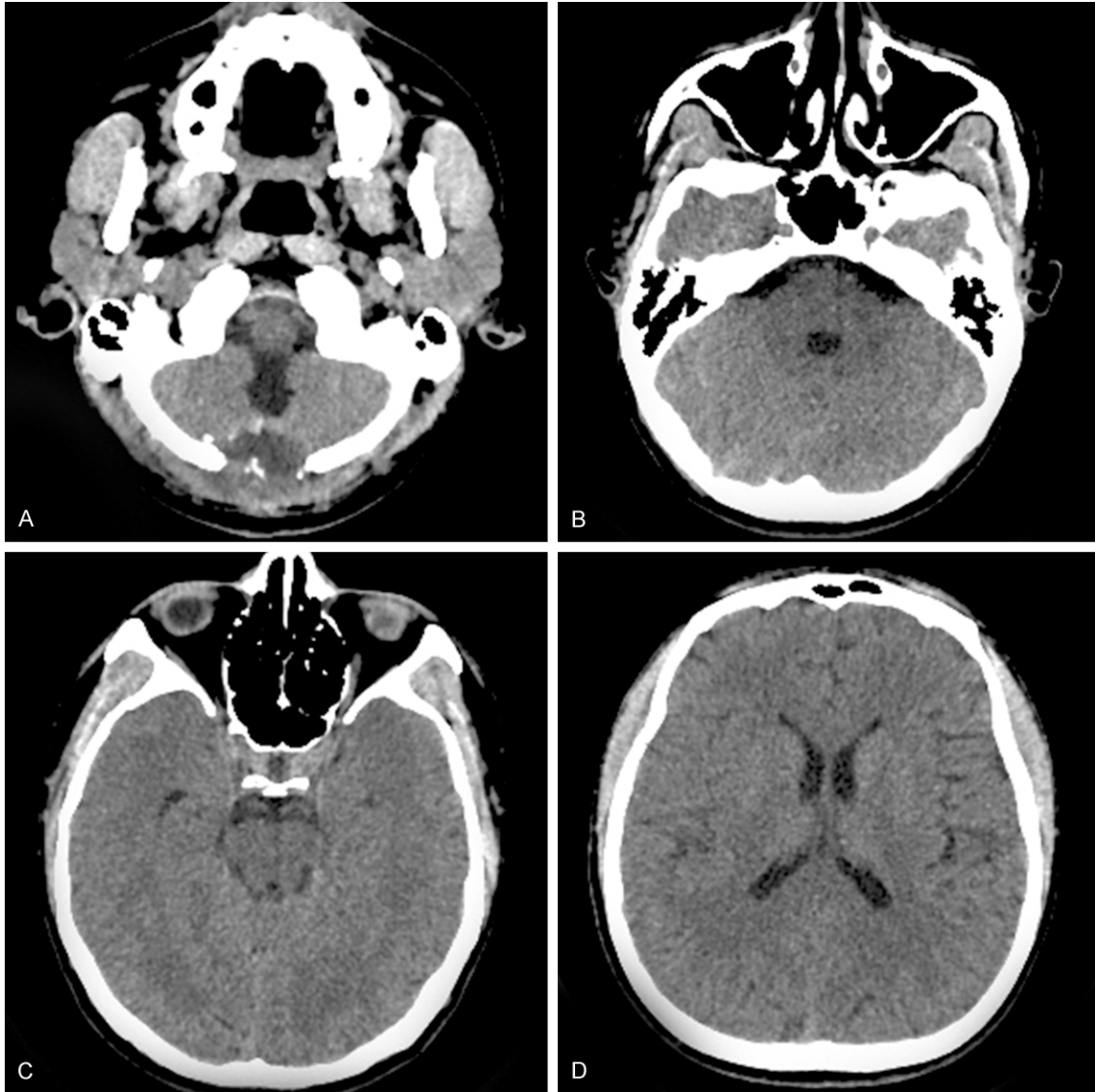


Figure 5. Follow-up head CT imaging. A: The tumor had been fully removed with no residual tissue, and the spaces at the inferior medullary velum and the median aperture of the posterior part of the fourth ventricle were open; B: The hematoma in the fourth ventricle was completely absorbed, and the size of the fourth ventricle was normal; C, D: The hemorrhage in the ambient cistern and lateral ventricles was absorbed, and the size was normal.

blastoma showed a result that was similar to what would be observed for arteriovenous malformations in the early arterial stage, but no obvious veins were observed in the late arterial stage, which is a result that is distinct from arteriovenous malformation [15]. In addition, the DSA imaging for the mid-late arterial stage revealed aneurysmal changes, which were considered to be a pseudoaneurysm formed after the tumor had ruptured. During tumor resection, multiple branches of posterior inferior cerebellar arteries for blood supply were observed,

but no obvious thick drainage vein was found, which might be because the draining veins of this hemangioblastoma were relatively small and not observable by DSA imaging.

Surgery remains the primary treatment of hemangioblastoma [16]. Reportedly, for tumors with rich blood supplies, preoperative embolization can be applied to reduce the blood volume [17]. The blood supplies of hemangioblastomas are rich; thus, hemodynamic aneurysms may even appear on the feeding artery. For

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example, in 2014, Suzuki et al reported one case of aneurysm on the tumor feeding artery, and an embolism was provided [18]. Therefore, preoperative embolization is necessary for hemangioblastoma. In this case, due to the small size of the tumor, the feeding artery was the distal posterior inferior cerebellar artery; thus, the risk of direct removal should be very low. During surgery, the tumor was found when the arachnoid of the cisterna magna was open. The tumor was successfully resected, and the hematoma was then removed, resulting in a satisfactory outcome.

Conclusions

The rupture of infratentorial hemangioblastomas may occur in extremely rare cases. When these tumors are located in the posterior part of the fourth ventricle, the hemorrhage may enter the fourth ventricle to cause a hemorrhage in the ventricular system; the hemorrhage could cover the tumor, which could then present as a simple intraventricular hemorrhage, resulting in a misdiagnosis.

Disclosure of conflict of interest

None.

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References

- [1] Brundl E, Schodel P, Ullrich OW, Brawanski A and Schebesch KM. Surgical resection of sporadic and hereditary hemangioblastoma: Our 10-year experience and a literature review. *Surg Neurol Int* 2014; 5: 138.
- [2] Kano H, Shuto T, Iwai Y, Sheehan J, Yamamoto M, McBride HL, Sato M, Serizawa T, Yomo S, Moriki A, Kohda Y, Young B, Suzuki S, Kenai H, Duma C, Kikuchi Y, Mathieu D, Akabane A, Nagano O, Kondziolka D and Lunsford LD. Stereotactic radiosurgery for intracranial hemangioblastomas: a retrospective international outcome study. *J Neurosurg* 2015; 122: 1469-1478.
- [3] Glasker S and Van Velthoven V. Risk of hemorrhage in hemangioblastomas of the central nervous system. *Neurosurgery* 2005; 57: 71-76; discussion 71-76.
- [4] Lee GJ, Jung TY, Kim IY, Jung S, Jang WY, Moon KS and Kim SK. The clinical experience of recent central nervous system hemangioblastomas. *Clin Neurol Neurosurg* 2014; 123: 90-95.
- [5] Shankar GM, Taylor-Weiner A, Lelic N, Jones RT, Kim JC, Francis JM, Abedalthagafi M, Borges LF, Coumans JV, Curry WT, Nahed BV, Shin JH, Paek SH, Park SH, Stewart C, Lawrence MS, Cibulskis K, Thorner AR, Van Hummelen P, Stemmer-Rachamimov AO, Batchelor TT, Carter SL, Hoang MP, Santagata S, Louis DN, Barker FG, Meyerson M, Getz G, Brastianos PK and Cahill DP. Sporadic hemangioblastomas are characterized by cryptic VHL inactivation. *Acta Neuropathol Commun* 2014; 2: 167.
- [6] Peyre M, David P, Van Effenterre R, François P, Thys M, Emery E, Redondo A, Decq P, Aghakhani N, Parker F, Tadié M, Lacroix C, Bhangoo R, Giraud S, Richard S; French NCI Network VHL Disease and Inherited Predisposition to Kidney Cancer. Natural history of supratentorial hemangioblastomas in von Hippel-Lindau disease. *Neurosurgery* 2010; 67: 577-587; discussion 587.
- [7] Fukuda M, Takao T, Hiraishi T, Yoshimura J, Yajima N, Saito A and Fujii Y. Clinical factors predicting outcomes after surgical resection for sporadic cerebellar hemangioblastomas. *World Neurosurg* 2014; 82: 815-821.
- [8] Ma D, Wang Y, Du G and Zhou L. Neurosurgical Management of Brainstem Hemangioblastomas: A Single-Institution Experience with 116 Patients. *World Neurosurg* 2015; 84: 1030-1038.
- [9] Ene CI, Morton RP, Ferreira M Jr, Sekhar LN and Kim LJ. Spontaneous Hemorrhage from Central Nervous System Hemangioblastomas. *World Neurosurg* 2015; 83: 1180, e1113-1187.
- [10] Hashimoto K, Nozaki K, Oda Y and Kikuchi H. Cerebellar hemangioblastoma with intracystic hemorrhage-case report. *Neurol Med Chir (Tokyo)* 1995; 35: 458-461.
- [11] Lee JY, Cho BM, Oh SM and Park SH. Delayed diagnosis of cerebellar hemangioblastoma after intracerebellar hemorrhage. *Surg Neurol* 2007; 67: 419-421.
- [12] Lee B, Marquez YD and Giannotta SL. Resection of a cystic brainstem hemangioblastoma via a retrosigmoid approach. *Neurosurg Focus* 2014; 36: 1.
- [13] Tani S, Ashida S, Yoneda H, Yoshioka N, Okada M, Kawabata Y, Nitta T and Yamashita K. [The Efficacy of CT angiography using the IVR-CT/angio system for surgical treatment of spinal hemangioblastoma]. *No Shinkei Geka* 2012; 40: 49-54.
- [14] Shin GW, Jeong HW, Seo JH, Kim ST, Choo HJ and Lee SJ. Preoperative embolization of cer-

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- ebellar hemangioblastoma with onyx: report of three cases. *Neurointervention* 2014; 9: 45-49.
- [15] Ivanov AA, Alaraj A, Charbel FT, Aletich V and Amin-Hanjani S. Recurrence of Cerebral Arteriovenous Malformations Following Resection in Adults: Does Preoperative Embolization Increase the Risk? *Neurosurgery* 2016; 78: 562-71.
- [16] Wu P, Liang C, Wang Y, Guo Z, Li B, Qiu B, Li X, Wen Z and Pan Q. Microneurosurgery in combination with endovascular embolisation in the treatment of solid haemangioblastoma in the dorsal medulla oblongata. *Clin Neurol Neurosurg* 2013; 115: 651-657.
- [17] Sakamoto N, Ishikawa E, Nakai Y, Akutsu H, Yamamoto T, Nakai K, Shiigai M, Tsurushima H, Isobe T, Takano S, Tsuboi K and Matsumura A. Preoperative endovascular embolization for hemangioblastoma in the posterior fossa. *Neurol Med Chir (Tokyo)* 2012; 52: 878-884.
- [18] Suzuki M, Umeoka K, Kominami S and Morita A. Successful treatment of a ruptured flow-related aneurysm in a patient with hemangioblastoma: Case report and review of literature. *Surg Neurol Int* 2014; 5: S430-433.