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Case Report

Case of Clear Cell Ependymoma Successfully Treated with Preoperative Embolization

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Objective: Clear cell ependymoma (CCE) is known to be very similar to hemangioblastoma (HB) in regards to neuroimaging and histopathology. We report a rare case of CCE in which successfully underwent preoperative embolization with a prior diagnosis of HB.

Case Presentation: A 58-year-old woman presented with vertigo for several months. MRI showed the right cerebellar tumor mimicking solid HB. DSA revealed the hypervascular tumor supplied by branches of the posterior inferior cerebellar artery (PICA). To reduce intraoperative bleeding, preoperative embolization was performed using n-butyl-2-cyanoacrylate (NBCA). A flow-guided microcatheter was guided to the proper feeders, and diluted NBCA was injected. Sufficient devascularization was achieved. The tumor was totally resected with minimal blood loss the next day. Postoperative pathological diagnosis was CCE.

Conclusion: This is the first report that preoperative embolization was performed to CCE with careful techniques and recent advanced devices. Since CCE has a poorer prognosis, preoperative embolization for safety total resection may be more important.

Keywords ▶ clear cell ependymoma, intracranial tumor, hypervascular tumor, preoperative embolization, transarterial embolization

Introduction

Preoperative embolization is often performed before resection of hypervascular tumors. It seems to have the effect of reducing bleeding, softening of the tumor, and shortening of the operation time.[1–4] While the target of the surgery is primarily meningioma, it also applies to other tumors such as hemangioblastoma (HB). Although clear cell ependymoma (CCE) is a rare tumor, the tumor at cerebellums is often known to have both neuroimaging and histological similarities with HB.[5] We experienced a rare case of CCE which successfully underwent preoperative embolization with a prior diagnosis of HB.

Case Presentation

A 58-year-old woman presented with vertigo for several months. She was referred to our hospital since a cerebellar tumor was pointed out at another hospital. MRI showed the cystic tumor with a maximum diameter of 30 mm in the right cerebellum and the wall components showed contrast enhancement (**Fig. 1**). The diagnosis at admission was HB and we prepared for tumor embolization before resection. DSA revealed the hypervascular tumor supplied by branches of the posterior inferior cerebellar artery (PICA) (**Fig. 2A–D**). DSA findings seemed to be consistent with the diagnosis of HB: enlarged feeders, intense tumor stain, contrast stagnation, early venous

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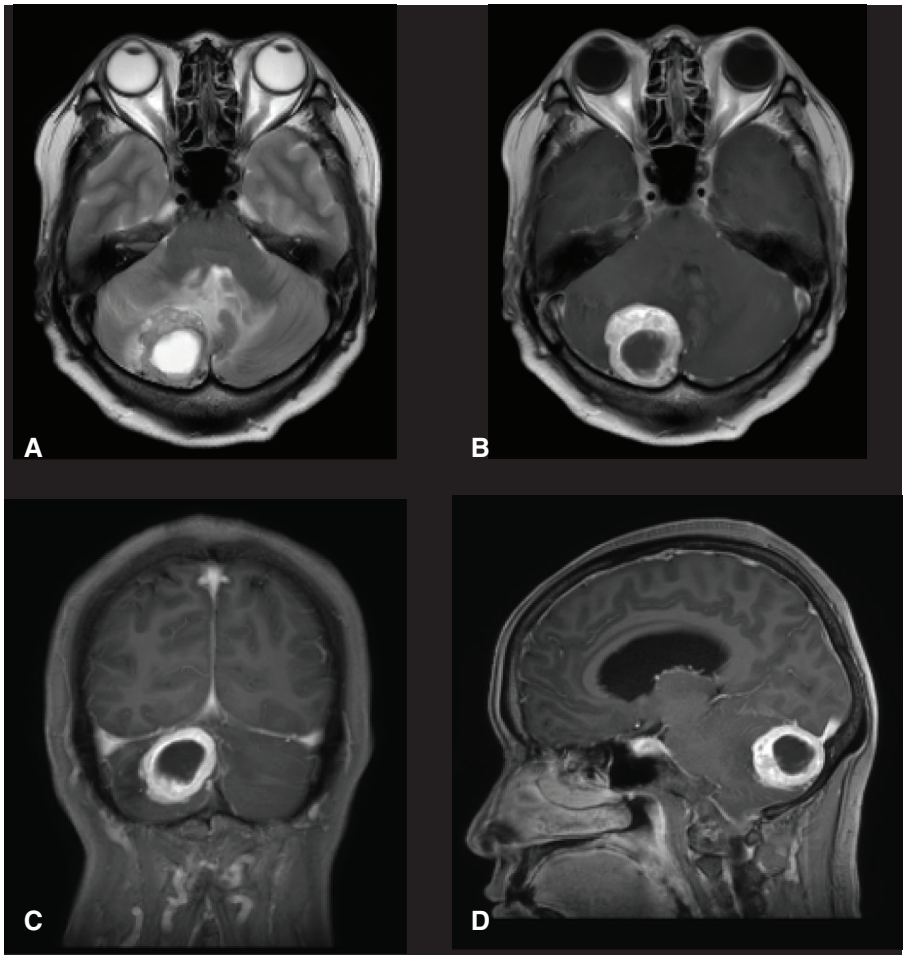

Fig. 1 MRI before treatments. (**A**) T2WI showed the cystic tumor with perifocal edema in the right cerebellum. (**B–D**) T1WI revealed an enhanced lesion mimicking solid hemangioblastoma. T1WI: T1-weighted image; T2WI: T2-weighed image

filling, and dilated draining veins. Transarterial embolization (TAE) using n-butyl-2-cyanoacrylate (NBCA) was performed under local anesthesia. After a 7Fr sheath was placed in the right femoral artery, a 7Fr FUBUKI guiding catheter (Asahi Intecc, Aichi, Japan) and 4.2 Fr FUBUKI distal access catheter (Asahi Intecc) were navigated into the left vertebral artery for use in tri-axial systems. Large profile catheters could not be reached to target vessels. Therefore, a magic flow-dependent microcatheter (Balt Extrusion, Montmorency, France) was guided to one of the proper feeder of the PICA, followed by NBCA/Lipiodol mixture solution (15% NBCA) embolization with a slow and intermittent injection. This method similar to "plug and push" was used to allow the glue to penetrate into the tumor while deeply paying attention to trapping the microcatheter. The same procedure was performed for another feeder (**Fig. 2E** and **2F**). The above treatment achieved sufficient devescularization (**Fig. 2G** and **2H**). The tumor was totally resected with minimal blood loss the next day (**Fig. 3**), and postoperative course was uneventful. Histopathological examination of the tumor was performed (**Fig. 4A**). The tumor was characterized by abundant vascular network and clear cells mimicking HB, but vague perivascular pseudo-rosettes and spindle-like cells were also observed (**Fig. 4B** and **4C**). The tumor cells, unlike HB, were diffusely positive for glial fibrillary acidic protein (**Fig. 4D**), but negative for synaptophysin on immunohistochemistry (IHC). Although there was neither a true ependymal rosette nor a perivascular pseudo-rosette, postoperative pathological diagnosis was CCE considering the results of IHC. Radiation therapy was not added because total resection was achieved.

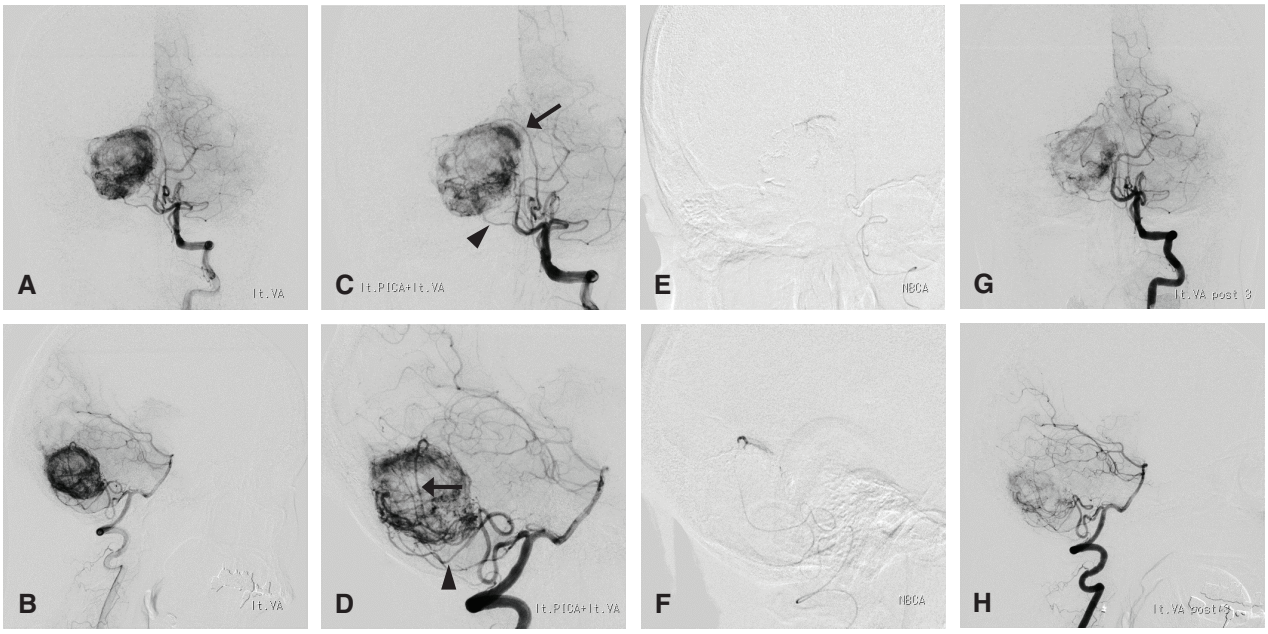

Fig. 2 Angiography of the left vertebral artery (**A**, frontal view; **B**, lateral view). It showed the hypervascular tumor supplied by branches of the posterior inferior cerebellar artery and seemed to be consistent with the diagnosis of hemangioblastoma: enlarged feeders, intense tumor stain, contrast stagnation, and dilated draining veins. (**C** and **D**) Working view of angiogram showed target feeders (arrowheads and arrows). (**E** and **F**) Each feeders were embolized using 15% n-butyl-2-cyanoacrylate. (**G** and **H**) Sufficient devescularization was achieved after embolization.

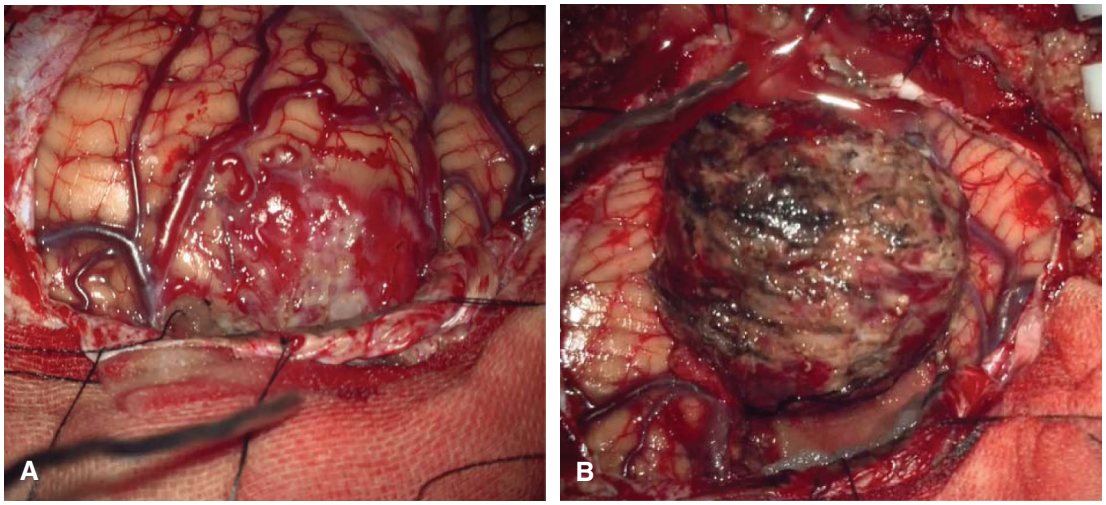

Fig. 3 Surgical findings. (**A**) The hypervascular tumor was exposed after dural incision. (**B**) The lesion was completely resected en bloc.

Discussion

A subtype of ependymoma that consisted mostly of clear cells was first described by Kawano et al[6,7] in 1983, and named "clear cell ependymoma" in 1989. According to 2016 World Health Organization Central Nervous System classification, ependymoma (grade II) include three histopathological variants: papillary, clear cell, and tanycytic ependymoma.[8] Of the three variants, clear cell and tanycytic ependymoma are uncommon. Unlike most ependymoma, CCE is associated with an aggressive course including early recurrence and extraneural metastases despite gross total resection, and needs more careful management.[9,10]

As reported in the past, MRI findings of cerebellar CCE are quite similar to that of HB. Histological features also

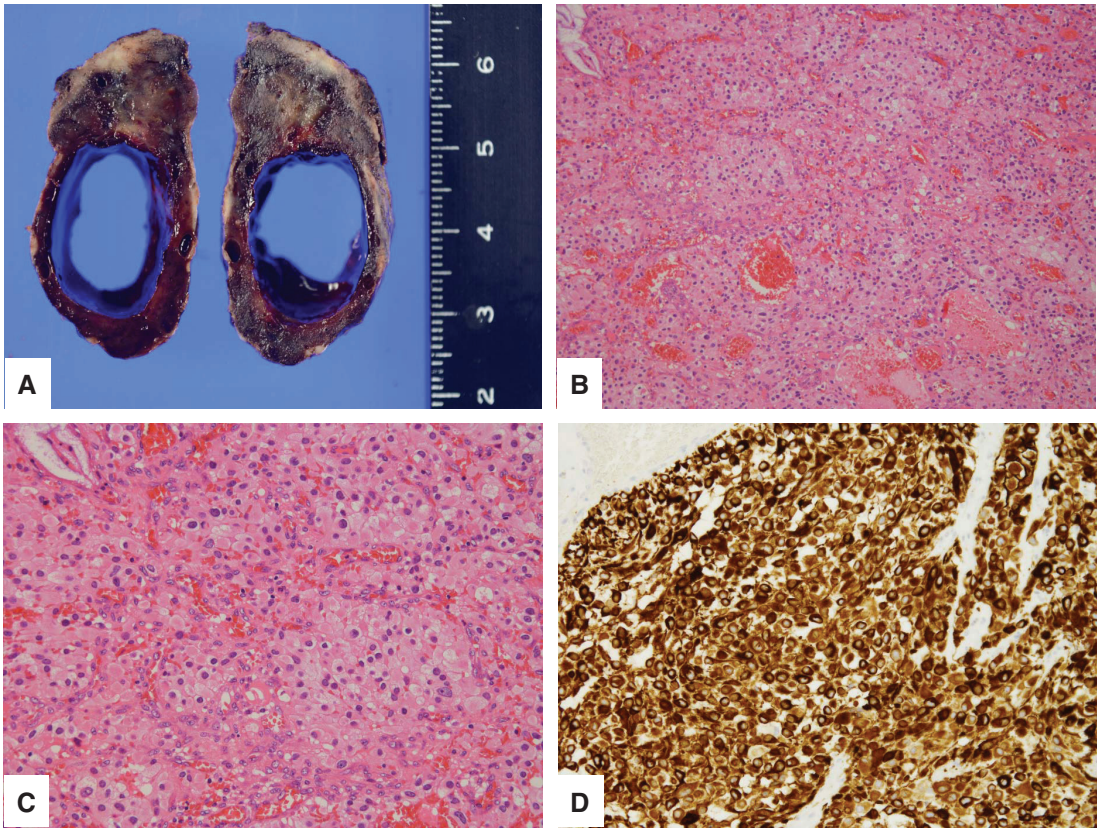

Fig. 4 Histopathological findings. (**A**) Resected tumor specimen. (**B** and **C**) Hematoxylin and eosin staining shows the tumor was characterized by abundant vascular network and clear cells. Vague perivascular pseudo-rosettes and spindle-like cells were also observed. (**D**) The tumor cells were diffusely and strongly positive for glial fibrillary acidic protein on immunohistochemistry. Postoperative pathological diagnosis was CCE, variant of ependymoma (WHO grade II). CCE: clear cell ependymoma

similar to those of HB, oligodendroglioma, central neurocytoma, and metastasis of renal cell carcinoma.[5] Therefore, differential diagnosis between cerebellar CCE and HB is sometimes significant challenging. In present case, we led to preoperative diagnosis of HB from MRI findings. HB is varied in appearance, including solid, solid-cystic, or mainly cystic with a mural nidus.[11] CCE at cerebellum shows similar findings to HB, making accurate differentiation difficult. Immunohistological examinations are useful for distinguishing the two. CCE express glial fibrillary acidic protein (GFAP) and its intensity is stronger and more extensive than in HB.[12] In addition, our group had reported that ^{201}Tl-SPECT can help to differentiate between cerebellar CCE and HB to establish the correct preoperative diagnosis, however, not performed in this case unfortunately.[10]

Moreover, there is very little information in the literature regarding DSA findings of ependymoma; tumor stain proportional to the thickness of solid component, supply by internal carotid artery (ICA) or vertebro-basilar artery (VBA), and early venous filling.[13,14] Furthermore, there were no reports describing the DSA findings of CCE. DSA findings of our case seemed to be consistent with the diagnosis of HB: enlarged feeders, intense tumor stain, contrast stagnation, early venous filling, and dilated draining veins. It seems to be difficult to distinguish CCE from HB by DSA in our case. The above findings may be common to various intra-axial hypervascular tumors.

After all, tumor embolization was performed with a prior diagnosis of HB. To the best of our knowledge, this is the first report that preoperative embolization was performed to ependymoma including CCE. Recently, several reports suggest that preoperative embolization is effective for HB. The multicenter Japanese Registry of NeuroEndovascular Therapy 3 (JR-NET3) study group reported the result of 1544 cases of embolization for intracranial tumors.[15] Among them, meningioma accounted for 86.6% and HB for 4.7%. In general, embolization is suitable only for cases in which feeding artery is definite and does not affect normal blood supply. Embolization for the vessels other than externa carotid

artery and embolization using liquid embolic materials were significantly associated with higher risk of complications, such as perioperative intra- or peritumoral hemorrhage and cerebral infarctions.[15] While one literature review has questioned the effectiveness of embolization for HB,[16] some recent case reports have shown efficacy. In the review, embolization did not increase the rates of gross total resection and decrease the rates of intraoperative blood transfusion and postoperative hemorrhage. On the other hand, several case series have demonstrated relatively good results with using various techniques and new devices.[17–20] In these reports, some cases resulted in total obliteration due to flow-guided microcatheter and liquid embolic materials.

In our case, TAE with a slow and intermittent injection was successfully performed with maximum attention to vessel injury, trapping of the microcatheter, and migration of NBCA into normal vessels. Although this method has been described for embolization of mainly external carotid artery in meningiomas,[21] it should be noted that there is a risk of trapping of a microcatheter when used on pial vessels. Embolization to intra-axial hypervascular tumors is not a routine treatment at present; therefore, it is important to consider treatment strategies taking into account risks and benefits in each individual case.

Conclusion

This is the first report that preoperative embolization was performed to CCE with careful techniques and recent advanced devices. Since CCE has a poorer prognosis, preoperative embolization for safety total resection may be more important.

Disclosure Statement

There are no conflicts of interest or sources of funding to disclose.

No author has a personal or institutional financial interest in the drugs, materials, or devices described in this paper.

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