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Case Report

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Ruptured Cavernoma Associated with Developmental Venous Anomaly: Case Report

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ABSTRACT

Introduction: Cerebral Cavernous Malformations (CCMs) are rare vascular lesions, often associated with genetic mutations. The association between these malformations and Developmental Venous Anomaly (DVA) has been the focus of recent studies, as they may influence the evolution of the lesions.

Case Presentation: A 26-year-old female patient presented with a sudden onset of severe headache, vertigo, and ataxia, requiring hospitalization due to cerebellar hemorrhage confirmed by CT scan. Magnetic Resonance Imaging (MRI) revealed a cavernoma in the right cerebellar peduncle with an adjacent DVA. The patient underwent surgical intervention with intraoperative neuronavigation, where the DVA was used as an anatomical landmark to locate and completely excise the cavernoma while preserving the anomalous vein. Postoperatively, the patient showed significant improvement without neurological deficits.

Conclusion: CCMs can be sporadic or familial, and they are frequently associated with DVAs. DVA resection can impair venous drainage and cause infarction, making its preservation crucial during surgery. A conservative approach is recommended in most cases, with resection indicated for symptomatic lesions or those at high risk of bleeding.

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INTRODUCTION

Cerebral Cavernous Malformations (CCMs) are rare, with only one-third of cases linked to familial genetic mutations [1]. Recent studies have identified a set of genetic mutations that increase the likelihood of these lesions developing, often accompanied by additional mutations in the same region, such as Developmental Venous Anomaly (DVA) [1–2]. The association between these two conditions has become a highly discussed topic. We report a case of a female patient with a ruptured cavernoma in the cerebellar peduncle associated with DVA, where the DVA was used as an anatomical landmark during the surgical procedure to locate and excise the cavernoma while preserving the DVA and avoiding extensive ischemic infarction.

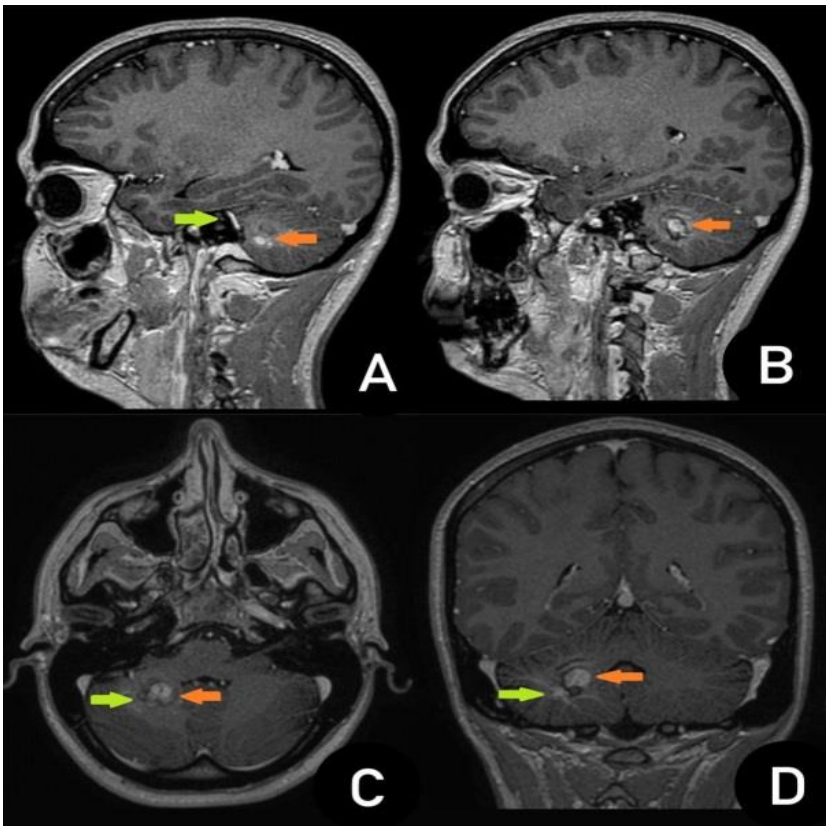


Fig. 1. Brain MRI with T2 flair weighting (A and B - sagittal cuts, C - axial, and D - coronal), showing DVA (green arrow) and CCM (orange arrow).

CASE PRESENTATION

A 26-year-old female patient presented with sudden-onset severe headache, vertigo, and ataxia, requiring admission to the Intensive Care Unit for 5 days due to cerebellar hemorrhage confirmed by a cranial CT scan. On physical examination, she had right appendicular ataxia, dysmetria, and dysdiadochokinesia on the right. The patient had no prior comorbidities. MRI of the brain revealed a hyperintense nodular image on T2, which enhanced with contrast, showing hypointensity on the gradient sequence in the right cerebellar peduncle and cerebellar folia, suggestive of a cavernous angioma. A branched linear hyperintense image in the right cerebellar folia indicated a venous developmental anomaly (Fig.1).

Surgical intervention was chosen one month after the ictus, with a right retrosigmoidal incision using intraoperative neuronavigation. Initially, the DVA (Fig.2A) was identified and used as an anatomical landmark to locate the cavernoma (Fig.2B). After full exposure of the cavernoma, total excision was performed while preserving the DVA (Fig.2C), thus preventing extensive ischemic infarction.

Postoperatively, the patient showed significant improvement of symptoms, with no new motor/sensory deficits, and was discharged to resume daily activities two weeks after surgery.

DISCUSSION

CCMs are dilated capillary structures with thin walls, lined by a simple endothelial layer and a thin fibrous adventitia, with no neural tissue between the lesion. The vessels in the lesion are devoid of or have a minimal muscular layer, making them more prone to rupture. The surrounding tissue is typically gliotic and filled with hemosiderin from prior hemorrhages [3–6]. These malformations are found in approximately 0.5% of the general population, with equal frequency in men and women, and an average age of onset between 30 and 40 years, although women have a higher risk of hemorrhage and neurological deficits [7–12].

They can occur sporadically or in a familial pattern, representing 15% of cases, often with multiple lesions and typically associated with autosomal dominant germline variants with incomplete penetrance. The most common pathogenic variants lead to loss of function in

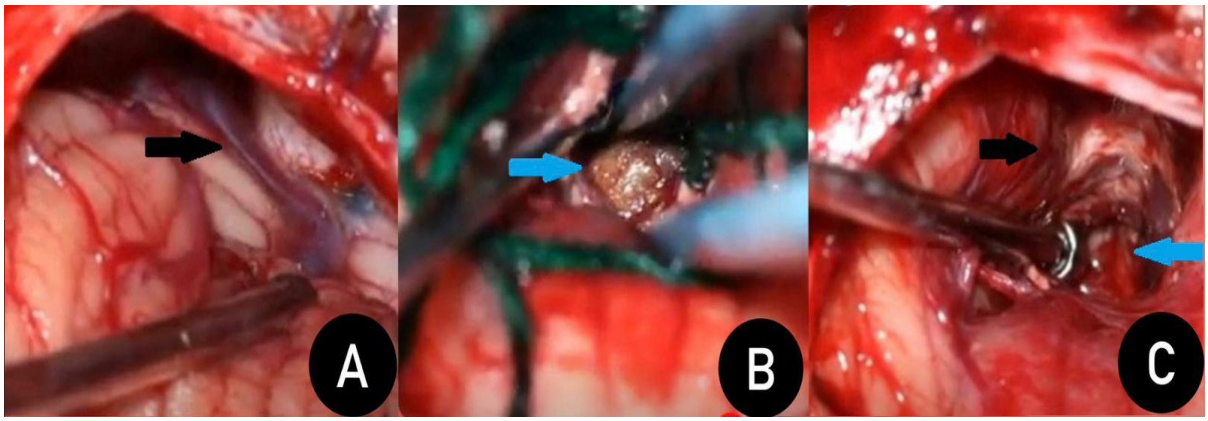


Fig. 2. Intraoperative images showing: 2.A - DVA (black arrow), 2.B - cavernoma (blue arrow), 2.C - total excision of the cavernoma (blue arrow) with preservation of the DVA (black arrow).

CCM1, CCM2, or CCM3 [8,13–16]. In rare familial cases, lesions may also occur in the retina or skin. The remaining 85% of cases are sporadic, presenting as solitary lesions occasionally associated with DVA. It is hypothesized that individual CCMs develop through a "two-hit" mechanism due to the loss of an allele in the germline matrix and somatic loss of the remaining wild-type allele [8,17,18].

The brain is the most common site for these lesions, especially in subcortical, Rolandic, and temporal areas. They are found in the cerebral hemispheres (66% of cases), brainstem (20%), cerebellum (6%), and basal ganglia or deep nuclei (approximately 8%) [12,19–21]. Symptomatology varies depending on location. Supratentorial lesions often present with hemorrhage, seizures, and progressive neurological deficits. Annual hemorrhage rates range from 0.25 to 1.1 percent. Seizures and progressive deficits may result from mass effects and secondary compromise of microcirculation or from micro-hemorrhages with local hemosiderin deposition, irritating cortical or subcortical tissue [22–23].

Infratentorial lesions typically present with hemorrhage and progressive neurological deficits. Brainstem lesions result in cranial neuropathies and long tract signs, leading to progressive neurological decline due to the high volume of critical nuclei and fiber tracts in this area. The natural history of brainstem lesions is worse than that of lesions in other areas. Annual hemorrhage rates for brainstem lesions range from 2 to 3 percent, with recurrent hemorrhage rates approaching 17 to 21%. Progressive neurological decline is observed in 39% [22–23].

MRI plays a key role in identifying and diagnosing CCMs. Characteristic findings in T1 and T2-weighted images include a "popcorn" pattern with variable signal intensities, consistent with the evolution of blood breakdown products. Gradient echo sequences can detect smaller lesions that are not visible on conventional sequences [8,24–26]. Contrast-enhanced imaging should be performed to delineate any associated DVAs. Susceptibility-weighted sequences typically demonstrate venous anomalies, often with a classic "medusa head" morphology and draining vein, which is crucial for surgical planning, as resection can compromise normal venous cortical drainage and lead to venous infarction [27,28].

DVA is considered a benign lesion, representing the most common vascular malformation found in 6–14% of the adult population in a solitary form. These small venous conduits drain into a dilated superficial or deep vein draining normal brain tissue. Lesions are commonly located in supratentorial regions of the brain, particularly in the frontal lobe, but can also be found in the cerebellum and pons [29,30].

Headache is the most common complaint, followed by seizures and sensorimotor phenomena [29,31,32]. MRI findings have identified adjacent DVAs in 24–32% of sporadic CCM cases. In contrast, familial cavernous malformations are not associated with venous anomalies. This suggests that DVA is not required for the formation of CCMs but may predispose to CCM development in sporadic cases [36–39].

Recent research has identified a mutation in the PIK3CA gene that leads to abnormal vascular patterns in the brain. Isolated DVA is typically harmless, but when a second mutation occurs in one of several genes, such as MAP3K3, CCM1 (KRIT1), CCM2, or CCM3 (PDCD10), a CCM develops [1,2].

DVAs should be treated conservatively in most cases. Obliteration may be considered in rare patients with hemorrhage or uncontrolled seizures associated with DVA. However, surgical or endovascular obliteration carries a risk of venous infarction [29].

CONCLUSION

Understanding the underlying causes of CCMs helps identify patients at higher risk for developing the condition and establish more effective treatments. Further studies are necessary to explore the association between CCMs and DVA, the involved genetic factors, when to operate on these lesions, and the use of medications to prevent disease progression.

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CONFLICT OF INTEREST

The authors declare there is no conflict of interest.

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