



Research Article

Pediatric Right Frontal Arteriovenous Malformation: Imaging Findings Using Multimodal Imaging at the Martinique University Hospital, France

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Abstract

Introduction: Cerebral arteriovenous malformations are rare congenital vascular anomalies that can be potentially serious due to their high risk of hemorrhage and neurological consequences. MR angiography is the gold standard for diagnosis and treatment planning. Endovascular embolization remains the treatment of choice for managing this condition. Our objective was to report a case of a right frontal pediatric arteriovenous malformation: multimodal imaging findings at the Martinique University Hospital in France. **Methodology:** This was a case study. Parental consent was sought and obtained prior to the patient's participation in the study. **Results:** The patient was a 17-year-old male referred for debilitating migraines with a family history of similar conditions and no focal neurological deficits. The patient had been followed since 2022 for a right frontal AVM that had been partially embolized during childhood. A brain MRI revealed a right frontal arteriovenous malformation. Conventional cerebral angiography confirmed a Grade II AVM, characterized by a loosely packed malformation nidus measuring approximately 12 mm in its longest axis. Endovascular management via embolization was performed using a dual arterial and venous approach. The procedure was successful, with no intraoperative or immediate post-procedural complications. **Conclusion:** Cerebral arteriovenous malformation is a rare congenital vascular anomaly. Endovascular embolization remains the treatment of choice for its management.

Keywords

Right Frontal AVM, Pediatrics, Angiography, Endovascular Embolization, France

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1. Introduction

A cerebral arteriovenous malformation is a congenital anomaly of the cerebral vascular system characterized by an abnormal direct connection between arteries and veins, without normal passage through the capillary network [1]. It typically manifests with symptoms between the ages of 20 and 40, including hemorrhages, seizures, or localized neurological deficits [2]. Imaging plays a central role in the management of AVMs. CT angiography is particularly useful in the emergency setting for the initial diagnosis in cases of suspected intracerebral hemorrhage, while MRI with MR angiography is the gold standard for detailed characterization and treatment planning [3, 4].

However, arteriovenous malformation is a rare vascular anomaly. Globally, its prevalence is approximately 10 to 18 people per 100,000, of whom 3 to 9% are pediatric patients [5]. In children, AVM rupture accounts for a higher proportion of spontaneous intracranial hemorrhages than in adults [6].

According to one study, the annual incidence of hemorrhage from unruptured and untreated cerebral AVMs is 2% to 4%, and approximately 38% to 71% of patients with cerebral AVMs experience an intracranial hemorrhage [7]. The annual risk of AVM rupture in medically treated children is estimated to be between 4.4% and 5.5% [6]. Given the high lifetime risk of hemorrhage, aggressive management is warranted in children with unruptured cerebral AVMs [6].

Treatment options for pediatric intracranial arteriovenous malformations include monitoring and medication; surgical resection, which remains the standard of care; endovascular embolization; radiosurgery; and combinations thereof [8]. However, surgical resection alone may sometimes prove insufficient to treat high-grade arteriovenous malformations and those located near functional structures [9]. To facilitate surgical resection, several endovascular techniques, such as embolization, are used to reduce blood flow in large arteriovenous malformations [10]. This can alleviate symptoms and reduce the size of the lesion, thereby improving the effectiveness of subsequent therapeutic approaches, such as surgery or radiosurgery [6].

Cerebral arteriovenous malformations (AVMs) are potentially serious conditions due to their high risk of hemorrhage and their neurological consequences. Their prevalence in the pediatric population is particularly high, as they occur in a developing brain, with significant functional and prognostic implications. It is in this context that we undertook this study.

Our objective was to report a case of pediatric right frontal arteriovenous malformation: multimodal imaging findings at the Martinique University Hospital, France.

2. Materials and Methods

This was a case report on a pediatric right frontal arteriovenous malformation: multimodal imaging findings. The patient's anonymity and confidentiality were respected. Parental consent was obtained prior to the patient's participation in the study.

The brain MRI scan was performed using a General Electric scanner. Conventional cerebral angiography was performed under general anesthesia, with the patient intubated and ventilated. After setup and rigorous aseptic preparation, a puncture of the right femoral artery was performed using the Seldinger technique. A 6-Fr arterial introducer was placed. Systemic anticoagulation was initiated via intravenous injection of 2,400 IU of heparin. We then performed selective catheterization of the right common carotid artery, followed by the right external carotid artery using a 5-Fr catheter, with contrast series acquired in the frontal and lateral views. Catheterization of the right internal carotid artery using a 6-Fr Benchmark guide catheter, with contrast studies performed in the anteroposterior, lateral, and double oblique views.

3. Case Report

This was a 17-year-old patient presenting with debilitating migraines and a family history of similar conditions, with no focal neurological deficits. The general and cardiovascular physical examination was normal. The patient was receiving Levetiracetam (Keppra® 500 mg morning and evening), prescribed following the discovery of old hemorrhagic sequelae on MRI in 2022, in the context of a right frontal AVM that had been partially embolized during childhood. A non-contrast brain CT scan ruled out any acute hemorrhagic recurrence.

A brain MRI was performed and revealed the persistence of a right frontal nidus measuring 12 mm in maximum diameter with multiple serpiginous structures in the flow void.

Conventional cerebral angiography confirmed a grade II right frontal AVM, following the identification of a loosely packed malformation nidus, approximately 12 mm in longest axis, primarily supplied by branches originating from the right anterior cerebral artery, with early venous drainage occurring mainly through a single, dilated cortical vein that drains into the superior longitudinal sinus.

Embolization via dual arterial and venous approaches was successfully performed without complications. The postoperative course was uneventful. The immediate and medium-term outcome was very favorable, with complete resolution of headaches and the absence of neurological deficits or migraine recurrence.

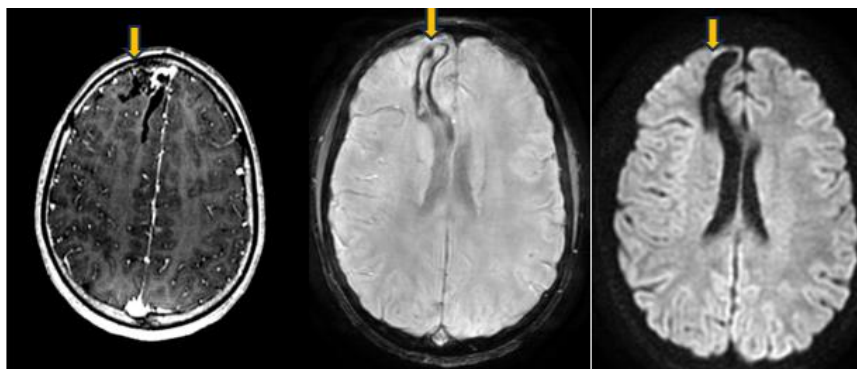


Figure 1. Brain MRI showing a maximal right frontal nidus with multiple serpiginous structures in areas of reduced blood flow.

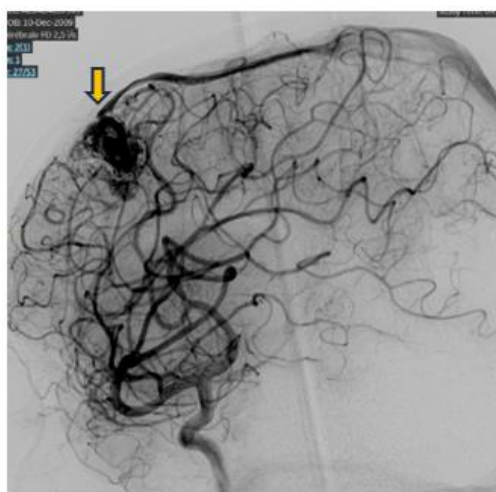


Figure 2. Cerebral angiogram showing a right frontal AVM.

4. Discussion

The patient was 17 years old. This finding differs from that reported by Parenrengi MA et al. [6], who described two cases of AVMs in patients aged 6 and 9 years in their 2021 study on endovascular embolization of pediatric cerebral arteriovenous malformations. This predominance in younger patients may be related to the congenital nature of the condition and its progressive manifestation during growth.

In our study, conventional cerebral angiography confirmed a grade II right frontal AVM, revealing a poorly compacted malformation nidus, approximately 12 mm in longest axis, primarily supplied by branches originating from the right anterior cerebral artery, with early venous drainage, which occurs mainly through a single, dilated cortical vein that drains into the superior longitudinal sinus.

In the study by Parenrengi MA et al. [6], angiography in the first case revealed a vascular malformation in the right paracentral lobule, with a fistula supplied by an artery originating from the posterior frontal artery and draining into the Rolandic vein. This fistula measured 5.62×7.48 mm. The diagnosis

was a ruptured pial arteriovenous malformation (AVM) of the right paracentral lobule. Endovascular embolization was scheduled and performed the day after the transfemoral cerebral angiography. In the second case, the examination revealed a vascular malformation (circled in red) in the right parietal lobe, supplied by a right pericallosal artery, itself a branch of the right anterior cerebral artery. A nidus measuring 4.86×2.43 mm, drained by the internal cerebral vein, was present. These results confirm that conventional cerebral angiography is the gold standard for the diagnosis of arteriovenous malformations.

In this study, the postoperative course was uneventful. The immediate and mid-term outcomes were very favorable, with complete resolution of headaches and no neurological deficits or migraine recurrence. In the study by Pezeshkpour P et al. [11], early complications following embolization were observed in 12.5% of patients, while late complications occurred in 22.9% of them, and recurrent hemorrhages occurred in 18 patients (9.7%) after treatment. The mortality rate was 1.1% of cases. Previous studies have shown that children tend to have smaller nidus, an important factor for the success of embolization alone in the treatment of AVMs [11]. This could mean that endovascular embolization alone would be more appropriate in most children, although individualized indications and treatment decisions must be made for each patient.

5. Conclusion

A cerebral arteriovenous malformation is a congenital anomaly of the cerebral vascular system. Conventional cerebral angiography is an effective method for its diagnosis and treatment through endovascular embolization. No immediate or late post-embolization complications were observed in this study.

Abbreviations

AVM	Arteriovenous malformation
MRI	Magnetic Resonance Imaging
CHU	University Medical Center

CT Computed Tomography

Author Contributions

Oumar Badjie Kone: Conceptualization, Project administration, Writing – review & editing

Keita Aboubacar: Supervision

Guillaume Lienemann: Supervision

Aldjouma Yanogue: Formal Analysis, Writing – original draft

Abdoulaye Modi Camara: Supervision

Conflicts of Interest

The authors declare no conflicts of interest.

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