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Case Report

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Treatment of a Pediatric Recurrent Dissecting Middle Cerebral Artery Aneurysm with a Flow Diverter: A Case Report

Zejin LI*, Yu FENG*, Tingbao ZHANG, Wenyuan ZHAO

Zhongnan Hospital of Wuhan University, Department of Neurosurgery, Wuhan, Hubei Province, China

*These authors contributed equally to this work.

Corresponding author: WENYUAN ZHAO ✉ zhaowenyuan2021@163.com

ABSTRACT

Intracranial aneurysms are rare in the pediatric population, while fusiform middle cerebral artery (MCA) aneurysms are more common. Although surgical clipping is the generally preferred treatment strategy for aneurysms, occasional recurrence may still occur after successful clipping. As expertise in the use of flow diverters in adults has developed, they have also been applied in the management of aneurysms in children. This study aims to report a case of recurrence of MCA aneurysm after clipping, which was effectively treated using the Tubridge flow diverter. In the event of a recurrently clipped aneurysm, the implementation of a flow diverter treatment may be considered. Furthermore, we investigated the use of dual antiplatelet protocols during the perioperative period in children.

KEYWORDS: Case report, Flow diverter, Pediatric, Intracranial aneurysm, Recurrence

ABBREVIATIONS: MCA: Middle cerebral artery, **CTA:** Computed tomography angiography, **DSA:** Digital subtraction angiography, **TEG:** Thromboelastography

INTRODUCTION

Intracranial aneurysms in pediatric patients tend to be infrequent lesions, and their genuine occurrence remains unknown. Children commonly represent less than 5% of patients with aneurysms in most published studies (3,11,14). However, the aneurysm morphology and pathogenesis may differ from that of adults. Fusiform MCA aneurysms are more prevalent in adolescents (2-4). Previous studies have reported that open surgery may be more durable and effective, but occasional recurrence may still occur after successful clipping (4,8). Endovascular treatment is a frequently used treatment method for recurrent aneurysms in adults. Pipeline flow diverters were initially approved for use in patients aged 21 years and above. However, similar to adults, the application of flow diverters in children has been considered an attractive treatment option for aneurysms, especially fusiform and dissecting aneurysms (9,11,13). In this study, we present a case of recurrent dissecting MCA aneurysm in a pediatric patient who was effectively treated using the Tubridge flow diverter.

CASE REPORT

This study included a 5-year-old boy who presented with intermittent headaches without a trigger and was found to have a large complex aneurysm on the right MCA based on the computed tomography angiography (CTA) results (Figure 1). Subsequent digital subtraction angiography (DSA) has revealed a large (14.6 mm × 10.8 mm) MCA aneurysm, with a neck width of 3.3 mm (Figure 2). Shortly after the DSA, the patient and family agreed that he should undergo elective clip reconstruction of the diseased section of the MCA. Moreover, the aneurysm was successfully clipped and the parent artery was remodeled.

Zejin LI : 0009-0006-8473-714X
Yu FENG : 0000-0002-4292-8777
Tingbao ZHANG : 0000-0002-4542-9068
Wenyuan ZHAO : 0000-0002-8125-711X

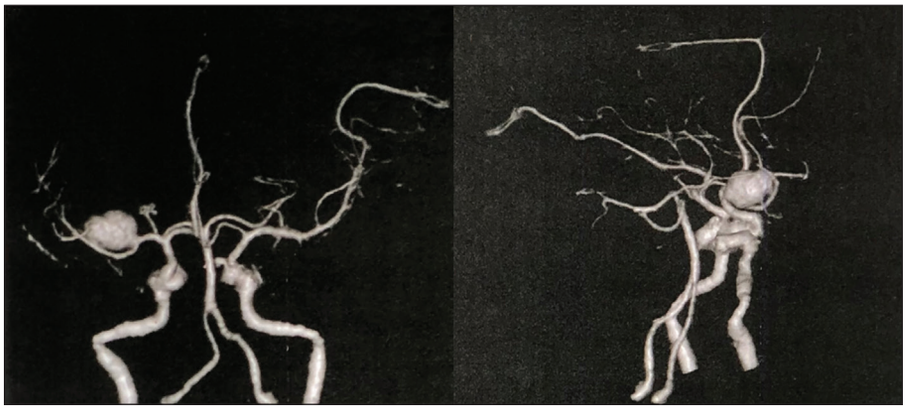

Figure 1: The CTA examination on admission. It shows a right MCA aneurysm.

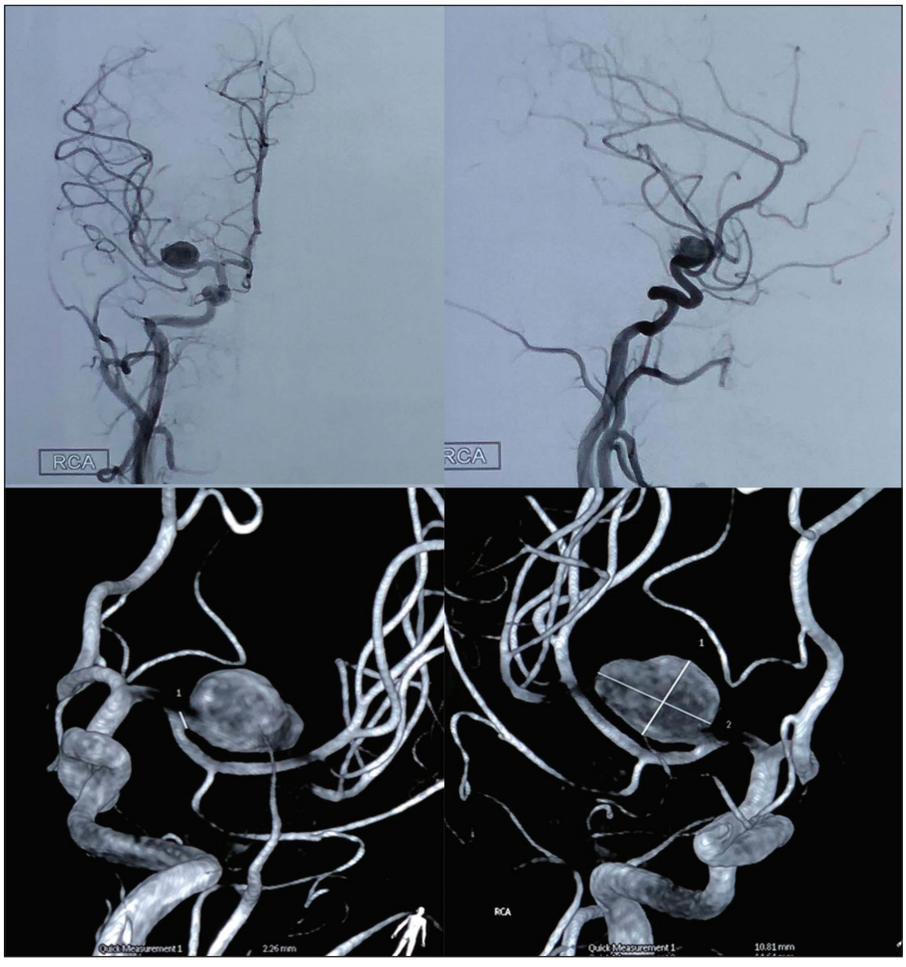

Figure 2: A preoperative DSA reveals a giant (14.6 x 10.8 mm) MCA aneurysm.

Three months after surgical clipping, he presented to the neurosurgery department with a severe headache, and the imaging studies revealed a recurrent aneurysm (Figures 3A, B). Notably, a new aneurysm had developed adjacent to the previously treated aneurysm (Figure 3C). Thus, various treatment options have been considered, including surgical and endovascular procedures. The application of the Tubridge flow diverter was selected as the best treatment option to achieve complete aneurysm obliteration with acceptable risk among other endovascular treatment options.

Since he had a body weight of 30kg, he was pretreated with 60 mg of aspirin and 30 mg of clopidogrel daily for 5 days. Subsequently, we refined the light transmission aggregometry and thromboelastography (TEG) platelet mapping, suggesting that both aspirin and clopidogrel were effective at reducing the platelet aggregation rate to 20% of the normal levels. The procedure was performed under general endotracheal anesthesia, and the patient was systemically heparinized. A bilateral femoral approach was applied to enable the simultaneous navigation of the two microcatheters. Under general anesthe-

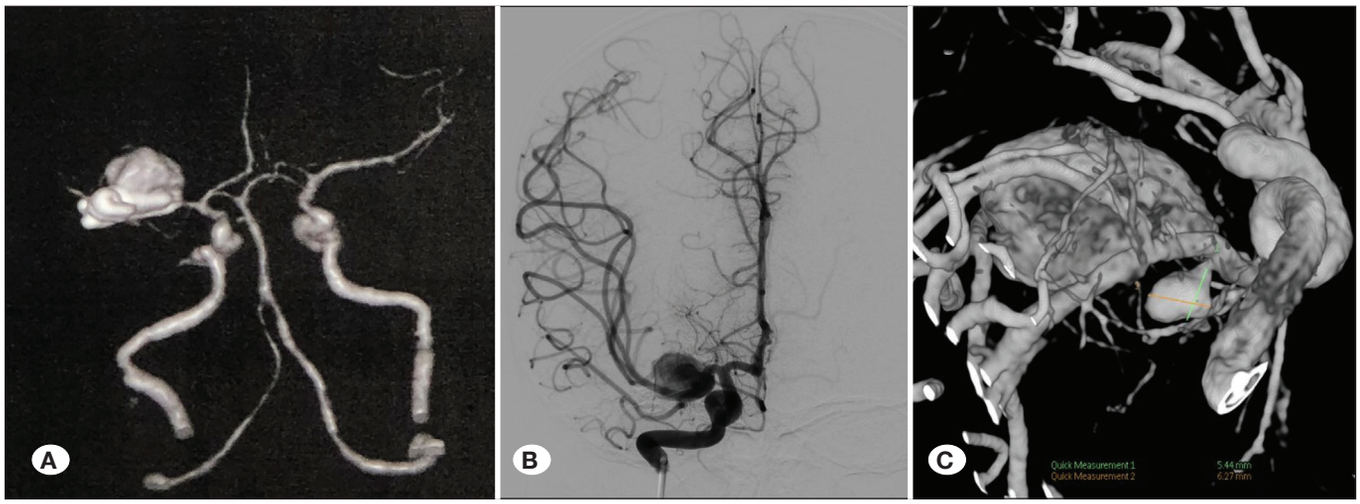

Figure 3: Right internal carotid angiogram 3 months after surgery show a recurrent MCA aneurysm. **A)** CTA **B)** DSA **C)** A reconstructed 3D DSA confirms a new aneurysm has developed near the recurrent aneurysm.

sia and anticoagulation, a 6F 90-cm-long sheath introducer and 5F Envoy guiding catheter were placed into the proximal right internal carotid artery. Moreover, a 5F DAC support catheter was guided through the long sheath and positioned within the right cavernous segment of the internal carotid artery. Subsequently, a T-track microcatheter was navigated via the DAC catheter into the right MCA M2, whereas an Echelon10 microcatheter was navigated coaxially into the small aneurysm sac via the Envoy guiding catheter. Three coils were inserted to embolize the aneurysm. The super-selective catheterization of the large aneurysm revealed a vessel branch arising from the aneurysm wall during angiography. Considering the possibility of acute aneurysm occlusion leading to vascular blockage and subsequent neurological dysfunction, we decided not to insert a coil into the large aneurysm. Finally, the Tubridge flow diverter (3.0 × 25 mm) was advanced into the microcatheter, which was deployed uneventfully and crossed the entirety of the aneurysm neck. The intraprocedural arteriograms revealed successful stent placement with a stagnation of blood flow in the aneurysm (Figure 4A).

The procedure was otherwise uneventful, and the patient was discharged after 4 days. The results of the follow-up catheter angiography, which was conducted 11 months after the Tubridge flow diverter procedure was performed, revealed complete exclusion of the aneurysm and reconstruction of the artery (Figure 4B, C). The Vaso CT indicated good apposition of the stent margins to the arterial wall (Figure 4D). The administration of clopidogrel was discontinued at 11 months, and the patient continued treatment with aspirin on a daily basis.

DISCUSSION

This study presents a case of recurrent aneurysm in the right MCA of a pediatric patient who underwent successful endovascular reconstruction using a flow diverter. Although several studies have reported cases of flow diverter placement in patients with MCA aneurysms, research on the use of the Tubridge flow diverter at this site among pediatric patients under the age of 10 years is limited (7). Moreover, this study aims to contribute significant findings to help develop additional therapeutic approaches for the potential management of recurrent aneurysms after pediatric aneurysm clipping.

Cerebral aneurysms tend to be rare in children, and only a few centers have extensive experience in their treatment (1, 11). Pediatric aneurysms differ from adult aneurysms in terms of sex, morphology, size, and location (13). Upon the re-evaluation of the child three months later, it was observed that not only did the previously clipped aneurysm recur but a new aneurysm also appeared adjacent to the recurrent aneurysm. It was suspected as a dissecting aneurysm, wherein an abnormality in the vessel wall led to the rapid recurrence of the clipped aneurysm and the formation of a new one. Unfortunately, the parents declined the MRI scan due to concerns about its effect on the aneurysm clips. This prevented us from completing the high-resolution MRI and other tests to produce a conclusive diagnosis. Based on the clinical manifestations alone, we can infer that it may be a dissecting aneurysm. Dissecting aneurysms involving the MCA during childhood are uncommon. The review conducted by Lasjaunias et al. on 59 patients younger than 15 years old reported 33 (45%) patients with dissecting aneurysms (only four involving MCA) having a mean age of 6 years (6).

Over the last two decades, a significant shift in the approach to vascular neurosurgery has been observed, wherein the emphasis has shifted from invasive surgical methods for treating intracranial aneurysms to the adoption of minimally invasive endovascular techniques (8). The emergence of flow diverters has facilitated this shift, leading to the treatment of aneurysms through the reconstruction of the parent artery. The Tubridge flow diverter has shown favorable outcomes in treating recurrent and dissecting aneurysms in adult patients (5,15). To our knowledge, the present case is the youngest patient who had received treatment for a recurring aneurysm using a Tubridge flow diverter.

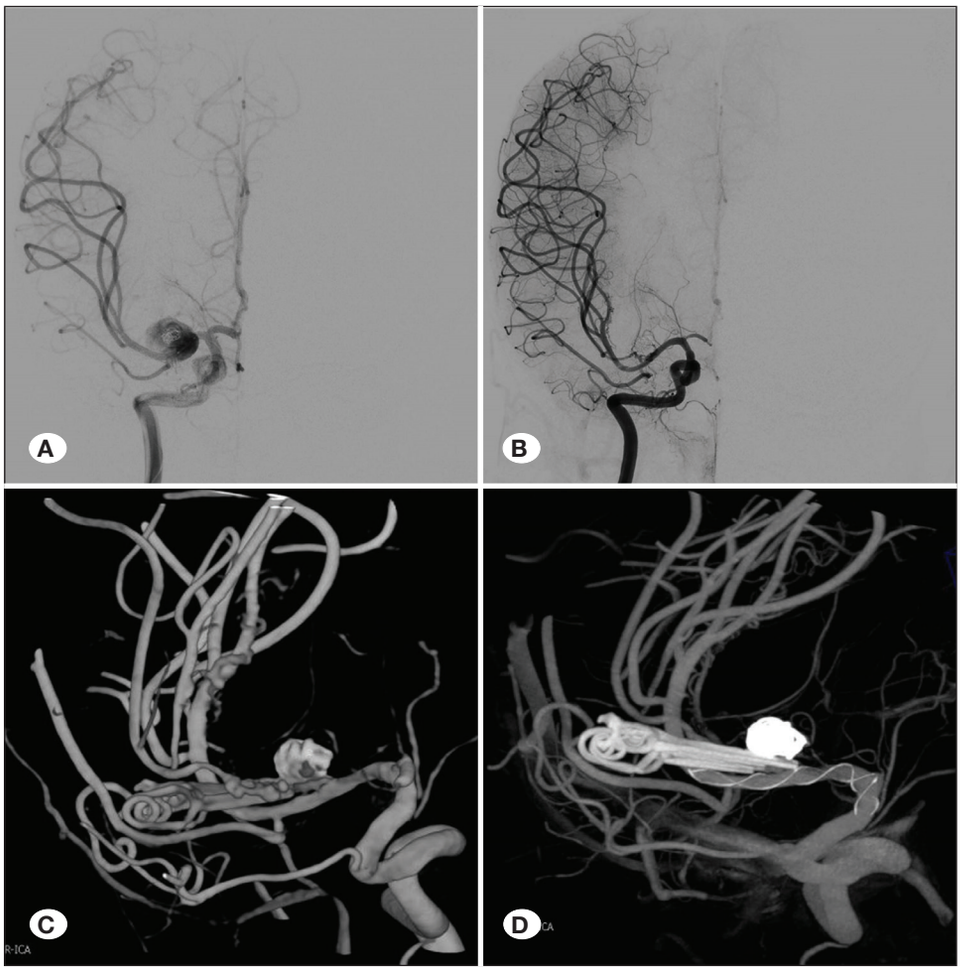

Figure 4: A) Intraprocedural angiogram reveals the contrast stasis within the aneurysm. **B)** The 11-month follow-up DSA. **C)** A reconstructed 3D. **D)** Vaso CT.

Another issue that should be considered is the growth of the arteries. Arat et al. have assessed the intracranial vessels in adults and children via digital subtraction angiography. They revealed that the internal carotid artery and anterior cerebral artery reach near their maximum diameter by four years of age, while the MCA reaches its approximate adult diameter at six months of age (10). The MCA forms during the early stages of embryonic development, appearing before most other blood vessels and providing a relatively large volume of blood flow. Further research has also shown comparable outcomes related to cerebrovascular growth in children. These studies revealed that the currently available intracranial stents or flow diverters come in a range of sizes suitable for use in the pediatric population, while the intracranial arterial diameters in children do not undergo significant growth, especially after early childhood (1).

More importantly, the antiplatelet protocols used during the perioperative period for flow diverters should be considered. At present, no standard antiplatelet therapy for children undergoing intracranial vascular device placement has been established. Moreover, no published guidelines on antiplatelet therapy for children with cerebrovascular diseases nor any definitive trials on pediatric antiplatelet therapy regimens have been implemented (1). The use of antiplatelet regimens varies among institutions. Some institutions have applied the identical antiplatelet protocol for adults (2), while some institutions administered a lower dose of medication with no definitive explanation (4). In this report, a dual antiplatelet agent was administered at approximately half of the adult dose. Regardless of the regimen, the drug dose should be adjusted based on light transmission aggregometry and TEG platelet mapping. Dual antiplatelet therapy with the administration of aspirin and ticagrelor has been applied in endovascular procedures in adults; however, its utilization in children has not been investigated (12).

CONCLUSION

Further research is needed to better evaluate the use of a dual antiplatelet regimen during the perioperative period for flow diverters in pediatric patients.

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Declarations

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Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author by reasonable request.

Disclosure: The authors declare no competing interests.

Institutional Review Board Statement: Ethical review and approval were waived for this study due to the fact that this is a single-case report.

AUTHORSHIP CONTRIBUTION

Study conception and design: WZ
Data collection: ZL, YF
Analysis and interpretation of results: TZ
Draft manuscript preparation: ZL, YF
Critical revision of the article: TZ
Other (study supervision, fundings, materials, etc...): WZ
All authors (ZL, YF, TZ, WZ) reviewed the results and approved the final version of the manuscript.

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