Fusiform M2 Aneurysm Treated By Flow Diversion: Case Report

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None

ABSTRACT

Fusiform cerebral aneurysms are uncommon vascular lesions, comprising approximately 3–13% of all intracranial aneurysms. The vertebrobasilar system represents the most frequent site of occurrence, while in the anterior circulation, the middle cerebral artery (MCA) is predominantly affected, followed by the internal carotid and anterior cerebral arteries. The pathogenesis of MCA fusiform aneurysms is primarily attributed to arterial dissection, atherosclerosis, or connective tissue disorders. Clinically, these aneurysms present with a spectrum of manifestations, including intracranial hemorrhage, cerebral ischemia, seizures, or mass effect, contingent upon their location, size, and extent of vascular involvement. The management of MCA fusiform aneurysms remains challenging due to anatomical complexities and technical difficulties associated with both open surgical and endovascular interventions. This report describes a case of a giant fusiform aneurysm located in the M2 segment of the MCA, successfully treated through an endovascular approach, highlighting the efficacy of this technique in complex neurovascular pathology.

CASE REPORT

BACKGROUND

Fusiform intracranial aneurysms are rare vascular anomalies, constituting approximately 3–13% of all intracranial aneurysms, with a predilection for the vertebrobasilar system followed by the middle cerebral artery (MCA). Within the MCA, these aneurysms most commonly affect the proximal (M1) segment, though involvement of distal segments, such as M2 or M3–M4, is also observed. Characterized by a cylindrical dilation of the vessel wall without a distinct neck, fusiform MCA aneurysms are often linked to arterial dissection, atherosclerosis, or connective tissue disorders, which complicates their management due to the absence of a clear target for conventional interventions [1-3]. The treatment of fusiform MCA aneurysms, particularly those located in the M2 segment, presents significant challenges. The lack of a definable neck precludes standard microsurgical clipping or endovascular coiling, while the proximity to lenticulostriate perforators or other critical side branches raises the risk of ischemic complications if these vessels are compromised. Traditional approaches, such as clip reconstruction, parent vessel occlusion with bypass, or conventional stent placement, are associated with high recurrence rates and technical difficulties, often due to inadequate retrograde flow or incomplete occlusion [3,5]. In recent years, flow diversion has emerged as a promising endovascular technique for managing complex MCA aneurysms, including those in distal segments. By redirecting blood flow and promoting endothelial remodeling, flow-diverting stents facilitate gradual aneurysm occlusion while preserving parent vessel patency. Recent meta-analyses report complete or near-complete occlusion rates of 78–80% at a mean follow-up of 12 months, with complication rates ranging from 9–20%, primarily due to thromboembolism or ischemia, though mortality remains low at approximately 2% [6-8]. Despite these advancements, data on flow diversion for M2 segment aneurysms remain limited, necessitating further exploration of its safety and efficacy in these distal locations. This case report describes the successful endovascular treatment of a giant fusiform aneurysm in the M2 segment of the MCA using a flow-diverting stent, underscoring the potential of this approach to effectively manage complex neurovascular lesions while minimizing complications in distal vascular territories.

CASE REPORT

A 41-year-old male with no prior medical history presented with acute, severe headache (VAS 6/10) unresponsive to analgesics. Clinical examination showed an alert patient with no vomiting, fever, motor deficits, or cranial nerve abnormalities. Initial multislice computed tomography (MSCT) at a local facility revealed a fusiform aneurysm in the left M2 segment of the middle cerebral artery (MCA), leading to transfer to Bach Mai Hospital. Brain MRI/MRA confirmed an unruptured fusiform aneurysm measuring 20.3x6.6mm with irregular margins and no surrounding hematoma.

Digital subtraction angiography (DSA) demonstrated a complex fusiform aneurysm (20.3x6.6mm, Proximal neck 3.3mm, distal neck 2.2mm, T-ICA 4mm) in the left M2 MCA segment. Following multidisciplinary consultation, endovascular flow diversion was planned, with the patient receiving dual antiplatelet therapy (Aspirin 81 mg, Ticagrelor 90 mg daily) for 5 days pre-procedure.

Under DSA guidance, an 8F sheath was placed in the right femoral artery. A Neuronmax 8F guiding catheter and NeuronDelivery 6F intermediate catheter were positioned in the left internal carotid artery (ICA). A Headway 2.7F microcatheter, navigated with a Transcend 0.014-inch microwire, reached the M3 temporoparietal branch. A Derivo 2 4.0/40 flow-diverting stent was deployed across the aneurysm, Spanning from the distal superior M2 branch to the terminal left ICA to achieve secure fixation and avoid migration, with 2000 IU heparin and 40mg SoluMedrol administered intravenously. Post-deployment VasoCT confirmed optimal stent apposition and contrast stasis in the aneurysm. The contralateral anterior cerebral artery provided bilateral frontal perfusion via the anterior communicating artery.

Ten minutes post-procedure, the patient developed expressive aphasia without motor deficits. Repeat DSA revealed sluggish flow in the superior M2 branch, corresponding to the clinical presentation, with small thrombi at the distal stent. Following urgent neurovascular consultation, 180 mg ticagrelor (two 90 mg doses) via nasogastric tube and 1000 IU intravenous heparin were administered. Follow-up DSA at 30 and 45 minutes demonstrated restored flow through the stent and the temporofrontal M2 branch. The patient remained aphasic but without limb weakness or paralysis at procedure completion.

The patient underwent repeat MRI 24 hours post-procedure, revealing acute infarction in the left frontal lobe, basal ganglia, and insula. Stable flow through the stent was observed, with occlusion of the M2 branch supplying the left frontoparietal region. Clinically, the patient showed improvement in right upper and lower limb strength to 4/5 after two weeks, with persistent Broca's aphasia.

DISCUSSION

Fusiform aneurysms of the middle cerebral artery (MCA), particularly in the distal M2 segment, are rare neurovascular lesions characterized by circumferential vessel wall dilation without a discrete neck, often resulting from arterial dissection, atherosclerosis, or connective tissue disorders [2,3]. These aneurysms pose significant therapeutic challenges due to their morphology, which precludes conventional microsurgical clipping or endovascular coiling, and their proximity to critical lenticulostriate and cortical branches, increasing the risk of ischemic complications [1,4]. This case report details the endovascular management of a giant, unruptured fusiform aneurysm (20.3x6.6mm) in the left M2 MCA segment using a Derivo 2 4.0/40 flow-diverting stent, demonstrating the potential of flow diversion in complex distal MCA aneurysms.

Flow-diverting stents have transformed the management of complex intracranial aneurysms by redirecting hemodynamic forces to promote endothelial remodeling, progressive aneurysm thrombosis, and preservation of parent vessel patency [5,13]. In this case, the Derivo 2 stent was deployed with technical precision, achieving optimal wall apposition and contrast stasis, as confirmed by post-procedural VasoCT. These findings align with reported outcomes for MCA aneurysms, with meta-analyses indicating complete or near-complete occlusion rates of 78–80% at 12-month follow-up and complication rates of 9–20%, primarily due to thromboembolism or ischemia [6,7,9]. The M2 segment's smaller vessel diameter and limited collateral flow amplify these risks compared to proximal M1 aneurysms, necessitating meticulous procedural planning [4,10]. The procedure was complicated by expressive aphasia 10 minutes post-deployment, attributed to sluggish flow and minor thrombi in the superior M2 branch, as identified on repeat digital subtraction angiography (DSA). A 24-hour post-procedure MRI confirmed acute infarction in the left frontal lobe, basal ganglia, and insula, with occlusion of the M2 branch supplying the frontoparietal region, likely contributing to persistent Broca's aphasia despite motor recovery (right limb strength 4/5 at two weeks). This complication reflects a known risk of flow diversion, with thromboembolism or jailed branch occlusion reported in 5–16% of MCA aneurysm cases [6,11].

Prompt administration of additional ticagrelor (180 mg via nasogastric tube) and heparin (1000 IU intravenously) restored flow within 45 minutes, highlighting the efficacy of escalated antiplatelet therapy in managing acute thrombotic events [7,14]. The pre-procedural regimen of dual antiplatelet therapy (aspirin 81 mg, ticagrelor 90 mg for five days) and intraprocedural heparin (2000 IU) and SoluMedrol (40 mg) adhered to established protocols to minimize thrombotic risks [2,6]. The contralateral anterior cerebral artery's supply to bilateral frontal regions via the anterior communicating artery likely mitigated more severe ischemic outcomes, underscoring the importance of preoperative collateral assessment in distal MCA interventions [10]. Immediate multidisciplinary neurovascular consultation and additional antiplatelet therapy exemplify best practices for managing intraprocedural complications, as supported by studies emphasizing rapid intervention to limit permanent deficits [5,14]. However, the persistent aphasia highlights the vulnerability of eloquent cortical territories in M2 aneurysms, where even minor branch occlusions can lead to lasting deficits. Advanced imaging, such as high-resolution cone-beam CT, and next-generation stent designs with improved perforator patency may further enhance outcomes [9,12].

This case supports the technical feasibility and efficacy of flow diversion for giant M2 MCA fusiform aneurysms, achieving aneurysm occlusion with manageable complications through vigilant monitoring and prompt intervention. However, the ischemic sequelae underscore the need for rigorous patient selection, precise stent deployment, and optimized antiplatelet regimens. Given the limited data on flow diversion in distal MCA segments compared to proximal M1 lesions, larger prospective studies with extended follow-up are essential to establish long-term safety and refine therapeutic indications [6,8].

This case demonstrates the efficacy of flow diversion using a Derivo 2 stent for treating a giant M2 MCA fusiform aneurysm, achieving occlusion with manageable complications. Despite post-procedural aphasia due to branch occlusion, prompt antiplatelet therapy mitigated further deficits. Flow diversion offers a viable alternative to surgery, but ischemic risks highlight the need for careful patient selection and advanced imaging. Further studies are essential to optimize outcomes in distal MCA aneurysms.

TEACHING POINT

Fusiform aneurysms of the middle cerebral artery (MCA), particularly in the M2 segment, appear on angiographic imaging as circumferential, elongated dilations of the vessel wall without a defined neck. Flow diversion with specialized stents offers an effective treatment by redirecting blood flow and promoting progressive thrombosis and vessel wall reconstruction, although meticulous antiplatelet management and collateral assessment are crucial to minimize ischemic complications.

QUESTION

Question 1 : What is the approximate prevalence of fusiform cerebral aneurysms among all intracranial aneurysms?

A. 1–2%
B. 3–13% (applies)
C. 20–30%
D. 50%
E. >70%

Explanation for question 1: B (Fusiform cerebral aneurysms are uncommon vascular lesions, comprising approximately 3–13% of all intracranial aneurysms. [Abstract, first sentence])

Question 2 : Which of the following are the primary attributed causes of pathogenesis for fusiform aneurysms in the middle cerebral artery (MCA)?

A. Arterial dissection (applies)
B. Atherosclerosis (applies)
C. Connective tissue disorders (applies)
D. Primary hypertension
E. Infectious vasculitis

Explanation for question 2: A, B, C (The pathogenesis of MCA fusiform aneurysms is primarily attributed to arterial dissection, atherosclerosis, or connective tissue disorders. [Abstract, fourth sentence])

Question 3: On digital subtraction angiography (DSA), fusiform aneurysms of the MCA M2 segment typically appear as:

A. Sac-like outpouchings with a narrow neck
B. Circumferential, cylindrical dilations of the vessel wall without a distinct neck (applies)
C. Tortuous vessels with focal calcifications
D. Multiple saccular projections
E. Complete vessel occlusion

Explanation for question 3: B (Characterized by a cylindrical dilation of the vessel wall without a distinct neck, fusiform MCA aneurysms are often linked to arterial dissection, atherosclerosis, or connective tissue disorders... [Introduction, third sentence])

Question 4: What are the reported outcomes of flow diversion for MCA aneurysms based on recent meta-analyses, including occlusion rates and common complications?

A. Complete occlusion in 90–95% at 6 months, with <5% complication rate
B. Complete or near-complete occlusion in 78–80% at 12 months, with 9–20% complication rate primarily due to thromboembolism or ischemia (applies)
C. Recurrence in >50% at 1 year, with high mortality >10%
D. No significant occlusion, but 100% preservation of branch vessels
E. Effective only for ruptured aneurysms, with 30% hemorrhage risk

Explanation for question 4: B (Recent meta-analyses report complete or near-complete occlusion rates of 78–80% at a mean follow-up of 12 months, with complication rates ranging from 9–20%, primarily due to thromboembolism or ischemia, though mortality remains low at approximately 2%. [Introduction, fourth paragraph, second sentence])

Question 5: In the presented case of endovascular flow diversion for an M2 MCA fusiform aneurysm, which of the following antiplatelet and anticoagulant measures were employed to manage the intraprocedural thrombotic complication?

A. Pre-procedural aspirin and ticagrelor only, without intraprocedural adjustments

B. Escalated ticagrelor (180 mg via nasogastric tube) and intravenous heparin (1000 IU) (applies)

C. Intravenous thrombolysis with alteplase

D. Pre-procedural clopidogrel substitution for ticagrelor

E. Post-procedural cessation of all antiplatelets

Explanation for question 5: B (Following urgent neurovascular consultation, 180 mg ticagrelor (two 90 mg doses) via nasogastric tube and 1000 IU intravenous heparin were administered. [Case Report, paragraph describing post-deployment complication])

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FIGURES

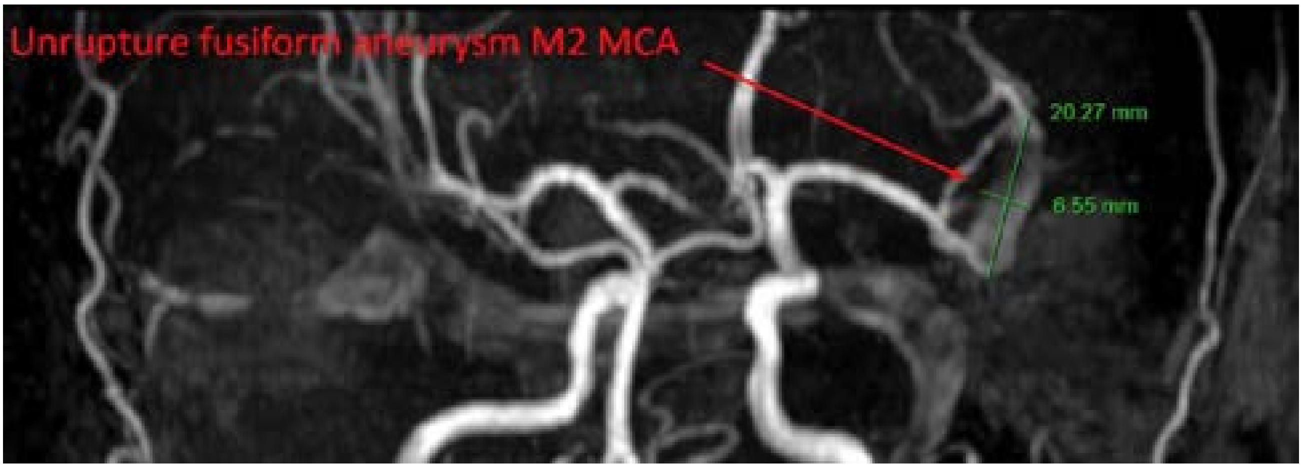

Figure 1: On the 3D TOF sequence: the image shows a fusiform aneurysm in the M2 segment of the left middle cerebral artery, measuring approximately 20.3 x 6.6 mm, with irregular borders.

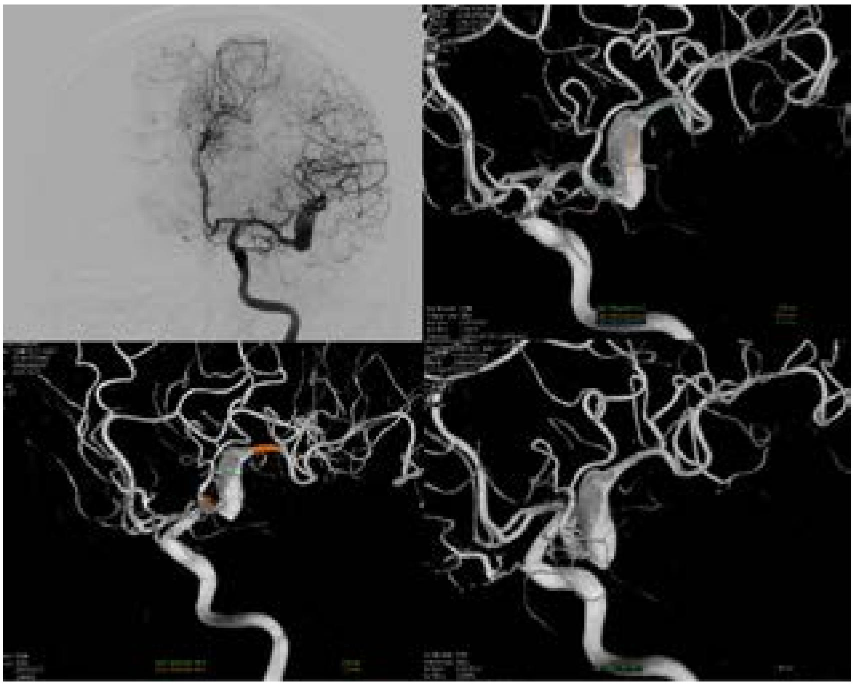

Figure 2: Digital subtraction angiography (DSA) demonstrated a complex fusiform aneurysm (20.3x6.6mm, proximal neck 2.2 mm, distal neck 3.3 mm) in the left M2 MCA segment

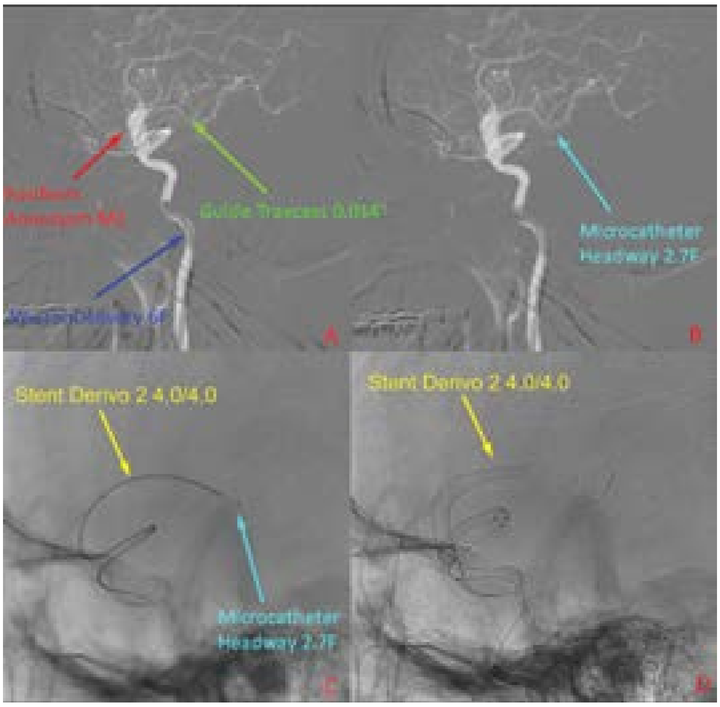

Figure 3: A, B: A Headway 2.7F microcatheter, navigated with a Transcend 0.014-inch microwire, reached the M3 temporoparietal branch. **C, D:** A Stent Derivo 2 4.0/40 flow-diverting stent was deployed across the aneurysm, spanning from the distal superior M2 branch to the terminal left ICA

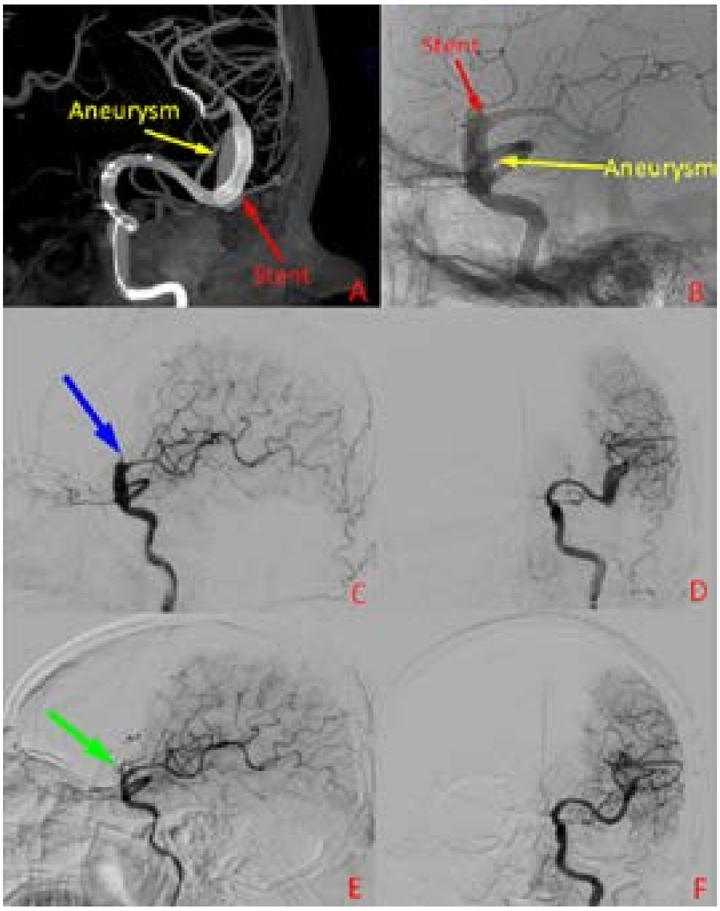

Figure 4: A, B: Post-deployment VasoCT confirmed optimal stent apposition and contrast stasis in the aneurysm. **C, D:** DSA revealed sluggish flow in the superior M2 branch, corresponding to the clinical presentation, with small thrombi at the distal stent. **E, F:** Follow-up DSA at 30 and 45 minutes demonstrated restored flow through the stent and the temporofrontal M2 branch.

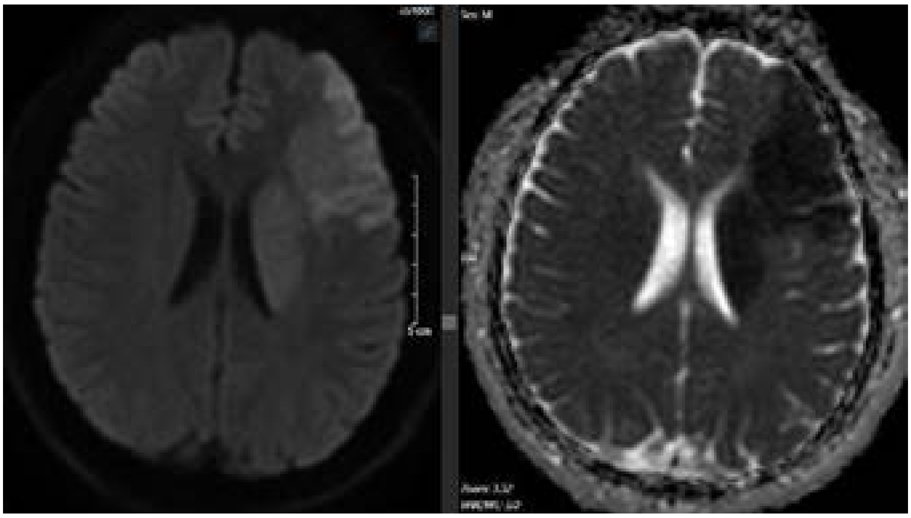

Figure 5: DWI/ADC sequence: Acute infarction in the left frontal lobe, basal ganglia, and insula

KEYWORDS

Flow diversion, Aneurysm, Fusiform, Middle cerebral artery, Endovascular treatment

ABBREVIATIONS

ADC = Apparent Diffusion Coefficient
DSA = Digital Subtraction Angiography
DWI = Diffusion-Weighted Imaging
ICA = Internal Carotid Artery
MCA = Middle Cerebral Artery
MRA = Magnetic Resonance Angiography
MRI = Magnetic Resonance Imaging
MSCT = Multislice Computed Tomography
TOF = Time-Of-Flight
VAS = Visual Analog Scale
VasoCT = Vaso Computed Tomography