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Combined microcatheter and guidewire technique in endovascular coiling of a wide-neck anterior communicating artery aneurysm: A case report

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Abstract. Wide-necked anterior communicating artery (ACoA) aneurysms pose challenges for endovascular coiling due to the risk of coil protrusion. This case report describes a new endovascular technique for managing ruptured wide-necked ACoA aneurysms, addressing the risk of coil protrusion during embolization. This method employs a combined microcatheter and guidewire-assisted embolization method, enabling coil deployment without needing adjunctive devices such as stents or balloons. Compared to traditional approaches, this technique avoids stent-related complications, preserves cerebral blood flow and minimizes procedural complexity. It may represent a safe and effective alternative in selected cases, with stent placement retained as a bailout strategy when necessary.

Introduction

Treatment options for wide-necked anterior communicating artery (ACoA) aneurysms include open surgical clipping and endovascular embolization. While surgical clipping offers robust aneurysm occlusion, endovascular techniques are increasingly preferred due to lower complication rates and favorable clinical outcomes (1). Despite these advantages, wide-necked ACoA aneurysms present technical challenges during endovascular intervention, primarily due to the risk of coil protrusion into the parent vessel. Therefore, adjunctive techniques such as stent-assisted or balloon-assisted coiling are frequently used. Stent-assisted coiling effectively prevents coil protrusion, improving the completeness and durability of embolization (2). However, the need for antiplatelet therapy following stent placement may increase the risk of rebleeding in patients with ruptured aneurysms (3,4). Other techniques, such as balloon remodeling and triple-microcatheter techniques, have been employed to mitigate coil protrusion (5,6). However, each has inherent limitations. Balloon remodeling in ACoA aneurysms requires temporary flow arrest, increasing the risk of ischemia, particularly in patients with a unilaterally dominant A1 segment. Furthermore, the small caliber and limited luminal space of the anterior cerebral arteries render triple-microcatheter techniques technically challenging (7). In the present study, a modified technique using dual microcatheter and guidewire support is described to address these limitations and provide a less complex, potentially safer alternative. This method offers vessel protection and enables successful coil embolization without adjunctive devices, thereby minimizing stent-related risks and procedural complexity.

Case report

A 36-year-old female presented with the sudden onset of a severe headache. Non-contrast computed tomography (CT) performed at a local hospital in September 2024 revealed subarachnoid hemorrhage, predominantly in the interhemispheric fissure, with a modified Fisher grade of 2 (Fig. 1A). CT angiography further demonstrated an ACoA aneurysm (Fig. 1B).

Following the initial evaluation, the patient was transferred to Beijing Anzhen Nanchong Hospital of Capital Medical University & Nanchong Central Hospital (Nanchong, China) later that day. Upon admission, neurological examination was unremarkable and the patient was classified as World Federation of Neurological Surgeons Grade 1. After a discussion of treatment options, the patient declined surgical clipping and opted for endovascular intervention. Diagnostic cerebral angiography confirmed an ACoA aneurysm predominantly supplied by the left anterior cerebral artery (Fig. 1C and D). Three-dimensional (3D) rotational angiography revealed a wide-necked aneurysm measuring ~4x3x3 mm (width x depth x height), with a dome-to-neck ratio of 1.2 (Fig. 2A). No

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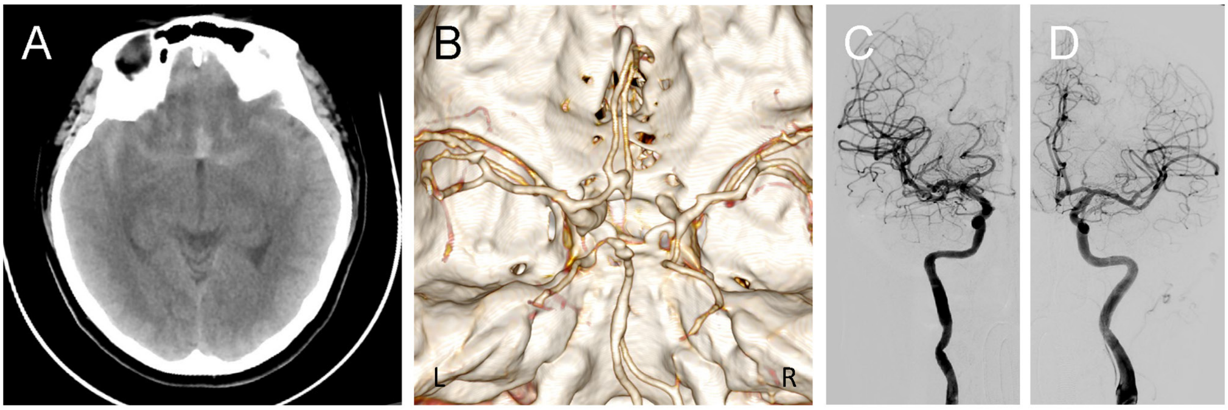

Figure 1. (A) Non-contrast head CT. (B) CT angiography. (C) Right internal carotid artery DSA revealing a hypoplastic right A1 segment of the anterior cerebral artery. (D) Left internal carotid artery DSA showing a dominant left A1 segment, with visualization of both pericallosal arteries and an anterior communicating artery aneurysm. CT, computed tomography; DSA, digital subtraction angiography.

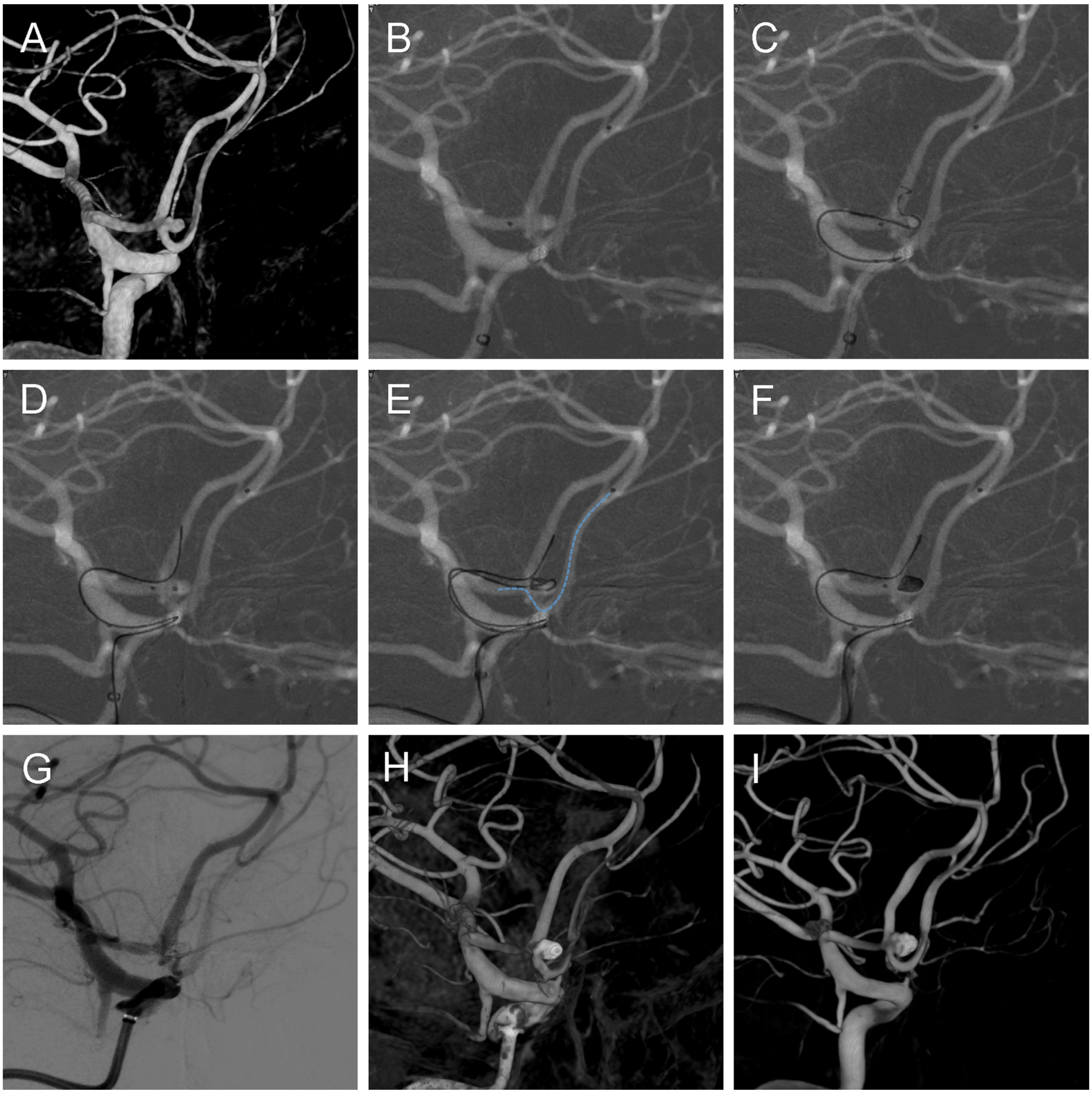

Figure 2. (A) Three-dimensional DSA revealing an anterior communicating artery aneurysm. (B) A stent microcatheter placed in the right A2 segment. (C) Coil protrusion into the parent vessel during initial coil deployment. (D) Guidewire advanced into the left A2 segment. (E) Satisfactory coil framing achieved with the microcatheter and guidewire support. The blue dashed line represents the stent microcatheter. (F) Three coils deployed, achieving stable aneurysm occlusion. (G) Post-procedural two-dimensional DSA. (H) Post-procedural three-dimensional DSA. (I) Six-month postoperative DSA follow-up. DSA, digital subtraction angiography.

pretreatment with dual antiplatelet agents was administered. The procedure was performed under general anesthesia with continuous nimodipine infusion at 5 ml/h. A right 8F femoral sheath (Terumo Corporation) was inserted and a 6F 115-cm intracranial support catheter (Tonbridge Medical Technology Co., Ltd.) was advanced into the distal internal carotid artery at the C4 segment. Following vascular access, systemic heparinization was initiated with a 5,000 U bolus, followed by maintenance at 1,000 U/h.

Due to the left-sided dominance of the ACoA aneurysm's inflow and its morphology, stent deployment, if required, would necessitate crossing from the ACoA to the contralateral (right) A2 segment to cover the aneurysm neck adequately. To prepare for this contingency, a Synchro 14 guidewire (Stryker Neurovascular) was used to advance a Headway 17 microcatheter (MicroVention, Inc.) into the distal right A2 segment, positioning it for potential deployment of a Neuroform Atlas stent (Stryker Neurovascular) (Fig. 2B). A second Headway 17 microcatheter (MicroVention, Inc.) was introduced into the aneurysm sac for coil embolization. However, during deployment of the initial coil, protrusion into the left A2 segment occurred despite multiple attempts (Fig. 2C). To address this coil protrusion, a Synchro 14 guidewire (Stryker Neurovascular) was inserted through the y-connector hemostasis valve (Merit Medical Systems, Inc.) of the stent microcatheter and navigated through the intracranial support catheter to a position distal to the left A2 segment (Fig. 2D). The guidewire tip was shaped ~1.5 cm from its distal end to optimize its conformation to the aneurysm neck, forming a stable 'guardrail' configuration at the aneurysm orifice. This Y-shaped configuration of the guidewire and microcatheter enabled stable coil framing without protrusion (Fig. 2E), leading to complete aneurysm occlusion without stent deployment (Fig. 2F). Given the instability typically associated with aneurysms of this configuration, strict adherence to a defined withdrawal sequence was essential to maintain coil stability (8). After confirming final coil detachment, the distal tip of the coil pusher was kept slightly extended beyond the microcatheter tip to facilitate the release of the coil tail and prevent displacement. The guidewire was then carefully withdrawn, followed by the gradual withdrawal of the coiling microcatheter. Finally, the stent microcatheter was withdrawn at a slow and controlled pace. Continuous digital subtraction angiography (DSA) was performed throughout the withdrawal process to monitor coil mass stability and ensure no displacement or protrusion.

Post-embolization 2D (Fig. 2G) and 3D (Fig. 2H) rotational angiography demonstrated satisfactory aneurysm occlusion, with patent bilateral A2 segments and no evidence of distal thromboembolic complications. The operative procedure is documented in Video S1.

The patient was discharged one week postoperatively without hemiparesis or cognitive deficits and resumed routine activities, including work. The modified Rankin Scale score was 0. At the six-month follow-up, DSA demonstrated stable coil placement with continued patency of the bilateral anterior cerebral arteries (Fig. 2I).

Discussion

Stent-assisted coiling for ruptured aneurysms presents significant challenges compared to coil embolization alone. The requirement for dual antiplatelet therapy increases the risk of post-procedural rebleeding, particularly in cases involving external ventricular drains (4).

Alternative endovascular strategies, including multi-catheter and balloon-assisted techniques, have their own limitations. Multiple microcatheter techniques frequently require removing previously placed catheters, necessitating upsizing a 7F or 8F access sheath. This approach escalates procedural complexity, duration and cost. Furthermore, the small caliber of the anterior cerebral arteries renders multi-catheter navigation technically challenging or unfeasible. When balloon remodeling fails to achieve adequate neck control, the lack of readily deployable stent bailout heightens the risk of coil protrusion (9).

The documented dual-catheter technique involves an adjunctive microcatheter that facilitates partial aneurysm neck occlusion to reduce coil migration and enhance framing (8). However, our initial experience with this technique revealed critical limitations: The stent microcatheter prevented coil protrusion into the right anterior cerebral artery A2 segment but not into the left. Based on the aforementioned technical enhancements, a combined microcatheter and guidewire technique was developed and implemented in the present study to overcome the challenges associated with treating ruptured wide-necked ACoA aneurysms. This novel approach, developed in our study, modifies the adjunctive microcatheter technique by incorporating a guidewire for enhanced support. This technique employs the strategic combination of guidewire and microcatheter placement to establish a 'Y'-shaped configuration that functions as a dual-support 'physical barrier'. This configuration thereby facilitates stable coil framing within the anterior communicating artery aneurysm while preventing coil protrusion into the parent vessel. The contrast between our initial and refined approaches demonstrates the technique's evolution: While the auxiliary method failed due to incomplete neck coverage, the microcatheter-guidewire combination achieved complete neck sealing and procedural efficacy.

This technology boasts broad clinical applicability, accommodating a wide range of patient populations, and is generally not constrained by the inherent disease severity or coexisting comorbidities. However, procedural success and safety remain contingent upon individual intracranial vascular anatomy and pathophysiology. Several technical challenges may arise. Primarily, long-distance microcatheter navigation through cerebral vasculature frequently diminishes torque transmission and pushability, compromising tactile feedback. This is particularly pronounced in tortuous vessels, necessitating intermediate catheter deployment for optimal maneuverability. Furthermore, simultaneous operation of two microcatheters and one micro guidewire reduces intraluminal space, predisposing to entanglement and knotting. Mitigation strategies include avoiding complex microcatheter shaping and sequential delivery with microcatheter positioning preceding microwire advancement. Additionally, patients with compromised cerebrovascular architecture, particularly those with atherosclerotic burden, vessel tortuosity or significant stenosis, demonstrate heightened susceptibility to thromboembolic complications and plaque disruption during manipulation (10-13). Risk mitigation encompasses prophylactic anticoagulation and precision navigation under continuous fluoroscopic monitoring (14).

Of note, there are currently no specific training programs or simulation methods dedicated to mastering the present technique, to the best of our knowledge. This procedure may have a certain learning curve and appear somewhat complex for beginners. However, experienced neurointerventional physicians may be able to acquire proficiency in this technique quickly and efficiently due to their foundational skills and experience with similar procedures.

This technique demonstrates several distinct advantages, as demonstrated in the present case. First, it eliminates the need to upsize the access sheath, allowing the procedure to be completed via a standard 6F system. This allows for further advancement of a guidewire to the A2 segment of the anterior cerebral artery without removing pre-existing long sheaths, intracranial support catheters and microcatheters. This minimizes catheter exchanges, thereby reducing procedural steps and mitigating the risk of vascular injury associated with repeated device manipulation. Second, it provides optimal support to both A2 segments of the anterior cerebral arteries, thereby minimizing the risk of coil protrusion and facilitating successful embolization without requiring adjunctive devices such as stents or balloons. Third, compared to balloon remodeling, this technique better preserves cerebral perfusion throughout the procedure (5).

However, certain limitations and risks must be acknowledged. Despite the enhanced stability afforded by this technique, the potential for coil migration or incomplete aneurysm occlusion persists. In such scenarios, stent deployment remains a viable contingency option to ensure coil retention and prevent protrusion. Furthermore, compared to stent-assisted coiling, coil embolization alone shows superior immediate occlusion rates and better prevents rebleeding in ruptured aneurysms. However, coil embolization alone may be associated with higher recurrence rates over time (15,16). The absence of extended follow-up is a limitation of the present study. Extended follow-up is essential to confirm the long-term stability and efficacy of the treatment.

In conclusion, ruptured wide-necked bifurcation aneurysms, such as those of the ACoA, carry a substantial risk of coil protrusion when treated with coil embolization alone. This report details an improved technique employing dual microcatheter and guidewire support via a 6F access system to embolize select ruptured wide-necked ACoA aneurysms, obviating the need for adjunctive devices. In the presented case, this technique proved safe and effective. However, stent deployment remains a viable bailout strategy in select complex cases.

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Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

HT performed the surgery as the lead surgeon. HT and ZL were involved in the conception and design of the study, were responsible for the project and provided final approval of the manuscript. ZL, CC and YZ collected, acquired and interpreted the data. HT, MS and ZL wrote the manuscript. HT, ZL and MS critically revised the article. HT and MS were responsible for creating and assembling the figures. HT and ZL edited the supplementary video. HT and ZL verified the authenticity of the raw data. All authors have read and approved the final manuscript.

Ethics approval and consent to participate

Written informed consent was obtained from the patient and their family for the proposed treatment.

Patient consent for publication

Written consent was obtained from the patient and family for the publication of the patient's case information and images. All identifying patient information has been removed to ensure confidentiality.

Competing interests

The authors declare that they have no competing interests.

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