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Delayed coil migration after endovascular treatment of a ruptured intracranial aneurysm managed by open microsurgical surgery: illustrative case

Chi Cuong Tran, MD, PhD,[1] Duy Vu Tran, MD,[1] Thi Ngoc Tuyen Nguyen, MD, MSc,[1] Quang Hung Nguyen, MD,[1] Thi Chi Lan Le, MD, MSc,[1] and Duy Linh Nguyen, MD, PhD[1,2]

[1]Department of Surgery, Can Tho S.I.S. General Hospital, Can Tho City; and [2]Department of Surgery, Can Tho University of Medicine and Pharmacy, Can Tho City, Vietnam

BACKGROUND Endovascular coil embolization is widely used for the treatment of ruptured intracranial aneurysms because of its minimally invasive nature and rapid effectiveness. However, coil migration is a rare but potentially severe complication that may lead to parent artery occlusion, thromboembolism, or cerebral infarction, requiring prompt management.

OBSERVATIONS A 65-year-old woman presented with subarachnoid hemorrhage caused by a ruptured intracranial aneurysm. She underwent emergency endovascular coil embolization. Postprocedural CT angiography revealed migration of the coil into the parent artery, posing a high risk of vascular compromise. Emergency open microsurgical intervention was performed. The migrated coil was carefully retrieved through arteriotomy, and the aneurysm neck was successfully clipped. Postoperative angiography demonstrated preserved cerebral blood flow and complete aneurysm occlusion. The patient recovered with neurological deficits and was discharged in stable condition.

LESSONS Open microsurgical coil retrieval combined with aneurysm clipping can be an effective treatment option in selected cases of coil migration, particularly when endovascular retrieval is not feasible or carries significant risk. Early recognition of this complication and timely multidisciplinary decision-making are essential to prevent ischemic injury and achieve acceptable outcomes.

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KEYWORDS ruptured intracranial aneurysm; coil migration; endovascular treatment; microsurgical clipping; subarachnoid hemorrhage

Ruptured intracranial aneurysms are a major cause of subarachnoid hemorrhage and are associated with significant morbidity and mortality. Over the past decades, endovascular coil embolization has become a widely accepted first-line treatment because of its minimally invasive nature and favorable clinical outcomes in selected patients. Despite these advantages, procedure-related complications may occur, including aneurysm perforation, thromboembolic events, coil compaction, and, more rarely, coil migration.

Coil migration is an uncommon but potentially severe complication of endovascular aneurysm treatment that may result in parent artery occlusion, distal embolization, or cerebral infarction. In many cases, migration can be recognized during the procedure through real-time angiographic monitoring, allowing immediate corrective measures. However, delayed coil migration represents a particular diagnostic and therapeutic challenge because it may occur hours to days after an initially satisfactory embolization, when routine imaging is less frequent and clinical manifestations may be subtle or nonspecific. Previous reports have emphasized that delayed migration is often detected only after new neurological symptoms develop or on follow-up imaging, which may increase the risk of ischemic complications. The optimal management of coil migration therefore depends on multiple factors, including aneurysm location, vascular anatomy, timing of migration, and institutional expertise. In selected situations, open microsurgical intervention may provide definitive treatment by enabling direct coil retrieval and secure aneurysm occlusion under direct visualization.

The purpose of this report is to present a case of coil migration following endovascular treatment of a ruptured intracranial aneurysm managed with open microsurgical retrieval and clipping, and to discuss the considerations relevant to treatment selection and surgical management in this rare but critical scenario.

ABBREVIATIONS TOF = time-of-flight.

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Illustrative Case

A 65-year-old woman presented with sudden-onset severe headache and vomiting. On admission, she was alert. Emergency noncontrast head CT demonstrated diffuse subarachnoid hemorrhage predominantly within the sylvian fissure, corresponding to Hunt-Hess grade I subarachnoid hemorrhage. Further evaluation with 3D time-of-flight (TOF) MR angiography demonstrated a small aneurysm arising from the left internal carotid artery terminus (Fig. 1A). Subsequent digital subtraction angiography confirmed the aneurysm morphology and vascular anatomy prior to intervention, measuring approximately 1.5 × 3 mm (Fig. 1B). Emergency endovascular coil embolization was performed, and the initial angiographic result appeared satisfactory. A 1.5-mm × 4-cm Barricade detachable coil (Balt) was successfully deployed within the aneurysm sac, achieving near-complete occlusion at the end of the procedure, as demonstrated on the final angiographic run (Fig. 1C). However, approximately 1 hour after the procedure, the patient developed acute neurological deterioration, with a decrease in consciousness to a Glasgow Coma Scale score of 12 and new-onset right-sided hemiparesis. Urgent MR angiography was performed to evaluate for procedural complications. Imaging demonstrated migration of the coil into the parent artery, with persistent visualization of the aneurysm sac and occlusion of the distal M2 segment near the M2–M3 bifurcation, resulting in impaired distal flow (Fig. 1D). No intraparenchymal hemorrhage was identified. Given the imaging findings and clinical deterioration, emergency microsurgical intervention was undertaken. Through a standard pterional approach, microsurgical dissection exposed the left middle cerebral artery bifurcation. Intraoperatively, the migrated coil was identified at the M2–M3 bifurcation, partially occupying the lumen at the branching point (Fig. 2A). Temporary clips were applied to the proximal M2 segment and both distal M3 branches. A limited longitudinal arteriotomy was then performed at the bifurcation, allowing direct visualization of the coil and facilitating safe extraction. The arteriotomy was then closed using interrupted 9-0 nylon sutures (Fig. 2C). The aneurysm neck was then definitively clipped. Final intraoperative assessment confirmed restoration of vessel patency and preservation of distal flow. Postoperative CT angiography demonstrated complete aneurysm occlusion and intact distal perfusion without evidence of residual stenosis or thromboembolic occlusion (Fig. 2D). The patient was discharged alert with residual hemiparesis (muscle strength 3/5). At the 3-month follow-up, her neurological status remained stable, with no additional deficits.

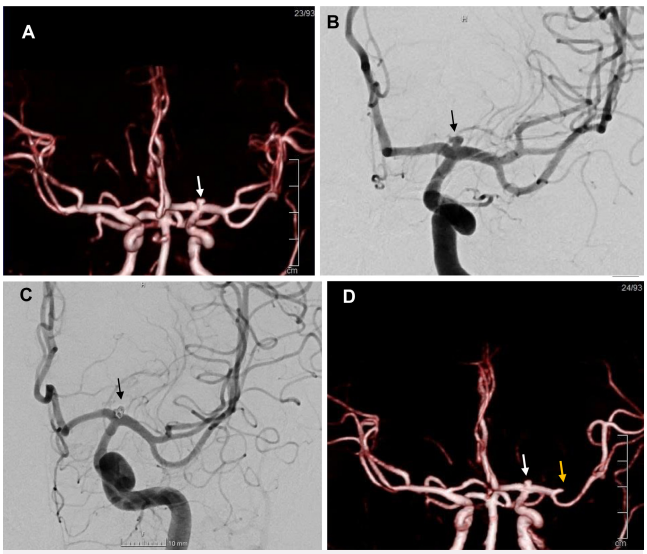

FIG. 1. Pre- and postprocedural images demonstrating aneurysm and coil migration. **A:** Pretreatment 3D TOF MR angiogram demonstrating a small aneurysm arising from the left internal carotid artery terminus (*arrow*). **B:** Subsequent digital subtraction angiogram confirming aneurysm morphology and vascular anatomy prior to intervention (*arrow*). **C:** Immediate postcoiling angiographic run showing satisfactory initial placement of the detachable coil within the aneurysm sac (*arrow*). **D:** Follow-up 3D TOF MR angiogram performed after neurological deterioration demonstrating migration of the coil into the parent artery, with persistent visualization of the aneurysm sac (*white arrow*) and occlusion at the distal M2 segment near the M2–M3 bifurcation with impaired distal flow (*yellow arrow*).

Informed Consent

The necessary informed consent was obtained in this study.

Discussion

Observations

Coil migration represents an uncommon but potentially devastating complication of endovascular treatment for intracranial aneurysms. Although endovascular coiling is widely established as a first-line therapy for both ruptured and unruptured aneurysms, as reflected in contemporary guidelines and major comparative trials,[1–4] procedure-related adverse events continue to pose significant clinical challenges. The reported incidence of coil migration ranges from approximately 0.3% to 6%, depending on study design and definitions used.[5] Despite its rarity, the clinical impact of migration can be profound, particularly when associated with parent artery compromise.

In the present case, abrupt neurological deterioration within 30 minutes after embolization prompted immediate reassessment and led to the diagnosis of coil migration into the parent artery. This

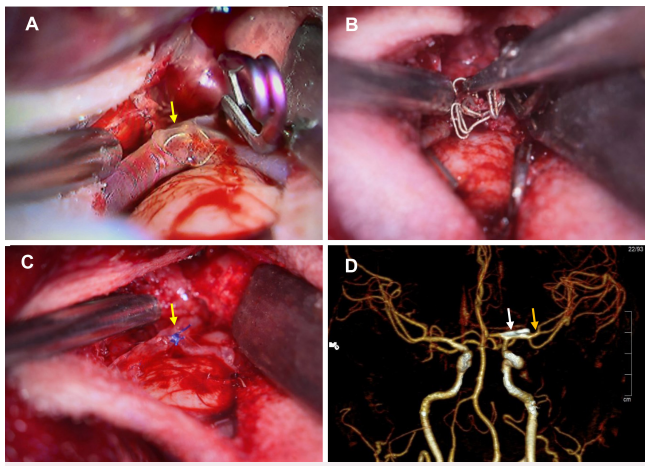

FIG. 2. Intraoperative findings and microsurgical management of migrated coil. **A:** The migrated coil was identified at the M2–M3 bifurcation (*arrow*). **B:** A longitudinal arteriotomy was performed at the bifurcation and the coil was removed. **C:** The arteriotomy was then closed with interrupted sutures (*arrow*). **D:** Postoperative CT angiogram confirming restoration of vessel patency and distal flow (*yellow arrow*) with complete aneurysm occlusion (*white arrow*).

temporal relationship underscores a critical clinical principle: neurological decline following an apparently successful coiling procedure must raise immediate suspicion for mechanical or thromboembolic complications. Delayed recognition may result in prolonged arterial obstruction, secondary cerebral ischemia, and irreversible neurological injury. Previous reports have documented both intraprocedural and delayed coil migration, including cases presenting days to weeks after an initially satisfactory angiographic result.[6–9] These observations highlight the unpredictable nature of this complication and the necessity for vigilant postprocedural monitoring.

Management strategies for coil migration are heterogeneous and must be individualized. Endovascular options such as snare retrieval or stent-assisted fixation have been described;[1,10] however, these techniques may carry substantial risks when the displaced coil extends into distal branches or is densely integrated within the thrombus burden. In such scenarios, microsurgical intervention may offer a more controlled and definitive solution.[11] The most direct approach is arteriotomy with coil extraction,[11,12] which allows definitive removal under direct visualization and was chosen in the present case due to the accessible location of the coil at the M2–M3 bifurcation. Alternative strategies include trapping of the involved arterial segment with or without bypass, particularly in situations where the vessel wall is severely compromised or safe arteriotomy is not feasible.[13] In selected cases, the coil may be left in situ with attempts to restore or maintain distal flow, especially if the risk of surgical retrieval outweighs potential benefits.[5]

In our patient, open surgery enabled direct visualization, safe coil extraction, and definitive aneurysm clipping in a single stage. This approach not only restored parent vessel patency but also eliminated the residual risk of rebleeding. In the present case, several technical aspects were critical to achieving a favorable outcome. A longitudinal arteriotomy was preferred over a transverse incision to minimize the risk of postoperative stenosis and to facilitate direct visualization of the intraluminal coil. Temporary clips of the proximal M2 segment and both distal M3 branches allowed for safe trapping and minimized intraoperative bleeding. The coil was gently extracted under high magnification, avoiding excessive traction that could injure the intima or disrupt distal branches. After removal, meticulous inspection of the lumen was performed to ensure no residual coil fragments remained.

While endovascular therapy has demonstrated favorable short- and long-term outcomes in major trials, surgical clipping remains an indispensable modality, particularly in complex or complication-driven contexts. Comparative analyses continue to show that procedural complications, durability, and retreatment risks differ between modalities,[2,3,14] underscoring the importance of maintaining surgical expertise within comprehensive cerebrovascular centers. Our case reinforces the principle that when coil migration results in acute neurological compromise, rapid multidisciplinary decision-making and timely surgical intervention may be decisive in preventing permanent disability. Delay in treatment may permit ongoing arterial compromise, leading to extensive infarction and poor functional outcome. Therefore, immediate recognition and decisive management are paramount to preserving neurological function.

Lessons

This case highlights several important points. Neurological deterioration after endovascular aneurysm treatment should prompt immediate evaluation for procedure-related complications, including coil migration, thromboembolism, or rebleeding. Rapid imaging and multidisciplinary decision-making are essential to optimize outcomes. Additionally, although endovascular techniques are the primary treatment modality for many ruptured aneurysms, microsurgical intervention remains an important and sometimes definitive rescue strategy. Direct visualization of the vessel and aneurysm allows safe coil extraction, precise vascular repair, and secure clipping when endovascular options are limited or carry significant risk.

This report also has limitations. As a single illustrative case, the findings cannot be generalized to all patients with coil migration, and treatment decisions must be individualized based on aneurysm anatomy, timing of migration, and institutional expertise.

In conclusion, early recognition of coil migration and timely surgical intervention can result in acceptable neurological outcomes in selected patients. Open microsurgical coil retrieval combined with aneurysm clipping remains a valuable treatment option in the management of this rare but potentially devastating complication.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: DL Nguyen, CC Tran, DV Tran, QH Nguyen. Acquisition of data: DL Nguyen, DV Tran, TNT Nguyen, Le. Analysis and interpretation of data: DL Nguyen. Drafting the article: DL Nguyen, DV Tran, TNT Nguyen, QH Nguyen. Critically revising the article: all authors. Reviewed submitted version of manuscript: all authors. Approved the final version of the manuscript on behalf of all authors: DL Nguyen. Statistical analysis: Le. Administrative/technical/material support: DL Nguyen, DV Tran, TNT Nguyen, QH Nguyen. Study supervision: DL Nguyen, CC Tran, DV Tran.

Correspondence

Duy Linh Nguyen: Can Tho University of Medicine and Pharmacy, Can Tho City, Vietnam. ndlinh@ctump.edu.vn.