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Original Article

Endovascular simple coiling for ruptured intracranial aneurysms

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Abstract

Aim: Subarachnoid hemorrhage (SAH) caused by ruptured intracranial aneurysms (RICAs) is a significant source of morbidity and mortality. This study seeks to assess the safety and efficacy of endovascular simple coiling (SC) in patients treated during the acute phase of RICA.

Materials and Methods: We retrospectively analyzed 127 patients who underwent SC for aneurysmal SAH (aSAH) from January 2019 to August 2025. We assessed demographic information, aneurysm details, and occlusion rates. Primary endpoints included rebleeding, perioperative complications, and mortality. Data regarding aneurysm size were analyzed for normality; given the non-normal distribution typical of vascular pathologies, the mean and standard deviation were retained for consistency with comparable literature.

Results: The study comprised 127 patients (mean age 57.0± 12.6 years; 76 females, 59.8%). The internal carotid artery was the most frequently observed aneurysm location (35.5%). The remaining 25.5% of aneurysms were located in the posterior circulation or other segments, including the posterior communicating artery (n=14), basilar artery (n=8), vertebral artery (n=6), distal anterior cerebral artery (n=3), and superior cerebellar artery (n=1). The mean aneurysm diameter was 9.0±5.6 mm. Complete aneurysm occlusion (Raymond-Roy Class 1) was achieved in 35 patients (27.6%). At the 1-year follow-up, the overall mortality rate stood at 20.5% (26 of 127). Rebleeding occurred in 2 patients (1.6%). The remaining 24 deaths were attributed to the severity of the initial subarachnoid hemorrhage (e.g., intracranial hypertension, brain edema) or delayed cerebral ischemia due to severe vasospasm, rather than procedural complications.

Conclusion: SC remains an effective and safe option for appropriate candidates. It offers low perioperative complication rates and acceptable aneurysm occlusion rates, prioritizing safety by avoiding the risks of dual antiplatelet therapy required for stent-assisted procedures.

Keywords: Subarachnoid hemorrhage, endovascular simple coiling, ruptured intracranial aneurysms

INTRODUCTION

Intracranial aneurysms (ICAs) pose a severe health risk (1). Multiple aneurysms are detected in up to 30% of patients (2). Rupture leads to aneurysmal subarachnoid hemorrhage (aSAH), a condition associated with high morbidity and mortality (3). Following a rupture, rebleeding poses a critical secondary threat that peaks within the first 24 hours (4), with mortality rates in rebleeding cases reaching up to 85% (5). While surgical clipping was the standard for decades, endovascular treatment (EVT) has emerged as a minimally invasive alternative (6). For complex geometries, alternative methods may be utilized (7).

Currently, treatment choice depends on patient and aneurysm-specific factors. Simple coiling (SC) involves placing coils into the sac to trigger thrombosis. Generally, SC is appropriate for ruptured aneurysms where the primary goal is to secure the dome against rebleeding without antiplatelet therapy. While stent-assisted coiling (SAC) offers higher occlusion rates for complex geometries, it requires dual antiplatelet therapy (DAPT), which carries an increased risk of hemorrhagic complications in the acute setting (8). This study seeks to evaluate the clinical and technical success, along with the safety profile, of SC for treating aSAH.

MATERIALS AND METHODS

Patients

We performed a retrospective, single-center analysis of 127 patients admitted with aSAH and treated with endovascular

coiling from January 2019 to April 2025. The Sakarya University Non-Interventional Research Ethics Committee granted ethical approval (Protocol No: E-43012747-050.04-463752), (Decission date: 12/04/2025).

The study enrolled patients aged 18 years or older with a confirmed aSAH diagnosis managed via endovascular SC. Exclusion criteria were patients who underwent primary surgical clipping, those treated electively for unruptured aneurysms, those requiring stent-assisted or flow-diversion techniques, or cases where the hemorrhage was attributed to a non-aneurysmal etiology (Figure 1).

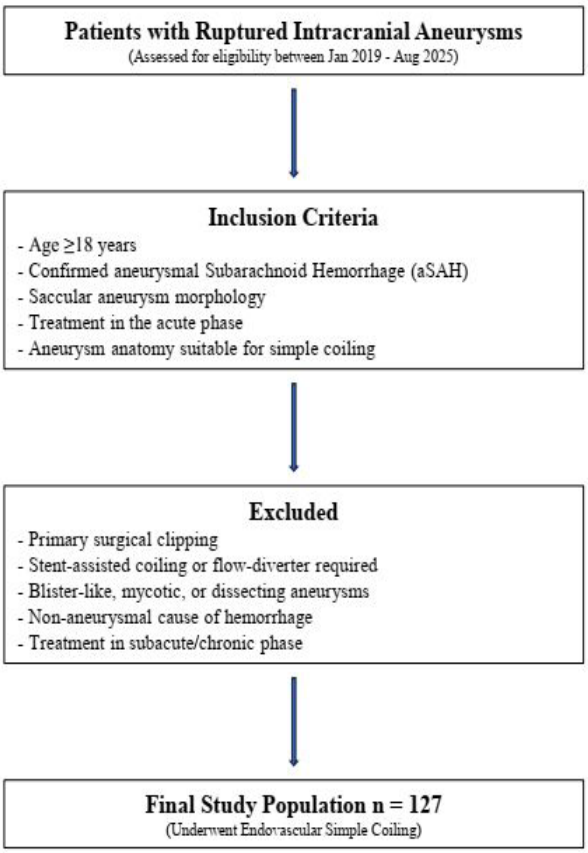

Figure 1. Flowchart of the patient selection process

Endovascular Procedure

All procedures were carried out by two experienced interventional radiologists, each with more than 10 years of experience in neurointerventional procedures. The main artery was catheterized using a 6 or 7-French long vascular sheath (Flexor, Cook, USA) and a 5 or 6-French distal access catheter (Noro-cath, Taha, Turkiye). The aneurysm sac was accessed with a microwire (Hybrid, Balt, France) and microcatheter (Rebar, Medtronic, USA). The aneurysm sac was embolized using coils (Axium, Medtronic, USA) without balloon or stent assistance. Technical success was defined as the successful catheterization of the aneurysm sac and the placement of coils, resulting in angiographic exclusion of the aneurysm from circulation.

Statistical Analysis

Data analysis was performed with IBM SPSS Statistics Version 26.0. Continuous variables were assessed for normality; mean± standard deviation (SD) were presented to allow comparison with existing literature.

RESULTS

Patients

The study comprised 127 patients (mean age 57.0± 12.6 years; 76 females [59.8%]). The location was most frequently observed in the internal carotid artery (35.5%), followed by the anterior communicating artery (26.2%) and the middle cerebral artery (12.8%). The remaining 25.5% of aneurysms were located in the posterior circulation or other segments. Specifically, these included the posterior communicating artery (n=14, 11.0%), basilar artery (n=8, 6.3%), vertebral artery (n=6, 4.7%), distal anterior cerebral artery (n=3, 2.4%), and superior cerebellar artery (n=1, 0.8%). The mean aneurysm size was 9.0± 5.6 mm.

Angiographic Outcomes

Angiography revealed complete aneurysm occlusion (Raymond-Roy Class 1) in 35 patients (27.6%) (Figure 2). Partial occlusion (Raymond-Roy Class 2 or 3) was observed in the remaining 92 patients (72.4%).

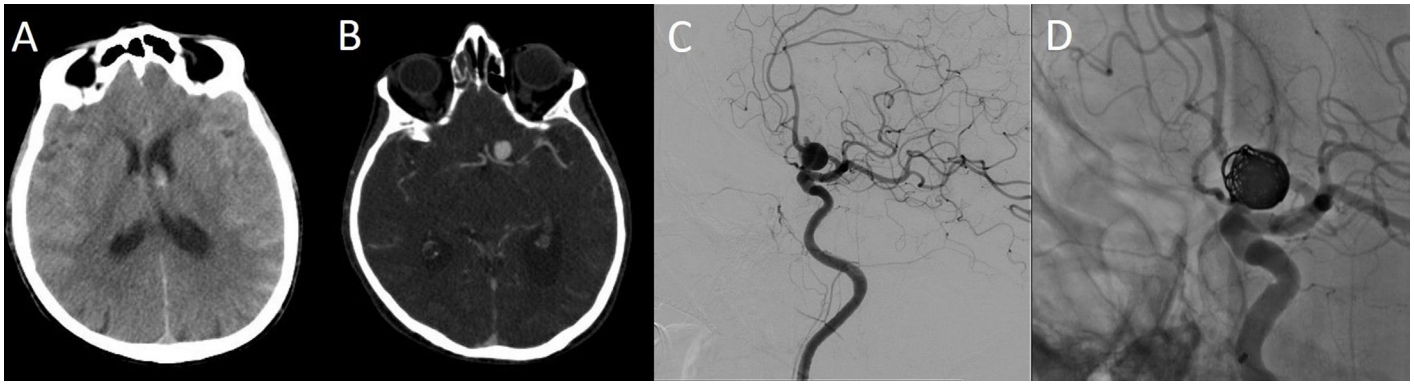

Figure 2. Digital Subtraction Angiography (DSA) of a representative case. (A) PcomA aneurysm. (B) Complete occlusion (Raymond-Roy Class 1) post-SC

Clinical Follow-up and Mortality

No perioperative hemorrhagic complications or mortality occurred. During the 1-year follow-up, the overall mortality rate was 20.5% (26 of 127). Rebleeding occurred in 2 patients (1.6%), both of whom died. The remaining 24 deaths were not related to procedural failure but were attributed to the severe clinical course of the initial hemorrhage, including sequelae of high intracranial pressure and infarction secondary to severe vasospasm.

DISCUSSION

Major progress in endovascular techniques has enhanced aneurysm management. Our study focuses on the safety of simple coiling in the acute phase. Decision-making in ruptured aneurysms is complex, balancing occlusion efficacy with procedural safety (9).

Our complete occlusion rate of 27.6% is lower than the long-term rates often reported in stent-assisted series (8). However, our rebleeding rate of 1.6% remains comparably low to the 2.6% risk reported in the coiling arm of the ISAT trial (10). The Barrow Ruptured Aneurysm Trial (BRAT) also confirmed the viability of endovascular treatment in long-term follow-up (11). This underscores a strategic trade-off in the acute phase: prioritizing safety by avoiding DAPT.

Systematic reviews and Cochrane meta-analyses support endovascular management as a primary treatment for ruptured aneurysms, balancing recurrence risks with lower procedural morbidity (12). While stents improve occlusion, they entail higher hemorrhagic complications (13,14).

The safety profile is closely tied to clinical outcomes. In our cohort, mortality (20.5%) was primarily driven by the initial clinical severity of the hemorrhage rather than procedural complications. Regarding SAC, Ma et al. noted that while it achieves higher occlusion, it is associated with higher hemorrhagic complications (8). Furthermore, meta-analyses comparing stent-assisted versus non-stent-assisted coiling emphasize that simple coiling remains a safer alternative in the acute phase of rupture due to the avoidance of antiplatelet-related risks (15). In addition to neuro interventions, primary coiling has been utilized in various types of bleeding, including those involving the abdominal wall (16), kidney (17), and gastrointestinal tract (18). Aligning with the safety benefits of SC, we observed no perioperative hemorrhagic complications.

Limitations

Our study has limitations. First, it is retrospective. Second, consistent baseline clinical grading scores (e.g., Hunt-Hess, mRS, or GOS) were not available for all patients due to archival limitations, preventing detailed stratification by clinical grade. Finally, the absence of a direct comparative arm prevents definitive conclusions.

CONCLUSION

Simple Coiling (SC) remains a crucial tool by removing the need for DAPT and minimizing perioperative risks. Our findings confirm that SC is an effective modality with acceptable occlusion rates, making it a viable safety-first strategy for ruptured aneurysms.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that there is no financial support.

Ethical Approval
The study protocol received approval from the Sakarya University Non-Interventional Research Ethics Committee granted ethical approval (Protocol No: E-43012747-050.04-463752), (Decission date: 12/04/2025).

Patient Consent
Not necessary for this manuscript.

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