Strategies and Outcomes for Coiling Very Small Aneurysms

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- Cerebral angiography
- Cerebrovascular disorders
- Embolism and thrombosis
- Endovascular procedures
- Intracranial aneurysm
- Neuroradiology
- Retrospective studies
- Treatment outcome
- Watchful waiting

Abbreviations and Acronyms
MCA: Middle cerebral artery
RR: Raymond-Roy grade

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■ OBJECTIVE: **Coiling of aneurysms 3 mm in diameter or less has been associated with a relatively high rate of complications, including iatrogenic rupture. The present study aimed to determine the clinical outcome of our technique for coiling small aneurysms.**

■ METHODS: **A retrospective chart review was performed of prospectively collected data for all patients who had endovascular coiling of an aneurysm 3 mm in diameter or less between 2003 and 2008. Follow-up imaging with magnetic resonance or catheter angiography was performed at varying intervals after coiling, ranging from 1 to 6 years after the procedure. Angiographic results were assessed using the Raymond-Roy (RR) grading system. Clinical outcomes during the same period were measured using the modified Rankin Scale.**

■ RESULTS: **Between March 2003 and April 2008, 20 patients underwent coil embolization of an aneurysm 3 mm or smaller—17 ruptured and 3 unruptured. After the procedure, 10 aneurysms were completely occluded (RR 1), 7 had residual filling of the neck (RR 2), and 3 had residual filling of the fundus (RR 3). There were no iatrogenic ruptures. Stent assistance was used in three cases. Balloon assistance was not used. Two patients were retreated, but no aneurysm reruptured. Clinical outcomes were as expected on the basis of the presenting Hunt & Hess grade. One patient with a ruptured aneurysm died from complications related to severe vasospasm.**

■ CONCLUSION: **Aneurysms 3 mm in diameter or smaller can be coiled safely with the use of both bare platinum and hydrogel-coated coils. In most cases, coiling of small aneurysms can be performed without the use of adjunctive devices such as balloons or stents.**

INTRODUCTION

The endovascular treatment of small aneurysms remains challenging. A small aneurysm fundus leaves little room for error during catheter manipulation and coil deployment. As a result, the coiling of small aneurysms is associated with a relatively high risk of iatrogenic aneurysm rupture or migration of the coil into the parent vessel. Although the limitations of the endovascular approach can be avoided by clip ligation or craniotomy, not all patients are good surgical candidates. Craniotomies are often not well tolerated in patients who are elderly, have brain swelling, or are in vasospasm. In patients who cannot be treated surgically, endovascular embolization offers an effective treatment that can be performed without brain retraction or significant blood loss.

We collected data regarding both the clinical and radiographic outcomes of each patient for up to 6 years after coiling. During this time, we refined our catheterization and coiling technique to overcome some of the anatomical and technological challenges commonly encountered during the embolization of very small aneurysms. We are presenting these modifications in technique alongside our clinical and radiographic outcome data to demonstrate one way that coiling very small aneurysms can be performed safely.

PATIENTS AND METHODS

Patients

A retrospective chart review was performed of all patients who had endovascular coiling of an aneurysm less than or equal to 3 mm in diameter at Albany Medical Center between 2003 and 2008. A total of 20 consecutive patients were enrolled: 17 patients with ruptured aneurysms and 3 patients with unruptured aneurysms. The angiographic results after coiling were assessed using the Raymond-Roy (RR) grading system. Follow-up imaging with magnetic resonance imaging or catheter angiography was performed at varying intervals after coiling ranging from 12 months to 6 years after procedure. Clinical outcomes during the same period were measured with the modified Rankin Scale. These patients were treated with an endovascular approach because in the vast majority of cases, the aneurysm was believed to have ruptured. The patients were thought to be poor candidates for clip ligation, given their neurological or medical condition. In three unruptured aneurysms, treatment was instituted because the patients had a previous

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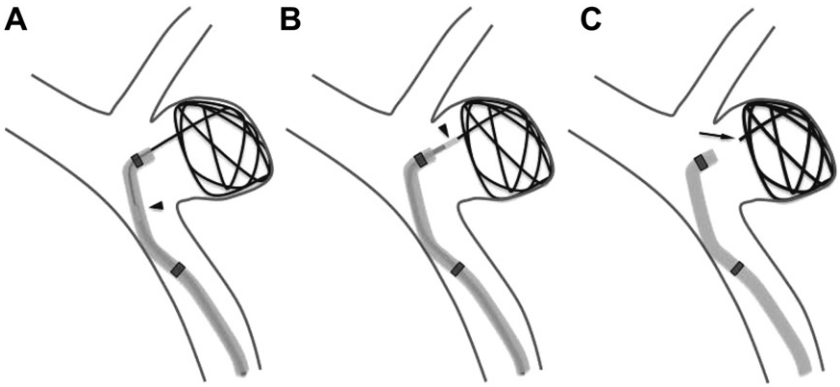

Figure 1. (**A**) Coiling from the parent vessel without selectively catheterizing the aneurysm can be performed safely. A larger, stiffer microcatheter may help stabilize the catheter during coil deployment. (**B**, **C**) Carefully extending the coil pusher (*arrowheads*) to the neck of the aneurysm before detachment will help prevent leaving a long "tail" of coil protruding into the parent vessel (*black arrow*).

incident of subarachnoid hemorrhage from another aneurysm and had medical or neurological risk factors increasing their risk of complications from clip ligation. In nearly all cases, the aneurysms were berry in nature with an aspect ratio less than 1.5 but greater than 1.0. In the three cases of stent-assisted coil embolization, the aspect ratio was less than 1.0. This study was reviewed and approved by the Internal Review Board at Albany Medical Center before data collection and analysis.

Endovascular Technique

Initial Diagnostic Angiography. Vascular access is obtained via a 6-French, 10-cm introducer (Terumo, Somerset, New Jersey, USA) percutaneously inserted into the right or left common femoral artery. Diagnostic angiography is performed using a 5-French Glidecath (Terumo) with either a Simmons-2 or angled tip. In most cases, rotational angiography with three-dimensional rendering is performed to help determine the optimal working angle for treatment.

Guide Catheter Placement. Interventions are performed through a 6-French MPC or Simm-2 Envoy guide catheter (Codman, Raynham, Massachusetts, USA) on a continuous heparinized saline flush. The guide catheter is positioned as distally in the precerebral vessel as possible for improved stability and maneuverability of the microcatheter and microwire. For unruptured aneurysms, a loading dose of 70 units/kg of heparin is administered intravenously after insertion of the introducer. For ruptured aneurysms, half the loading dose of heparin (35 units/kg) is administered after positioning of the guide catheter in the precerebral vessel and the second half is given after detachment of the first coil.

Microcatheter Selection

Most commonly, a small, braided microcatheter such as an Excelsior SL-10 (Boston Scientific, Boston, Massachusetts, USA), Prowler 14 (Codman), or Echelon 10 (ev3 Neurovascular, Irvine, California, USA) is selected. Smaller microcatheters generally have softer, more pliable tips, making them less likely to perforate the aneurysm if they are inadvertently advanced too far. In very small aneurysms that are difficult to catheterize directly, coiling can often be performed with the microcatheter in the parent vessel

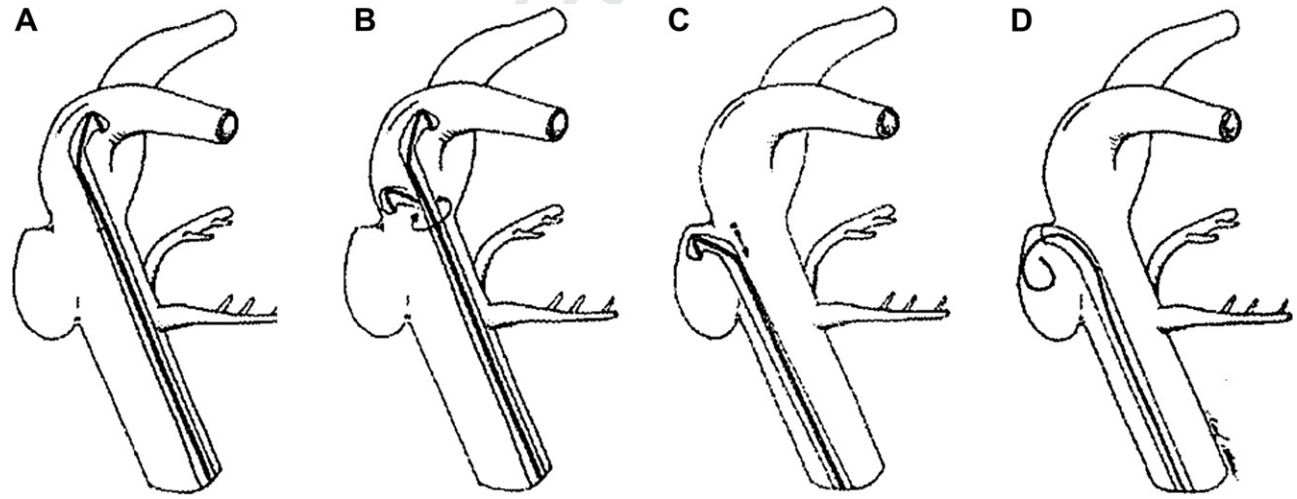

Figure 2. Small aneurysm "wireless" catheterization technique in a sidewall basilar artery aneurysm. (**A**) The catheter is positioned distal to the neck of the aneurysm and the wire is pulled back into the tip of the microcatheter. (**B**) The microcatheter is then slowly pulled back toward the aneurysm neck while simultaneously the wire is spun inside the microcatheter. Friction between the wire and the microcatheter will steer the tip of the microcatheter toward the neck of the aneurysm. (**C**) Maintaining gentle negative pressure on the microcatheter during this maneuver will help engage the neck of the aneurysm. (**D**) Coiling should proceed as usual from the neck of the aneurysm.