

Endovascular Management of Microcerebral Aneurysms with Diameter Smaller than 3 mm: Is It Feasible and Safe?

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Background: The neurosurgical management of microcerebral aneurysms with diameter smaller than 3 mm remains a great challenge as many complications can occur. *Aim:* Our target was to assess the efficacy and usefulness of endovascular treatment of these lesions. *Methods:* We did a prospective and retrospective gathering of the results of endovascular treatments for a group of 16 patients with 16 microcerebral aneurysms. Four patients were treated by direct coil embolization, and 12 patients were managed by remodeling techniques. *Results:* Coil embolization was technically accessible in all cases. Initial complete occlusion is achieved in 12 patients. We did not face major technical complications such as aneurysmal rupture or coil migration during the endovascular management in 15 patients. Only in 1 case the second and last coil (21 mm) migrated distally and could not be retrieved. In this case clinical evidence of neurologic deterioration and weakness in left lower limb due to right anterior cerebral artery territory stroke was evidenced in the follow-up computed tomography scan. Follow-up clinical and radiological studies were available for 9 of 12 surviving patients and showed complete occlusion in 7 cases, and in 1 case aneurysm tiny recanalization was demonstrated after 1 year, which was retreated with complete occlusion, and in another case tiny aneurysm recanalization at the neck appeared after 2 years, which was left under observation. *Conclusions:* Endovascular treatment is a beneficial and effective therapeutic alternative to microsurgery for microaneurysms. The long-term assessment of endovascular management for these lesions was not included in that study. **Key Words:** Endovascular—microcerebral—aneurysms—coil embolization—remodeling.

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Introduction

With advancement of endovascular techniques, endovascular management of intracranial aneurysms is considered a valid alternative to microsurgical clipping.

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Received August 14, 2017; revision received January 7, 2018; accepted January 12, 2018.

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1052-3057/\$ - see front matter

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<https://doi.org/10.1016/j.jstrokecerebrovasdis.2018.01.015>

This has been documented by the International Subarachnoid Aneurysm Trial, which demonstrated greater efficacy of endovascular treatment for ruptured aneurysms compared with clipping.¹

However, endovascular management of intracranial microaneurysms smaller than 3 mm in diameter was considered to be technically difficult. The technical difficulties were due to the small cavity in which the microcatheter has to be placed, which also may compromise the stability of microcatheter position after successful placement and during coiling, as well as the increased risk of perforation related to placing coils into this tiny, fragile aneurysm sac.² For these reasons, microaneurysms were excluded from the International Subarachnoid Aneurysm Trial and from the study by Viñuela et al that led to approval of the Guglielmi detachable coils in the United States.^{3,4}

However, with the advancement of endovascular materials especially the better suitable coils, the growing improvement of the experience obtained by endovascular surgeons and an increased use in adjunctive techniques, such as balloon or stent assisted coiling, have significantly reduced the procedure-related risks⁵

Recently, several studies have shown that endovascular treatment of microaneurysms can be done with acceptable risk.^{6,7-10}

To re-evaluate the treatment results of endovascular therapy of microcerebral aneurysms in the matter of feasibility, efficacy, clinical outcomes, procedure related risks, and safety, we report both our own experience as well as the results of other reports in the literature regarding coil embolization of very small intracranial aneurysm.¹¹

Objectives of This Study

The purpose of the study is to present series of cases of cerebral microaneurysms managed with endovascular embolization, to analyze the outcome of this practice and to review the current literature that is concerned with the endovascular treatment of this particular group of aneurysms, detailed outcomes, recurrence, morbidity, mortality, rebleeding and other complication rates.

Patients and Methods

Study Design, Inclusion, and Exclusion Criteria

This study is prospective and retrospective study that has been done from January 2009 through December 2015 to assess the outcome of the endovascular approach to treat microaneurysms as an alternative to microsurgical approach.

Ruptured microaneurysms 3 mm or smaller were the most important inclusion criteria. Aneurysms larger than 3 mm, suspected pseudoaneurysms, and aneurysms associated with brain arteriovenous malformations were excluded in our study.

The patient's hospital records including outpatient clinic and procedural reports, all angiographic and noninvasive imaging data (computed tomography and magnetic resonance studies) were subjected to careful analysis and review after Institutional Review Board approval. Final decisions regarding the treatment of patients with microcerebral aneurysms were discussed among the faculty members of the microvascular neurosurgery and endovascular neurosurgery group. The indications for endovascular therapy included surgical difficulty determined by the referring neurosurgeon or the medical center's neurosurgical team, unsuccessful surgical attempt, refusal of surgery, direct embolization referral, and elderly patients.

Sixteen patients fulfilled the above-mentioned criteria so they are included in that study. There were 7 men and 9 women with age ranging from 21 to 66 years with mean age 46 years. The ruptured aneurysms are located in the

Table 1. *Microcerebral aneurysm location*

Location	No. of Patients
ICA	3
PICA	1
AcoA	7
Ophthalmic artery	1
AchA	2
MCA bifurcation	1

Abbreviations: AchA, anterior choroidal artery; AcoA, anterior communicating artery; ICA, internal carotid artery; MCA, middle cerebral artery; PICA, posterior inferior cerebellar artery.

anterior communicating, middle cerebral artery bifurcation, and anterior choroidal arteries. Computed tomography (CT) scan was done to all the patients and was revealing subarachnoid hemorrhage (SAH) (Table 1).

Immediate and Follow-Up Angiographic Outcome Analysis

The initial treatment angiograms including high magnification views (treatment working angle) and all follow-up angiograms including also the high magnification views that reproduced the initial treatment working angles were subjected to careful analysis.

Several anatomic characteristics were collected as measurement of the aneurysm: width, height, maximal sac diameter, neck size, and sac-to-neck ratio, using the on-board digital subtraction angiography computer at the time of embolization. Only when the anatomic characteristics could be clearly established in the available films were the cases included for analysis.

A microaneurysm was defined as the aneurysm with the largest sac diameter less than 3 mm. Sac-to-neck ratios were categorized into those greater than 2 and those with ratio less than or equal to 2.

The angiographic results were evaluated in the immediate postembolization angiographic projections. A qualitative assessment of the aneurysm occlusion was performed using a 3-point Raymond scale as in Figure 1. "Complete occlusion" was considered only when the aneurysm had dense packing and no contrast filling of the aneurysm sac or neck obtained in multiple projections. "Neck remnant" was defined if there was residual filling of part of the neck of the aneurysm. "Residual aneurysm" was considered if there was continuing contrast filling of the dome or sac.

Attempted occlusion was defined as endovascular intervention that was attempted but embolization was not performed. A first angiographic follow-up was usually carried out at 6 months, and a second at 18-24 months. A third angiographic follow-up was usually performed and decided according to the results of the first and second angiographic follow-ups. The angiographic projections used

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