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Review

# Risk factors for angiographic recurrence after treatment of unruptured intracranial aneurysms: Outcomes from a series of 178 unruptured aneurysms treated by regular coiling or surgery

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ABSTRACT

*Background.* – Long-term stability after intracranial aneurysm exclusion by coiling is still a matter of debate; after surgical clipping little is known.
*Objective.* – To study outcome after endovascular and surgical treatments for unruptured intracranial aneurysms in terms of short- and long-term angiographic exclusion and risk factors for recanalization.
*Methods.* – From 2004 and 2009, patients treated for unruptured berry intracranial aneurysms by coiling or clipping were reviewed. Aneurysmal exclusion was evaluated using the Roy-Raymond grading scale; immediate clinical outcome was also assessed. Clinical outcome, recanalization, risk factors for recurrence and bleeding during the follow-up period were analyzed by groups; "surgery" and "embolization".
*Results.* – From 2004 to 2009, 178 consecutive unruptured aneurysms were treated. The post-procedure angiographic results for "surgery" were: total exclusion 75.6%; residual neck 13.5%; residual aneurysm 10.8%. For "embolization", the results were, respectively: 72%; 20.7%; and 7.2%. Morbidity was 3% for "surgery" and 1.6% for "embolization" ($P = 0.74$); mortality was nil. Mean clinical and angiographic follow-up was 5 years. Recurrence rate was of 11.5% for "surgery" vs. 44% for "embolization" with a mean follow-up of 4 and 5.75 years, respectively ($P = 1.10–5$). The retreatment rate was 8.4%. Two significant risk factors for recanalization were identified: maximum diameter of the aneurysm sac ($P = 0.0038$) and pericallosal location ($P = 0.0388$). No bleeding event occurred.
*Conclusion.* – Both techniques are safe. The rate of aneurismal recurrence was significantly higher for embolization, especially for large diameter aneurysms and pericallosal locations. No bleeding event occurred after recanalization.



## Introduction

Endovascular coiling, owing to the results of the ISAT [1] study, has become in the recent decades the first-line treatment for ruptured intracranial (IC) aneurysms. However, in unruptured IC aneurysms, especially in the anterior circulation, the best strategic option between endovascular coiling and surgical clipping remains debated [2,3]. Indeed, the relatively high recanalization rate after endovascular coiling 4 as well as technical difficulties for the endovascular treatment of large necked aneurysms remains a limitation for this technique [4].

*Abbreviations:* ACho, Aanterior choroidal artery; ACom, anterior communicating artery; IC, intracranial; ICA, internal carotid artery; DSA, digital subtraction angiography; MCA, middle cerebral artery; PCom, posterior communicating artery; PD, packing density.

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**Table 1**
Patient's demographics.

| | | Surgery (P = 54, a = 67) | Embolization (P = 89, a = 111) | *P* |
|---|---|---|---|---|
| Sex ratio (F/M) | | 38/16 | 66/23 | 0.61 |
| Age | | 50.04 ± 9.4 | 51.3 ± 11.8 | 0.59 |
| Multiple aneurysms | 20 (37%) | 40 (45%) | 0.35 | |
| *Revealing condition* | | | | |
| Incidental | | 46 (67%) | 66 (60%) | 0.10 |
| SAH History | | 20 (31%) | 36 (32%) | 0.23 |
| Oculomotor Palsy | | 0 | 8 (7%) | 0.02 |
| Ischemic Stroke | | 1 (2%) | 1 (1%) | 1.00 |

SAH: subarachnoid hemorrage; P: patients; a: aneurysms.

In the literature, recurrence rates for clipped aneurysms have been reported from 0.02 to 0.5% year [5–7]. For endovascular treatment the recanalization rate may exceed 30%, especially when a remnant is seen at the end of the procedure [7,8].

The purpose of our study was to evaluate the long-term angiographic recurrence rate in both clipped and coiled unruptured IC aneurysms in our institution over a 5-year period. We also aimed to identify the risk factors for further aneurysmal recurrence.

## Materials and methods

### *Design of the study*

Monocenter retrospective study involving 143 consecutive patients treated for 178 intracranial berry aneurysms.

### *Patients' demographics*

Patients' demographics are summarized in Table 1.

Between 2004 and 2009, 943 consecutive aneurysms in 693 patients were treated in our institution. Among these 943 aneurysms, 752 were ruptured: 153 were clipped and 599 embolized; 191 were unruptured: 67 were treated by clipping, 124 by embolization with 111 treated by regular coiling (± remodeling technique) (see the flow chart in Fig. 1). Among these 124 embolized aneurysms, 13 (large or giant aneurysms; dissecting or fusiform aneurysms) were treated by stent assisted coiling or flow diverter stents, and were excluded from the analysis (see exclusion criteria below). One hundred and seventy-eight unruptured aneurysms in 143 patients (sex ratio F/M: 2.7) were analyzed in our study.

### *Inclusion criteria*

Inclusion criteria were as follows: adult patients (i.e. over 18 years), presenting an unruptured bifurcation berry intracranial aneurysm that was eligible for either microsurgery or endovascular coiling (regular coiling or balloon-assisted coiling). All cases were discussed in multidisciplinary meeting involving interventional neuroradiologists, neurosurgeons and neuro-anesthesiologists. For all aneurysms, if a given aneurysm was eligible for both techniques, embolization was chosen as a first option. If the aneurysms seemed highly challenging to treat endovascularly (very large neck, tortuous vessels, major atheroma) and if the surgical option seemed more straightforward, surgery was preferred. Aneurysms located on the vertebrobasilar system were proposed as first intention for endovascular embolization given that their location is less favorable for surgery.

### *Exclusion criteria*

Intracranial aneurysms in children were not included in our study. Giant/large (i.e. > 25 mm and 15 mm, respectively) aneurysms, as well as fusiform or dissecting aneurysms were also excluded because their treatment requires more complex techniques such as stenting. We chose to exclude patients treated by stenting to obtain a homogeneous study population and because the stenting devices had evolved considerably during the 5-year period of our study. Finally, ruptured aneurysms were not included in the study.

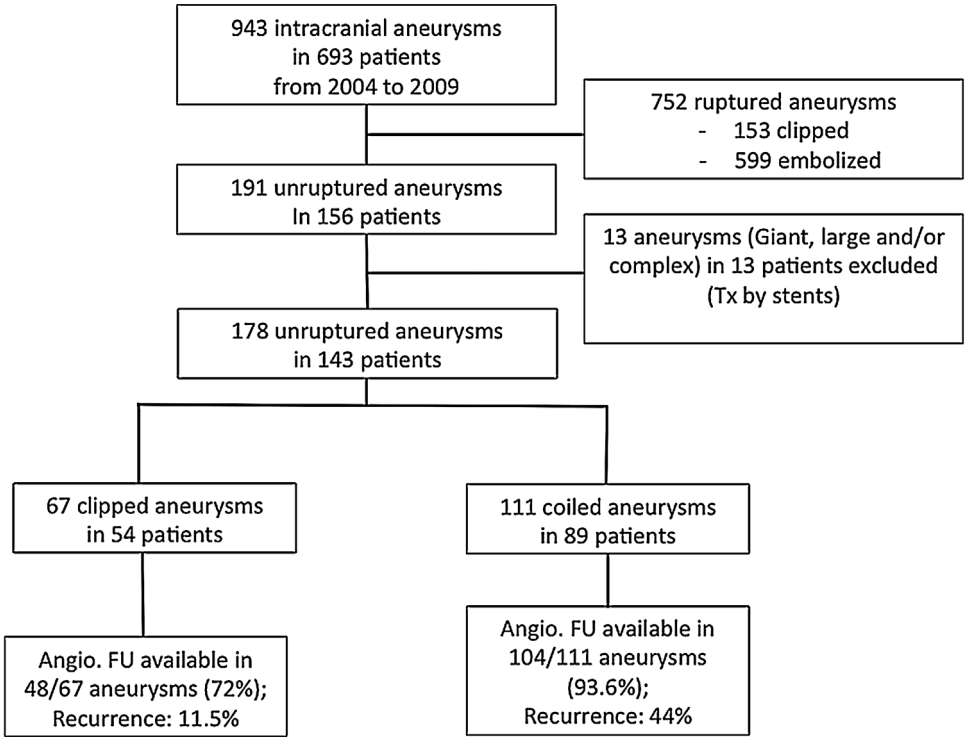


**Fig. 1.** Flow chart of the patients included in our study.