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# Regarding ''Endovascular Treatment of Very Small Intracranial Aneurysms: Meta-Analysis''

X. Wu, V.B. Kalra, D. Durand and A. Malhotra

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# Regarding "Endovascular Treatment of Very Small Intracranial Aneurysms: Meta-Analysis"

We thank Yamaki et al[1] for updating their review of the outcome of endovascular treatment in patients with very small (<3 mm) intracranial aneurysms (IAs). However, we have a few concerns regarding the "Results"/"Conclusions."

The conclusion that coil embolization in very small aneurysms can be performed safely and effectively should be reserved for ruptured IAs. The authors themselves discuss the very low rupture rates in very small IAs as reported in the literature. The meta-analysis results show the high rate of complications and poor neurologic outcome in almost 21% of patients overall. One should also note from the study the high rate at which these previously unruptured IAs had been treated (261/1105 treated aneurysms), despite their not-well-understood natural history and likely very low rupture rates. In a recent study by Murayama et al,[2] 301 IAs measuring 2–4 mm were treated, while 1717 were observed; these results show the high rates of treatment in these small IAs. It is disappointing that most of the studies in this meta-analysis do not mention the long-term neurologic outcomes in patients with unruptured IAs, but the high rate of complications, as shown in this meta-analysis, is clearly a reason for concern. In this era of patient-centered decision-making, it would be interesting to see how many patients with unruptured aneurysms are told that the procedure-related mortality rate is roughly 3% and the morbidity rate is 2%, with poor neurologic outcome in a large number of patients. It is also disappointing but important to note that despite advances in treatment, though procedure-related rupture is lower, long-term angiographic occlusion rates are similar and rates of good neurologic outcome are actually worse after 2010. The authors' conclusion regarding the safety and efficacy of coiling, given all these findings, should be restricted to ruptured IAs.

Table 1 of the article shows that many included studies are unbalanced in terms of ruptured and unruptured IAs. The authors also noted that 9 studies included only ruptured IAs and 2 included unruptured IAs (from Table 1, the study of Pierot et al[3] seems to be the only one reporting only unruptured IAs). The extent of bias in these studies in terms of patient selection is not clear. In addition, there were many more ruptured-than-unruptured IAs. The distribution is not likely to be representative of the patient population with very small IAs, rendering the outcome rates of limited statistical power.

Careful review of the included studies also shows that follow-up was not reported in all the 1105 aneurysms included in the study. For example, Lu et al[4] reported repeat angiographic results in only 21/52 patients, and mean angiographic follow-up was only around 11 months though they said they followed the patients for a mean of 46.7 months (range, 10–105 months). Van Rooji et al,[5] who had the largest series in this meta-analysis of 196 patients, had angiographic follow-up at 6 months in only 158 patients. Hwang et al[6] had follow-up MRA and/or DSA in 33/43 patients.

Although $I^2$ for procedural rupture for previously unruptured aneurysms is reported to be zero, results from individual studies vary widely, with Hwang et al[6] reporting none, Pierot et al[3] reporting rupture in 3.9% of 51 patients, and Brinjikji et al[7] reporting rupture in 8.5% in their respective studies.

We thank the authors for summarizing and highlighting the results of treatment in very small aneurysms. Hopefully, this will lead to more objective decision-making and discussions with patients, especially those with previously unruptured aneurysms.

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**X. Wu**
**V.B. Kalra**
**D. Durand**
**A. Malhotra**
Department of Radiology and Biomedical Imaging
Yale School of Medicine
New Haven, Connecticut