

Cerebral Aneurysm Size before and after Rupture: Case Series and Literature Review

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Background: The conclusions of the International Study of Unruptured Intracranial Aneurysms (ISUIA) demonstrating that anterior circulation aneurysms less than 7 mm in maximal diameter have a 0% risk of rupture continue to be widely cited despite discordance with the anecdotal observation that the majority of ruptured cerebral aneurysms are less than 7 mm. The leading hypothesis to reconcile this discrepancy is that cerebral aneurysms shrink after rupture. Our case series of 6 subjects adds to the scarce published literature that addresses our limited understanding of aneurysm size before and after rupture. *Methods:* Our institutional database was evaluated for patients with brain vascular imaging before and after cerebral aneurysm rupture. We evaluated clinical and anatomic features as well as aneurysm dimensions using a submillimeter measurement tool with adjudication between 2 physicians. *Results:* Among our 6 subjects who met the inclusion criteria, and even when combined with the 17 subjects published in the literature with similar information before rupture, no aneurysms decreased in size more than 2 mm. In total, 17 out of 23 aneurysms studied increased in size after rupture. *Conclusions:* Our data add additional evidence that unruptured aneurysms do not shrink in size after rupture. The discrepancy between the ISUIA conclusion on aneurysm size and rupture risk and what is observed anecdotally remains an area in need of additional study. **Key Words:** Aneurysm—hemorrhage—angiography—subarachnoid.

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Introduction

The widely cited, observational International Study of Unruptured Intracranial Aneurysms (ISUIA) concluded that, in patients without a history of subarachnoid hemorrhage, anterior circulation aneurysms less than 7 mm

had a 0% risk of rupture over 5 years, while posterior circulation aneurysms less than 7 mm had a 2.5% risk.¹ These conclusions are inconsistent with what is anecdotally observed, which is that the majority of ruptured cerebral aneurysms that present to medical attention are less than 7 mm.^{2,3} Hypotheses to reconcile this discrepancy suggest that aneurysms decrease in size after rupture.⁴ Small previously published series with a total sample size of 17 with imaging before and after rupture have not shown a decrease in size following rupture.^{5,6} With our case series of 6 subjects combined with the 17 subjects published in the literature, we sought to evaluate if cerebral aneurysm size significantly decreases following rupture, which has implications regarding the interpretation of the ISUIA conclusions.

Methods

After local institutional review board approval, a query of a neurointerventional database at Rush University

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Medical Center yielded 6 patients with both ruptured cerebral aneurysms and brain vascular imaging before rupture. These cases were screened from a total of over 300 ruptured aneurysm patients treated between 2007 and 2015 from a single neurointerventionalist. Demographic and clinical information was obtained from patient charts. All patients had prior cerebrovascular imaging with digital subtraction angiography, computed tomography angiography, or magnetic resonance angiography. All images were independently reviewed on a picture archiving and communications system, and measurements were made using a submillimeter measurement tool for aneurysm location, maximal diameter, and presence of a daughter sac. Two of the authors of the present study (J.Y. and M.C.) reviewed all images and had access to all clinical data. After initial independent measurements were made by one of the authors, images were masked for identification and were adjudicated by the other reviewing author.

Results

The mean patient age was 49 ± 15.3 years, and 5 of the 6 patients were women. Half were anterior circulation aneurysms. Prerupture imaging was split equally between magnetic resonance angiography, computed tomography angiography, and digital subtraction angiography (see Table 1). All aneurysms increased in maximal diameter after rupture, with an average increase of 2.4 ± 1.5 mm. The increase was significant (>2 mm) in three of these cases. New daughter sacs were seen after rupture in 5 of 6 patients. Samples of 4 cases are depicted in Figures 1-4.

Combining all 3 studies (see Table 2), the average patient age was 58 ± 17.5 years, and 20 of the 23 patients were female. Seventy-four percent of aneurysms increased in size (10 were significant increases), 9% decreased in size, and 17% remained the same.

Table 1. Imaging modalities before and after rupture

Patient	Prerupture imaging	Postrupture imaging
Chien et al		
1	DSA or CTA	DSA or CTA
2	DSA or CTA	DSA or CTA
3	DSA or CTA	DSA or CTA
4	DSA or CTA	DSA or CTA
Rahman et al		
1	CTA	DSA
2	CTA	DSA
3	DSA	DSA
4	MRA	CTA
5	CTA	DSA
6	CTA	CTA
7	CTA	DSA
8	DSA	DSA
9	DSA	DSA
10	DSA	DSA
11	CTA	DSA
12	DSA	DSA
13	DSA	DSA
Our series		
1	MRA	DSA
2	DSA	DSA
3	CTA	DSA
4	DSA	DSA
5	CTA	DSA
6	MRA	DSA

Abbreviations: CTA, computed tomography angiography; DSA, digital subtraction angiography; MRA, magnetic resonance angiography.

Of the 2 aneurysms that decreased in size, both found in the Rahman et al⁵ study, change was less than 2 mm. The apparent increase in aneurysm size from pre- to post rupture in our study reduced to 1.8 ± 1.9 mm when all



Figure 1. (A) MRA of a posterior communicating artery aneurysm 2 weeks before rupture. (B) Noncontrast head CT showing subarachnoid hemorrhage from the left posterior communicating artery aneurysm. (C) Catheter cerebral angiography showing no decrease in the size of the posterior communicating artery aneurysm. Abbreviations: CT, computed tomography; MRA, magnetic resonance angiography.

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