

## Original Article

## “Microbleeding” from intracranial aneurysms: Local hemosiderin deposition identified during microsurgical treatment of unruptured intracranial aneurysms

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### Abstract

**Background:** During elective surgery for unruptured aneurysms, we have identified a group of patients with hemosiderin staining of the pial surface immediately adjacent to the aneurysm dome suggesting a remote and unrecognized history of microbleeding from the aneurysm. These cases form the basis for this report.

**Methods:** Medical records of 421 unruptured cerebral aneurysm patients treated surgically between January 2003 and September 2010 were retrospectively reviewed. Patients with a history of prior subarachnoid hemorrhage, craniotomy, or significant closed head injury were excluded from review. Records were reviewed for intraoperative descriptions of hemosiderin deposition in the vicinity of the aneurysm as well as history of headaches, time to presentation, comorbidities, aneurysm characteristics, procedures, and radiologic imaging.

**Results:** Local hemosiderin staining immediately adjacent to the aneurysm was identified intraoperatively in 13 cases. Each of these patients had a history of remote atypical headache prior to presentation. Eight of these patients (62%) had aneurysms described as particularly “thin-walled” at the time of surgery. Aneurysm locations included the internal carotid artery (ICA) (54%), middle cerebral artery (MCA) (23%), anterior communicating artery (ACOMMA) (15%), and the anterior cerebral artery (ACA) (8%). More than half (54%) of these patients had a history of smoking, while 31% had hypertension, and 23% had a history of alcohol abuse. Dyslipidemia and family history of aneurysms were present in 15% and hypercholesterolemia was noted in one patient (8%).

**Conclusion:** We suggest this group of patients had suffered a “microbleed” resulting in local hemosiderin deposition next to the aneurysm. The origins and clinical implications of such microbleeds are unknown and warrant further investigation.

**Key Words:** Hemosiderin, microbleed, unruptured aneurysms

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## INTRODUCTION

Intracranial aneurysm rupture may be preceded by a sentinel or warning leak typically occurring days to weeks prior to subarachnoid hemorrhage. The classic symptoms of a warning leak include the sudden onset of a severe and unusual headache often different from anything the patient has previously experienced. Even after a major hemorrhage from an intracranial aneurysm, some patients will never rebleed; therefore, we presume that some individuals who experience a minor hemorrhage will not go on to suffer a more serious hemorrhage.<sup>[6,7]</sup> At the time of the mild rupture, these individuals may mistake the episode for a migraine or flu-like illness, on occasion lasting for several days. At some point in the future, these patients may undergo screening magnetic resonance imaging (MRI) for an unrelated reason and an incidental, seemingly unruptured aneurysm may be discovered.

In a large series of unruptured aneurysms explored surgically, we have encountered a subset of patients with clear evidence of hemosiderin deposition around the aneurysm. We propose that such “microbleeds” may be identified in a unique subgroup of patients who have suffered a small amount of self-limited bleeding from their otherwise, seemingly “unruptured” aneurysm. The natural history and prognostic relevance of such microbleeds is unknown at this time, and similar findings have only rarely been described in the past.<sup>[11]</sup>

## MATERIALS AND METHODS

Medical records of 421 unruptured cerebral aneurysm patients treated surgically between January 2003 and September 2010 were retrospectively reviewed. Inclusion criteria consisted of a primary diagnosis of nonruptured cerebral aneurysm and surgical exploration of the lesion. Patients with a prior history of subarachnoid hemorrhage, craniotomy, or severe closed head injury were excluded from review. Records were reviewed for intraoperative descriptions of hemosiderin deposition around the aneurysm structures as well as a history of atypical or severe headaches, time to presentation, comorbidities, aneurysm characteristics, procedures, and radiologic imaging.

## RESULTS

Local hemosiderin staining immediately adjacent to the aneurysm was identified intraoperatively in 13 cases. Each of the 13 patients had a history of remote atypical headache prior to presentation. In all cases, a diagnosis of sentinel bleed or subarachnoid hemorrhage had never been suggested, and no patient had been admitted to the hospital for formal evaluation of their prior headache episode. In every instance, hemosiderin deposition

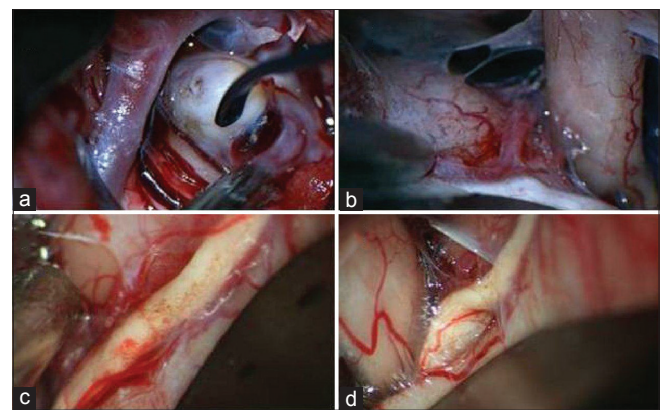
was restricted to the area immediately adjacent to the aneurysm and was not identified remote from the aneurysm location. In general, the pia was stained with brownish black spots, which also involved the olfactory nerve and the optic nerve in several cases [Figure 1].

Aneurysm locations included the internal carotid artery (ICA) (54%), the middle cerebral artery (MCA) (23%), the anterior communicating artery (ACOMMA) (15%), and the anterior cerebral artery (ACA) itself (8%). More than half, 53.8%, of these patients had a history of smoking, while 30.8% had hypertension and 23.1% had a history of alcohol abuse. Dyslipidemia and family history of aneurysms were each present in 15.4% of the patients and hypercholesterolemia was noted in one patient (8%).

In each case, the aneurysm was dissected and clipped without difficulty. The aneurysms were considered particularly “thin-walled” in eight cases.

## DISCUSSION

Although the rate of bleeding of an unruptured intracranial aneurysm is low, rupture rates appear to be substantially higher among patients who have suffered prior rupture from another intracranial aneurysm.<sup>[1-6,10,12-14]</sup> In up to two-thirds of patients with major aneurysmal subarachnoid hemorrhage (ASAH), a warning leak may occur during the days to weeks prior to their hemorrhagic event.<sup>[1,8]</sup> Typically, the clinical presentation of this sentinel bleed is similar to that noted in acute ASAH, including a “thunderclap” headache. We have identified an interesting subset of patients with “unruptured” intracranial aneurysms who have been found to have intraoperative evidence of local “microbleeding” and who report a remote history of a vague flu-like illness associated with headache and meningismus.



**Figure 1: (a-d) Intraoperative micrograph images demonstrating hemosiderin deposition around the aneurysm fundus and chiasm (a and b). The A1 segment of the ACA can be seen crossing over the optic nerve (1b). Hemosiderin evidence is also noticed along the pia and olfactory nerve (c and d)**

This finding leaves several questions unanswered and may thus warrant further investigation. First, many individuals will likely report some similar illness at some point, and whether these episodes actually represented subtle subarachnoid hemorrhages remains uncertain. Although it is possible that these individuals suffered bleeding from an unrelated cause such as mild head injury, the fact that the hemosiderin changes appeared to be restricted to the immediate vicinity of the aneurysm dome suggest a true causal relationship. One fascinating question is whether this tiny amount of bleeding, assuming it actually came from the neighboring aneurysm, would have been enough to result in a positive lumbar puncture if such a study had been performed.<sup>[14]</sup> One wonders whether the finding of local hemosiderin deposition carries an increased risk of future rupture for these patients. If so, the progressive refinement of noninvasive MRI techniques such as susceptibility-weighted imaging may be able to detect such local hemosiderin deposition and could be used to select for treatment patients with “unruptured” aneurysms at high risk for future bleeding.

In this study the diagnosis of hemosiderin was based solely on intraoperative findings. In two cases, retrospective examination of a previously obtained gradient echo MR sequence failed to reveal evidence of prior bleeding, although thin cut sequences had not been performed in these instances. Based on prior reports, it may be possible to identify radiological evidence of minor hemorrhage by performing such thin cut studies utilizing T2 gradient recall echo or MRI-SWI techniques. MRI-SWI is three to six times more sensitive than conventional T2-weighted gradient echo sequences for hemosiderin detection.<sup>[9]</sup> We are currently investigating the use of this technology when evaluating patients with “unruptured” aneurysms who offer a suspicious history of remote atypical headache.

Takada *et al.* have recently described the finding of hemosiderin deposition detected during aneurysm surgery.<sup>[11]</sup> In their case series, hemosiderin deposits in the subarachnoid space were observed in a very high percentage (18%) of 49 patients studied. Findings were compared with MR susceptibility-weighted imaging and pathological findings. These authors suggested that the hemosiderin deposits were likely related to a previous minor leak.<sup>[11]</sup> As in our series, the lack of rupture site found in their patient population may indicate a long

duration from previous leaks or reconstruction of the aneurysm wall after rupture. The exact meaning and ramifications of this finding is unknown at the present time and merits further exploration.

## CONCLUSION

During surgical exposure of unruptured intracranial aneurysms, we have occasionally encountered clear evidence of local hemosiderin deposition in proximity to the aneurysm dome. We suggest that this group of patients had suffered mild bleeding in the past resulting in local hemosiderin deposition next to the aneurysm. The origins and clinical implications of such microbleeds are unknown and warrant further investigation.

## REFERENCES

1. de Falco FA. Sentinel headache. *Neurol Sci* 2004;25 Suppl 3:S215-7.
2. Heiskanen O. Risk of bleeding from unruptured aneurysms in cases with multiple intracranial aneurysms. *J Neurosurg* 1981;55:524-6.
3. Heiskanen O, Marttila I. Risk of rupture of second aneurysm in patients with multiple aneurysms. *J Neurosurg* 1970;32:295-9.
4. International study of unruptured intracranial aneurysm investigators: Unruptured intracranial aneurysms-risk of rupture and risk of surgical intervention. *N Engl J Med* 1998;339:1725-33.
5. Jane JA, Kassell NF, Torner JC, Winn HR. The natural history of aneurysms and arteriovenous malformations. *J Neurosurg* 1985;62:321-3.
6. Juvela S, Porras M, Heiskanen O. Natural history of unruptured intracranial aneurysms: A long term follow-up study. *J Neurosurg* 1993;79:174-82.
7. Juvela S, Porras M, Poussa K. Natural history of unruptured intracranial aneurysms: Probability of and risk factors for aneurysm rupture. *J Neurosurg* 2000;93:379-87.
8. Juvela S. Minor leak before rupture of an intracranial aneurysm and subarachnoid hemorrhage of unknown etiology. *Neurosurgery* 1992;30:7-11.
9. Mittal S, Wu Z, Neelavalli J, Haacke EM. Susceptibility-weighted imaging: Technical aspect and clinical applications. Part 2. *AJNR Am J Neuroradiol* 2009;30:232-52.
10. Taylor CL, Yuan Z, Selman WR, Ratcheson RA, Rimm AA. Cerebral arterial aneurysm formation and rupture in 20,767 elderly patients: Hypertension and other risk factors. *J Neurosurg* 1995;83:812-9.
11. Takada S, Inoe T, Niizuma K, Shimizu H, Tominaga T. Hemosiderin detected by T2-weighted magnetic resonance imaging in patients with unruptured cerebral aneurysms: Indication of previous bleeding? *Neurol Med Chir (Tokyo)* 2011;4:275-81.
12. Wiebers DO, Whisnant JP, Sundt TM Jr, O'Fallon M. The significance of unruptured intracranial aneurysms. *J Neurosurg* 1987;66:23-9.
13. Winn HR, Almaani WS, Berga SL, Jane JA, Richardson AE. The long-term outcome in patients with multiple aneurysms. Incidence of late hemorrhage and implications for treatment of incidental aneurysms. *J Neurosurg* 1983;59:642-51.
14. Withman TF, Kaufmann AM. Unruptured cerebral aneurysm producing a thunderclap headache. *Am J Emerg Med* 2000;18: 88-90.