Rupture of previously documented small asymptomatic saccular intracranial aneurysms

Report of three cases

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ALTHOUGH in Rochester, Minnesota, the fatality rate in cases of aneurysmal subarachnoid hemorrhage (SAH) may have decreased in the last decade, overall mortality and physical as well as psychological morbidity rates associated with SAH remain inordinately high. Knowledge about the etiology and pathogenesis of intracranial aneurysms is fragmentary, and prevention of the development of aneurysms is unlikely to be an obtainable goal in the foreseeable future. In contrast to the dismal prognosis of aneurysmal SAH, the morbidity and mortality rates associated with elective surgery for intact asymptomatic intracranial aneurysms is low. Consequently, when an aneurysm is discovered incidentally or at the time of investigation of SAH from another source, definitive repair of the unruptured intracranial aneurysm should be considered.

In their study on the natural history of intact saccular intracranial aneurysms, Wiebers and colleagues observed that only aneurysms 10 mm in diameter or larger had ruptured during their follow-up monitoring and surgical treatment was not recommended for aneurysms smaller than 10 mm. We now report our experience with previously documented asymptomatic saccular intracranial aneurysms less than 5 mm in diameter that subsequently ruptured, refuting beliefs that small asymptomatic aneurysms are innocuous.

Case Reports

Case 1

This 70-year-old hypertensive man with congestive heart failure developed a left hemiparesis. Cranial computerized tomography (CT) suggested a calcified intracranial aneurysm in the region of the left internal carotid artery (ICA) bifurcation. Angiographic studies showed a 10-mm aneurysm of the left ICA which was at least partially calcified and bilateral 4-mm middle
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cerebral artery (MCA) aneurysms (Fig. 1). Surgery was not recommended as the aneurysms were asymptomatic and the patient was considered to be a poor operative risk.

The patient collapsed at his home 2½ years later. On admission he was semicomatose. A head CT scan showed a large left temporal intracerebral hemorrhage with a massive amount of blood in the subarachnoid space. Angiography revealed no change in the size or configuration of the three aneurysms (Fig. 2). The patient underwent a craniotomy with evacuation of the hematoma. At the base of the hematoma, the left 4-mm MCA aneurysm was identified as the clear source of the hemorrhage. Clot extended from the aneurysm into the hematoma. The aneurysm was clipped. The 10-mm left ICA aneurysm was found to be calci-
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Fig. 3. Case 2. A and B: Right innominate artery injection, oblique (A) and lateral (B) views, demonstrating a 7 × 9-mm ruptured aneurysm arising from the vertebral artery at its junction with the posterior inferior cerebellar artery (PICA, arrowheads) and a 4-mm intact aneurysm located at the bifurcation of the pericallosal and callosal marginal arteries (arrows). C: Right innominate artery injection, lateral view, performed 91 years later. The pericallosal aneurysm, which has now ruptured, has not changed in size but has developed a daughter sac (arrow). The PICA aneurysm is clipped.

fied and was also clipped. There was no evidence of hemorrhage from the ICA aneurysm, which was well visualized. The patient remained in a vegetative state postoperatively and died 5 months later due to complications of the subarachnoid and intracerebral hemorrhage.

Case 2

This 57-year-old normotensive woman was found unconscious at her home. On examination, a right hemiparesis and a varying level of consciousness were observed; SAH was diagnosed by lumbar puncture. Angiography demonstrated a 7 × 9-mm aneurysm arising from the right vertebral artery at its junction with the posterior inferior cerebellar artery (PICA) and a 4-mm aneurysm arising from the bifurcation of the right pericallosal and callosal marginal arteries (Fig. 3A and B). A right suboccipital craniectomy was performed and the right PICA aneurysm, which showed clear evidence of recent hemorrhage, was clipped. The patient recovered well from her surgery.

At the age of 66 years, 9½ years after her initial SAH, the patient suddenly developed an excruciating headache. On examination, she was lethargic without neurological deficit. A CT scan showed subarachnoid blood in the suprasellar cisterns, both sylvian fissures, and the pericallosal cistern. An angiogram revealed the previously detected pericallosal aneurysm, which had not changed in size but had developed a daughter sac (Fig. 3C). The right PICA aneurysm was obliterated (Fig. 3C). At craniotomy, the pericallosal artery aneurysm was found to be 4 mm in diameter with a daughter sac arising superiorly and was the source of the recent hemorrhage. The aneurysm was clipped and the patient has remained in good condition during 2 years of follow-up observation.

Case 3

This 41-year-old woman experienced a severe frontal headache of sudden onset and developed a right ptosis several weeks later. On examination, a third cranial nerve paresis was observed. Head CT scans were normal. Angiography demonstrated a 5 × 12-mm right ICA aneurysm with two daughter sacs in the region of the posterior communicating artery (Fig. 4A) and a right PICA aneurysm measuring approximately 2 mm (Fig. 4B and C). The ICA aneurysm was clipped and the patient recovered well from her surgery.

Four years later, the patient developed a severe headache and suddenly collapsed. On admission, she was obtunded with a marked stiff neck. A CT scan showed blood in the cisterna ambiens. On angiography the right PICA aneurysm was again demonstrated, now measuring 4 to 5 mm (Fig. 5). The right ICA aneurysm was obliterated. At surgery, the cistern around the right vertebral artery was found to contain an extensive clot. The aneurysm was clipped and the patient recovered well from her surgery.

Discussion

Natural History

The natural history of intact intracranial aneurysms has been the subject of numerous investigations, and no consensus has been reached about the risks associated with these lesions. Calculating the
risk of rupture, irrespective of size, is complicated by the lack of clear discrimination between symptomatic and asymptomatic aneurysms in most studies.\textsuperscript{1,13,24,25,35,37} The annual risk of rupture of an asymptomatic aneurysm may be estimated as less than 0.5% to 2%.\textsuperscript{8,9,11,35,37,38} Symptomatic intact aneurysms are associated with a significantly higher risk of hemorrhage and these aneurysms rupture at a rate of at least 4% per year.\textsuperscript{3,17} Although the natural history of incidental aneurysms and those discovered during the investigation of SAH from another source was not shown to be significantly different in one study,\textsuperscript{38} this point has never been properly investigated and the risk of rupture for these two groups of aneurysms may be dissimilar.\textsuperscript{36} In Case 1 there had been no indication of previous rupture from any of the aneurysms.
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Controversies and Aneurysm Size

Wiebers and coworkers\textsuperscript{35,37} have incontrovertibly shown that the angiographic size of an intact saccular aneurysm is an important determinant of the risk of rupture. In their study, 29\% of 51 aneurysms 10 mm in diameter or greater ruptured during a mean follow-up period of 8.3 years, while none of the 102 aneurysms smaller than 10 mm ruptured. The authors concluded that intact aneurysms smaller than 10 mm carry a negligible risk for future hemorrhage and surgical intervention was not recommended. This study and its conclusions have created a great deal of controversy,\textsuperscript{2,6,19,20,22,29,34,36} as the majority of ruptured aneurysms are found to be smaller than 10 mm.\textsuperscript{4,14,17,18,30} This apparent discrepancy may be explained partially by the observations of McCormick and Acosta-Rua,\textsuperscript{18} who found that the size of intact aneurysms in cadavers increased by 30\% to 60\% during infusion of the cerebral arteries with normal saline. Moreover, following rupture, aneurysms may appear significantly smaller due to the collapse of part of the aneurysm or the presence of clot surrounding or within the aneurysm sac.\textsuperscript{14,36,37}

Following the report of Wiebers and colleagues,\textsuperscript{37} Solomon and Correll\textsuperscript{39} were the first to demonstrate that a previously intact asymptomatic aneurysm smaller than 10 mm can rupture. However, the 6-mm aneurysm in their patient ruptured following an ipsilateral carotid endarterectomy.\textsuperscript{34} The presently reported cases show that asymptomatic aneurysms smaller than 5 mm do carry a certain risk for future hemorrhage and should not be dismissed as innocuous. Rather, careful consideration must be given to their surgical repair or long-term follow-up observation.

The size at which asymptomatic aneurysms are being considered for surgery varies widely among neurosurgeons.\textsuperscript{2,6,14,19,21,22,25,29,39} A critical size for aneurysmal rupture undoubtedly exists but is unlikely to be the same for each aneurysm. In addition, it has been shown that intracranial aneurysms may enlarge unpredictably over variable periods of time.\textsuperscript{4,12,13} These observations are corroborated by the studies of Austin, et al.,\textsuperscript{3} who demonstrated sudden increases in the diameter of model aneurysms following a rise in intra-aneurysmal pressure. In addition to size, other determinants of the structure of the aneurysmal wall may influence the risk of rupture. It is likely that the presence of a daughter sac increases the susceptibility to rupture. Thin-walled aneurysms in general may be unusually prone to rupture. Preliminary data suggest that cine phase-contrast magnetic resonance angiography may be able to detect differences in pulsatility of aneurysm sacs possibly related to wall thickness and compliance (FB Meyer, et al., unpublished data). Austin, et al., observed that a sudden increase in the size of thin-walled more compliant model aneurysms occurred at significantly lower intra-aneurysmal pressures than that of thick-walled aneurysms.

Many factors in addition to size and configuration affect the decision to treat an asymptomatic aneurysm, including the patient's general medical condition, age, and family history, the aneurysm location, the presence of concomitant cervicocerebral vascular disease, and the surgeon's personal morbidity and mortality rates associated with the procedure.\textsuperscript{7,26,28,31,32} The likelihood for long-term benefit versus the operative risk has to be weighed carefully in the social context of each patient. Decision-analytical methods may be applied to the decision-making process, forming an objective foundation for the complicated management of these lesions.\textsuperscript{11,32} Nevertheless, risks and benefits are difficult to quantify, and many unknown and unconsiderable conclusions remain. The present study demonstrates that small asymptomatic aneurysms are not free of the risk of rupture; consequently, small size does not in itself determine the management of the aneurysms.

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