Three Cases of Tiny Intracranial Aneurysm Identified to be Ruptured by Site of Remaining Clot in Follow-up Computed Tomography and Subsequent Angiogram

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Introduction: The authors report three patients with tiny aneurysms for whom coil embolization was performed, evaluating them as the source of hemorrhage on subsequent angiogram based on follow-up CT findings of residual hematomas although each aneurysm was not recognized as the site of rupture on imaging early after the onset of subarachnoid hemorrhage.

Case Presentations:

Case 1: A 44-year-old female with a basilar-superior cerebellar artery aneurysm. The presence of an aneurysm was suspected, but it was very small, and it could not be concluded as the source of hemorrhage. Case 2: A 66-year-old male with an internal carotid artery aneurysm. A tiny aneurysm was detected, but it could not be concluded as the source of hemorrhage based on the distribution of hemorrhage. Case 3: A 58-year-old female with a basilar artery aneurysm. Initially, imaging did not reveal this aneurysm, and other aneurysms were treated. In all patients, these were evaluated as ruptured aneurysms during the course based on changes in CT and angiography findings, and coil embolization was performed. There has been no recurrence.

Conclusion: Angiography based on CT findings of residual hematomas is useful for estimating the rupture of tiny aneurysms.

Keywords ▶ subarachnoid hemorrhage, intracranial, tiny aneurysm, head computed tomography

Introduction

Tiny aneurysms measuring <3 mm may be overlooked on 3D-CTA or cerebral angiography in the acute phase of rupture,1,2 and, when several aneurysms are present, hemorrhage may be misdiagnosed as hemorrhage from other aneurysms.3–4) We encountered three patients with tiny aneurysms for whom coil embolization was performed, evaluating them as the source of hemorrhage using 3D-CTA or cerebral angiography based on follow-up head CT findings of residual hematomas although these aneurysms were not recognized as the site of rupture on imaging early after the onset of subarachnoid hemorrhage. We examined changes in hematoma findings on CT and serial changes in the aneurysms on 3D-CTA or cerebral angiography.

Case Presentations


Neuroradiological findings: Head CT revealed subarachnoid hemorrhage (Fisher group 3) (Fig. 1A). CTA on the day of admission showed infundibular dilatation of the bilateral internal carotid artery (ICA)-posterior communicating artery bifurcations and bilateral posterior cerebral arteries. However, there was no cerebral aneurysm at any area, including the left basilar artery-superior cerebellar artery (BA-SCA) bifurcation, where an aneurysm was detected on subsequent examination (Fig. 1E). The CTA...
findings did not suggest the source of hemorrhage. Cerebral angiography the day after admission revealed a bulge measuring approximately 1 mm at the BA-SCA bifurcation, suggesting an aneurysm (Fig. 1H).

Therapeutic strategy: At this point, it was unclear whether the bulge at the left BA-SCA bifurcation is the source of hemorrhage, and we adopted a strategy to continue follow-up involving imaging procedures.

Course: Follow-up CT the day after onset did not show any difference in the distribution of hematomas (Fig. 1B). However, CT 3 days after onset revealed residual hematomas at the left BA-SCA bifurcation (Fig. 1C). CTA 8 days after onset suggested an aneurysm at the left BA-SCA bifurcation (Fig. 1F). At this point, CT revealed that the hematomas at the BA-SCA bifurcation had disappeared (Fig. 1D). On CTA 15 days after onset, the aneurysm was clearer than on previous CTA (Fig. 1G). The tiny left BA-SCA aneurysm was considered to be the source of hemorrhage, and coil embolization was performed 16 days after onset. Intraoperative angiography showed an aneurysm measuring approximately 1.5 mm, being clearer than on previous angiography (Fig. 1I). There was no perioperative complication, and the course was favorable. Cerebral angiography confirmed the absence of a recurrent aneurysm.
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16 days after intervention. The patient was discharged without neurological complications. After 6 months, follow-up angiography did not reveal any recurrent aneurysm.


Neuroradiological findings: Head CT showed subarachnoid hemorrhage (Fisher group 3). At the left Sylvian fissure, thicker hematomas were observed (Fig. 2A). 3D-CTA (Fig. 2D) and cerebral angiography (Fig. 2F) on the day of admission revealed an aneurysm measuring approximately 2 mm at the right ICA-anterior cerebral artery bifurcation (ICA top), but there were no other findings suggestive of the source of hemorrhage.

Therapeutic strategy: The aneurysm was not considered to be the source of hemorrhage based on the distribution of subarachnoid hemorrhage (laterality) and size/site of the aneurysm. Therefore, we adopted a strategy to continue follow-up involving imaging procedures.

Course: On CT 3 days after onset, subarachnoid hemorrhage remained in the entire cistern, but not at the periphery of the right ICA top alone. However, retrospectively, a stronger high-attenuation area was localized in the aneurysmal site (Fig. 2B). CT 12 days after onset showed a light high-attenuation area remaining at the periphery of the right ICA top alone (Fig. 2C). On the same day, 3D-CTA (Fig. 2E) and cerebral angiography (Fig. 2G) revealed that the right ICA top aneurysm had increased in comparison with that on the day of onset. Furthermore, blebs were confirmed in the aneurysm (Figs. 2G and 2H). Conventional right internal carotid angiogram (G) and 3D rotational angiogram (H) obtained 12 days after onset demonstrated the aneurysm enlargement and the bleb protruded medially (arrow). ICA: internal carotid artery; SAH: subarachnoid hemorrhage; 3D-CTA: three-dimensional computed tomography angiogram.


Neuroradiological findings: Head CT revealed subarachnoid hemorrhage (Fisher group 4) (Fig. 3A). 3D-CTA on the day of onset revealed an anterior communicating artery aneurysm measuring approximately 4 mm (Fig. 3D).
There were no abnormal findings suggestive of the source of hemorrhage in any other site.

Therapeutic strategy: Under a diagnosis of subarachnoid hemorrhage related to the rupture of the anterior communicating artery aneurysm, coil embolization was performed, as the state of consciousness improved the day after onset.

Course: CT after treatment (the day after onset) showed residual hematomas although subarachnoid hemorrhage remained in the interpeduncular cistern (Fig. 3B). On CT 4 days after onset, the hematomas were localized in the ventral mesencephalon (Fig. 3C). Based on the CT findings, 3D-CTA was performed on the same day. At the tip of basilar artery, an aneurysm measuring approximately 2 mm was observed (Fig. 3E). Angiography 5 days after onset also confirmed it (Fig. 3F). Retrospectively, 3D-CTA on the day of onset had shown a slight bulge at the tip of basilar artery (Fig. 3D). Under a diagnosis of subarachnoid hemorrhage related to a ruptured basilar artery aneurysm, coil embolization was performed. There was no sequela, and the patient was discharged. During the 5-month follow-up, there has been no additional hemorrhage or recurrence.

Summary of the three patients: In the three patients, hematomas remained around the aneurysm even after head CT confirmed the disappearance of subarachnoid hemorrhage in the cistern. The timing when images of hematomas remaining around the aneurysm alone after the disappearance of cisternal hematomas were obtained differed among the three patients. In Cases 1 and 3, the cisternal hematomas had disappeared 3 and 4 days after onset, respectively, and residual hematomas were localized in the aneurysmal site (Figs. 1C and 3C). On the other hand, in Case 2, the cisternal hematomas remained 3 days after onset (Fig. 2B), and residual hematomas were localized in the aneurysmal site 12 days after onset (Fig. 2C). In the three patients, 3D-CTA or cerebral angiography findings were initially unclear, but the aneurysms had serially become clear.
Discussion

We demonstrated three patients with tiny aneurysms as these aneurysms not recognized as the site of rupture on imaging early after the onset. Of 74 patients with ruptured cerebral aneurysms who had been treated between April 2014 and December 2015 in our hospital, ruptured aneurysms could not be evaluated based on CTA or angiography findings at the time of onset in three patients (2.7%). The three patients had aneurysms measuring ≤3 mm and they were presented in this study. Of the 74 patients, 9 had aneurysms measuring ≤3 mm; therefore, ruptured tiny aneurysms could not be evaluated at the time of onset in three of the nine aneurysms (33.3%). Unruptured smaller cerebral aneurysms rarely rupture, but hemorrhage from small aneurysms is frequent among ruptured cerebral aneurysms. As demonstrated in our series, some aneurysms measuring <3 mm are not detected or may be overlooked on imaging early after onset (Cases 1 and 3). Even if they are detected in the early stage, it is sometimes difficult to evaluate whether each aneurysm is the source of hemorrhage (Case 2). Ruptured smaller aneurysms are not readily detected on imaging for the following reasons: small aneurysms are easily not visualized in the presence of slight thrombosis, and they may be overlooked due to their small size.

As imaging procedures to identify ruptured aneurysms, several studies reported the usefulness of contrast-enhanced MRI findings of the aneurysmal wall, and another study indicated that cone-beam CT facilitated the visualization of the aneurysmal rupture site. The above procedures may be useful for evaluating the source of hemorrhage. However, in patients with tiny aneurysms, as observed in the present cases, the image-based assessment of the aneurysmal wall may be difficult. In this study, examination using these methods was not conducted due to the patients’ general conditions or unavailability of examination devices in our hospital.

We performed 3D-CTA or cerebral angiography based on follow-up CT findings, including residual hematomas, and conducted coil embolization under a diagnosis of ruptured aneurysms. Although the site of rupture could not be microsurgically confirmed, there has been no recurrence or additional hemorrhage during the subsequent follow-up; therefore, each treated aneurysm was possibly a responsible lesion.

Karttunen et al. reported that middle cerebral and anterior communicating artery aneurysms could be readily predicted as rupture sites based on the distribution of hematomas on CT at the time of onset, whereas prediction was difficult in other sites. In the present three cases, it was difficult to predict the site of rupture based on CT findings at the time of onset. In all patients, after the disappearance of hematomas in the cistern, CT showed a high-attenuation area, suggesting residual hematomas localized around the aneurysmal site. We evaluated the site of rupture based on this finding. Ishikawa et al. pathologically examined ruptured aneurysms, and classified them into four types: 1) a thrombus is present on the outer aneurysmal wall at the site of rupture, 2) a thrombus involves the site of rupture to inner/outer aneurysmal wall, 3) a thrombus is present on the inner aneurysmal wall, and 4) there is no hemostatic thrombus. Therefore, thrombi may be formed in and around a ruptured aneurysm. In Case 3, treatment was performed 5 days after onset, and CT findings may have suggested intra-aneurysmal thrombosis. In Cases 1 and 2, imaging 2 weeks after onset showed small aneurysms; therefore, a high-attenuation area on CT may have primarily suggested hematomas on the outer side of the aneurysm. They may be similar to hard hematomas adhered to an area adjacent to the site of aneurysmal rupture, as frequently observed during clipping for ruptured aneurysms. If so, we can understand that hematomas remain after the disappearance of hematomas in the cistern.

Head CT is a general examination, but it is important to carefully confirm residual hematomas based on our experience. The combination of CT and 3D-CTA or cerebral angiography may be useful for estimating ruptured aneurysms. During coil embolization, it is impossible to confirm whether aneurysms are ruptured under direct vision, differing from clipping, as demonstrated in Case 2. Therefore, it may be important to evaluate residual hematomas on follow-up CT after intervention. On the other hand, the timing when hematomas remain in the site of rupture on CT is limited, and there may be individual differences in the timing related to the volume or site of subarachnoid hemorrhage. In the future, the timing of examination must be further reviewed.

Conclusion

We reported three patients with tiny aneurysms, evaluating them as the site of rupture using angiography based on follow-up CT findings of residual hematomas although these aneurysms were not recognized on imaging early after the onset of subarachnoid hemorrhage. Angiography based on CT findings of residual hematomas is useful for estimating the rupture of tiny aneurysms.
Disclosure Statement

There is no conflict of interest for the author and coauthors.

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References