Early Rebleeding of Small Anterior Communicating Artery Aneurysm with Presumed Extrusion of Coil Loop to Outside the Aneurysmal Wall during Endovascular Treatment

A Report of Two Cases

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Key words: aneurysm, anterior communicating artery, embolization

Summary

Although endovascular treatment has been proved to be as effective as surgical clipping in the prevention of rebleeding of ruptured aneurysm, early rebleeding after coil embolization has seldom been reported. We experienced early re-hemorrhage in two patients of ruptured small anterior communicating artery aneurysms of complete treatment with coil-embolization initially. In both cases what interested us was not early rebleeding itself but how the presumed extrusion of the first part of coil loop beyond aneurysmal wall developed. However, there was no evidence of intraprocedural rupture and moreover complete occlusion with only one or two coils was obtained. Our two patients underwent successful second treatment. We discovered the presumed extruded first part of the coil loop initially was located inside the enlarged aneurysmal sac in retreatment stage.

In case of coil embolization of ruptured small anterior communicating aneurysm, the phenomenon we experienced with no evidence of intraprocedural rupture in spite of obvious extrusion of coil loop beyond the aneurysmal wall can be a sign of necessity for early follow-up study including plain radiography to track the change in the presumed extruded coil loop.

Introduction

Endovascular coil embolization has been proved to be as effective as surgical clipping in the prevention of rebleeding of ruptured intracranial aneurysms^{1,2}. A recent study comparing the durability and rebleeding rates of both coiling and clipping concluded that, in spite of more common late re-treatments in the coiling group, rebleeding after both procedures were rare at one-year follow-up³. However, according to a recent report by Sluzewski et Al.⁴, early rebleeding after coiling of ruptured aneurysms does seem to occur. The fact itself of early rebleeding in the coiling treatment group is not new however, we experienced two cases of ruptured small anterior communicating artery (AcomA) aneurysms, both of them showing rebleeding four weeks after initial complete coil embolization. This report is focused on a specific finding that developed during the first treatment and offers possible explanation for early rebleeding.

Case Report

Case 1

A 49-year-old woman with an unremarkable medical history presented with severe heada-

che, followed by deterioration of mental status (Hunt and Hess grade III). Brain CT showed profuse subarachnoid hemorrhage (SAH) and intraventricular hemorrhage (IVH) and additional CT angiography demonstrated an oval-shaped, small AcomA aneurysm, which was 2.7 mm in height and 2.0 mm in width. Its neck diameter was about 1.8 mm (Figure 1A). She subsequently underwent coil embolization of the aneurysm. Because of the unfavorable architecture of the aneurysm, it took many trials to insert the first coil (2 mm in diameter, 15 mm in length) (TruFill minicomplex 10, Cordis, Johnson and Johnson, Miami, FL). During an attempt at the second coil insertion, we detected the first loop of a previously inserted coil was beyond the aneurysmal margin (Figure 1B). Immediate angiography did not show any contrast media leakage. The patient's blood pressure monitored through an arterial line was not changed at all. Additional delayed angiography depicted no further contrast filling of the sac suggesting the possibility of combined intra-aneurysmal thrombosis (Figure 1C). Post-procedural CT scan did not show extravasation of contrast or increased SAH. We judged the presumed penetrated distal coil loop was protected by intraaneurysmal thrombus formation at that moment. She was hospitalized for two weeks uneventfully and discharged with minimal neurological deficit.

Four weeks after the initial treatment, severe headache and vomiting attacked her again. Brain CT scan revealed recurrent SAH with IVH. Slack coil mesh including distal portion of coil loop which presumed beyond aneurysmal sac initially was depicted within an increased index aneurysm on catheter angiography (Figure 1D). Additional coil embolization of the recurrent aneurysm was performed after external ventricular drainage. Three coils were inserted to achieve satisfactory embolization of the aneurysm without any difficulty during initial endovascular treatment. She underwent a ventriculo-peritoneal shunt and was discharged with minor neurologic deficit one month after the second embolization. Follow-up MR angiography obtained one and six months after the second endovascular treatment showed no evidence of recanalization.

Case 2

A healthy 45-year-old man presented with persistent headache for five days. He was al-

most alert without any neurologic deficit. A brain CT scan taken elsewhere demonstrated focal SAH in the anterior interhemispheric cistern. Additional CT angiography confirmed a small AcomA aneurysm. The aneurysm measured approximately 3.5 mm in its maximum diameter with a relatively narrow neck which measured 2.1 mm and incorporated the right A1-2 junction. Coil embolization was performed. Immediately after insertion of only a single bare coil (2 x 40 mm, GDC 10-360, Boston Scientific, Fremont, CA) to form a framework, near total occlusion of the aneurysmal sac was demonstrated on angiography. We were concerned about recurrence due to the relatively low packing ratio and tried to insert an additional coil several times but acute thrombus formation in the sac prevented the subsequent coil from packing. However we had barely succeeded in filling an additional coil in the sac (2 x 10 mm, GDC 10-Ultrasoft, Boston Scientific, Fremont, CA) when we noticed the first loop of the supplementary coil lay outside the presumed aneurysmal sac (Figure 2A). Neither immediate nor delayed angiography showed contrast media leakage. No discernible change in blood pressure monitored through arterial line was noted. Final angiography depicted complete obliteration of aneurysmal sac (Figure 2B). There was no evidence of intraprocedural rupture even on the post embolization CT scan.

The patient recovered rapidly and was discharged two weeks later without any neurologic deficit. About two weeks after discharge, he complained of severe headache just after heavy sneezing and showed stuporous mentality. Brain CT showed thick SAH along anterior interhemispheric fissure combine with intracerebral hemorrhage (ICH) in the right frontal lobe. Migration of coil mesh to the dome and contrast filling of aneurysmal neck was demonstrated on catheter angiography (Figure 2C). Further endovascular treatment was declined and he underwent a surgical clipping. During microsurgical management, the sac was larger than demonstrated on preoperative angiography. All of the coil mesh including the first loop presumed beyond the index aneurysmal wall was seen through the thin aneurysmal wall and was positioned at the dome (Figure 2D). The lesion was clipped successfully without removal of coil mesh. After additional shunt surgery he was able to return to work.

Figure 1 A 49-year-old woman presented with sudden onset headache and drowsy mentality. A) Initial catheter angiography shows a small aneurysm of anterior communicating artery. B) Presumed extruded coil loop beyond the index aneurysm depicts on intraprocedural radiography. C) Total occlusion of aneurysmal sac is obtained on final angiography. D) Enlarged sac with loose migrated coil loop in post rebleeding angiography.

Discussion

The primary common goal of both endovascular and surgical treatment of a ruptured intracranial aneurysm is to protect the patient from rebleeding. According to the recent report of International Subarachnoid Aneurysm Trial (ISAT) II, the rebleeding incidence after coiling and clipping during four years of mean follow-up interval was 3.3% and 1.2%, respectively². Although the major clinical concern after en-

dovascular treatment of the aneurysms is focused on the long-termed anatomical durability, more than half of the rebleeding events were observed within 30 days of the procedure².

Sluzewski et Al. reported six cases of early rebleeding out of their 431 ruptured aneurysm coiling procedures (1.4%)⁴. The incidence is comparable to that of ISAT II, which leaves 1.8% of incidence when a case of early rebleeding from another aneurysm was excluded. It is of note that five of the six early rebleeds

Figure 2 A 45-year-old man with persistent headache for 5 days. A) Intraprocedural radiography shows extrusion of coil loop outside of the presumed aneurysmal wall. B) Total obliteration of aneurysm is achieved on final angiography. C) Repetitive angiography after rebleeding demonstrates recanalization of neck and migration of coil mesh to the dome. D) In microsurgical view, presumed extruded coil loop (arrow) is observed within translucent wall.

reported by them were small (<6 mm), originated from the AcomA and developed within the first 16 days⁴. Unlike the cases of late rebleeding, which usually occur in large aneurysm^{1,5}, most of the reported cases of early rebleeding occurred in small aneurysms^{4,6}. It is a well-known fact that intraprocedural ruptures also frequently occur in small aneurysms^{7,8}. Both of the undesired incidents are probably due to inherent limitations of current endovascular coiling device and technology^{8,9}.

The presumed causes of frequent early rebleeding in the small aneurysm are the following. Firstly, as generally assumed, one possible explanation can be the relatively low coil packing ratio achieved with the current coiling technique. When the aneurysm has a small sac, it is generally not easy to obtain enough packing density, which is believed to be about 30%¹⁰, further effort to obtain more packing density might cause inevitable trauma to the otherwise thin and friable wall of the small aneurysm and

Figure 3 Simple radiograms performed immediately after embolization (A), 10 days (B) and 30 days (C) after initial endovascular treatment show serial changes in the presumed extruded coil loop in the second patient.

compromise of parent artery. Although studies on the relation between packing density and late recanalization of aneurysm have reported contradictory findings^{10,11}, we can not deny the possible relation between higher early rebleeding rate and low packing density especially in small aneurysms.

A second possible explanation is early lysis of the partially thrombosed part of the aneurysmal sac formed in the intraprocedural period, which is regarded as the reason for a good angiographic embolization result even after filling of the aneurysms with just a single coil as our cases. Multiple manipulations of the coil loops, tip of the microcatheter in the small aneurysmal sac is enough to provoke early intra-aneurysmal thrombosis in spite of the proper antithrombotic strategy not only because of the mechanical causes but also up-regulated coagulation system. In addition, the microcatheter itself within the anterior cerebral artery proximal to aneurysm, the volume of fresh blood supplied is lower originally than that of distal internal cerebral artery or middle cerebral artery, could be a factor reducing that to the aneurysmal sac. Relatively low packing ratio in some of the completely embolized small aneurysms in Goddard et Al's series and some of the aneurysms treated with just one or

two coils in Kwon et Al's series can be explained by this mechanism^{11,12}. Intra-aneurysmal thrombosis occurring during the procedure would serve as a good source of intra-aneurysmal tissue reaction, which is a prerequisite for successful aneurysm healing if subsequent fibrous organization of the primary thrombus ensued¹³. However, large amounts of fresh thrombus tend to dissolve with time by the endogenous thrombolytic effect causing early recanalization of the aneurysm. Apart from thrombus formation during the procedure, the other side of the coin that can be given more weight is the existence of preprocedural intra-aneurysmal thrombus after rupture. During ini-

tial endovascular treatment of our two patients, we noticed a distal coil loop beyond the margin of the index aneurysm. At first, we thought a disastrous accident had happened. However, there was no evidence of intraprocedural rupture such as contrast media leakage or abruptly increased blood pressure. Post-procedural CT finding or symptoms of the patients were not aggravated. After rebleeding, the first patient retreated with additional embolization, initially estimated an extruded coil loop was located inside an enlarged aneurysm. In microsurgical view of the second patient, all the coil loops could be observed inside the sac through the translucent aneurysmal wall.

We believe this phenomenon *-the tip of the iceberg-* can be one cause of early rebleeding after endovascular treatment of ruptured small ACoA aneurysm. In addition, we missed the change in coil shape on plain radiographic performed before discharge of the second patient. Loosening of the first coil loop is evidently demonstrated on serial skull radiographies (Figure 3A-C). Simple skull radiography of in the

short-term interval seems to have an advantage to tack the change in presumed extruded coil loop in such cases. Our two patients underwent successful retreatment and fortunately we did not lose any patient contrary to other reports^{4,6}.

Conclusions

We experienced the presumed extrusion of a distal coil loop beyond the index aneurysmal wall during endovascular treatment of two small ruptured AcomA aneurysms. Unlike the usual situations, there was no evidence of intraprocedural rupture by problem coil loop. However complete occlusion on final angiography out of proportion to the inserted coil length could be obtained as in our patients, the lesion require more awareness with prompt and frequent radiographic studies to monitor early recanalization.

Acknowledgments

This work was supported by INHA UNIVERSITY Research Grant. (INHA-37460)

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