

Distal Basilar Artery Aneurysms: Conditions for Safe and Secure Clipping

Tadayoshi Nakagomi

Abstract In general, vertebro-basilar aneurysms are good indications for endovascular treatment. However, basilar artery (BA) bifurcation aneurysms, BA-superior cerebellar artery (SCA) aneurysms, and sometimes mid-basilar aneurysms are also good indications for clipping. In this paper, conditions for safe and secure clipping for distal basilar aneurysms are discussed.

There are several tips for the clipping of distal BA aneurysms. Among them, the following are very important: patency of the perforators, posterior cerebral artery (P1), and SCA must always be maintained. Several modalities including micro-Doppler ultrasonography and indocyanine green video-angiography (ICGVA) should be used to confirm the patency of these vessels. Each confirmation of patency of the vessels after clipping must be compared to those from before the clipping. Intra-operative digital subtraction angiography (DSA) is needed for large or giant aneurysms.

Keywords Intracranial aneurysm • Surgical clipping • Basilar artery aneurysm • TIPS

In general, vertebro-basilar aneurysms are good indications for endovascular treatment [2, 5, 6]. However, basilar bifurcation (BA-bif) aneurysms, BA-superior cerebellar artery (BA-SCA) aneurysms, and sometimes mid-basilar aneurysms are also good indications for this procedure [4, 9]. On the other hand, surgical clipping is relatively contraindicated for elderly patients, in particular those in poor clinical condition, as well as for large or giant aneurysms.

There are several important things to keep in mind in operative planning for BA-bif and BA-SCA aneurysms; these

include projection of the dome, height of bifurcation, or distance from the neck of the aneurysm to posterior clinoid process, size of the neck, location of the perforators, origin of the neck, size of posterior communicating (Pcomm) artery, etc. The aneurysms where the neck is 5–10 mm above the clinoid line are suitable for a pterional approach [3] (Fig. 1, upper left).

BA-bif and BA-SCA aneurysms can be approached using pterional craniotomy. A basilar top complex that looks like a dragonfly appears when Lilliequist's membrane is opened, and the optimal route to the aneurysm's neck, lateral to internal carotid artery (ICA), medial to ICA, or posterior to ICA, is selected (Fig. 1, upper right).

There are several tips for clipping distal BA aneurysms [1]. Superficial Sylvian and frontobasal veins must be preserved. Proximal control at the proximal BA should be prepared, in particular, when the height of the neck is low or the size of the aneurysm is large. It is very useful to soften the dome during neck dissection and clip placement. For emergent control for intra-operative rupture, proximal control of BA is absolutely necessary. For this purpose, posterior clinoidectomy is sometimes carried out. The drilling during the posterior clinoid process must be done meticulously. Retraction or division of the anterior tentorium is sometimes effective for proximal control of BA. Perfect clipping must be carried out after the BA-complex is confirmed. After surgical clipping, it is important to verify that the aneurysm is excluded, perforators are patent, and P1 and SCA are patent.

Several representative cases are shown here.

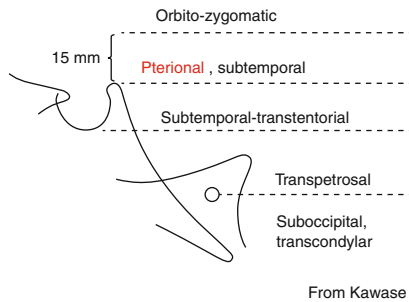
Case 1 is a 60-year-old female who suffered from a subarachnoid hemorrhage (SAH). Her clinical grade was IV according to WFNS grading. Surgical clipping for BA-bif An was carried out 10 days after the onset of SAH (Fig. 1, lower left).

Case 2 is a 65-year-old female who suffered from SAH. First, endovascular coiling was carried out. Follow-up angiograms revealed a neck remnant, so clipping for BA-bif aneurysm was performed (Fig. 1, lower right).

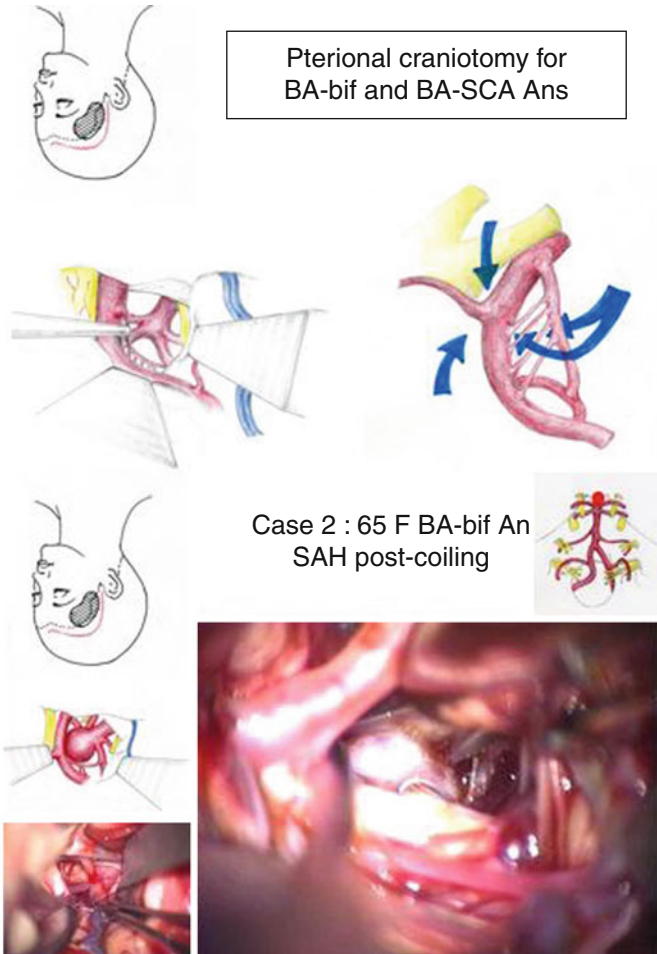
Case 3 is a 65-year-old female who suffered from SAH; a ruptured distal anterior cerebral artery aneurysm was

T. Nakagomi, MD
Department of Neurosurgery,
Teikyo University School of Medicine,
2-11-1 Kaga, Itabashi City, Tokyo, 173-8605, Japan
e-mail: nsnaka@med.teikyo-u.ac.jp

Approaches according to height bifurcation, or neck of aneurysm relative to posterior clinoid



Pterional craniotomy for BA-bif and BA-SCA Ans



Case 1 : 60 F BA-bif An.
SAH Grade 4 Day 10

Case 2 : 65 F BA-bif An
SAH post-coiling

Fig. 1 Upper left: Surgical approaches according to height of bifurcation or neck of basilar distal aneurysm relative to posterior clinoid. Upper right: Surgical routes for the distal basilar aneurysms when

pterional craniotomy is selected. Lower left: Intra-operative photographs of Case 1. Lower right: Intra-operative photographs of Case 2

successfully clipped. Surgical clipping for an unruptured BA-bif aneurysm was carried out (Fig. 2, upper left).

Case 4 is a 47-year-old male who suffered from SAH. His clinical grade was II according to WFNS grading. Surgical clipping for a BA-trunk aneurysm was carried out 1 day after the onset of SAH (Fig. 2, upper right). In this case, posterior clinoidectomy was carried out.

Case 5 is a 50-year-old female. Surgical clipping was done for her unruptured L.BA-SCA aneurysm (Fig. 2, lower left)

Case 6 is a 45-year-old female who suffered from SAH. Her ruptured middle cerebral artery aneurysm was successfully clipped. Surgical clipping for unruptured BA-SCA aneurysm was performed (Fig. 2, lower right).

Case 7 is a 59-year-old female who suffered from SAH and had been admitted to another hospital. CTA and DSA revealed a partially thrombosed BA-SCA aneurysm (Fig. 3, upper left). Coil embolization was performed immediately. A follow-up DSA showed refilling of the neck, so a second coil embolization was performed.

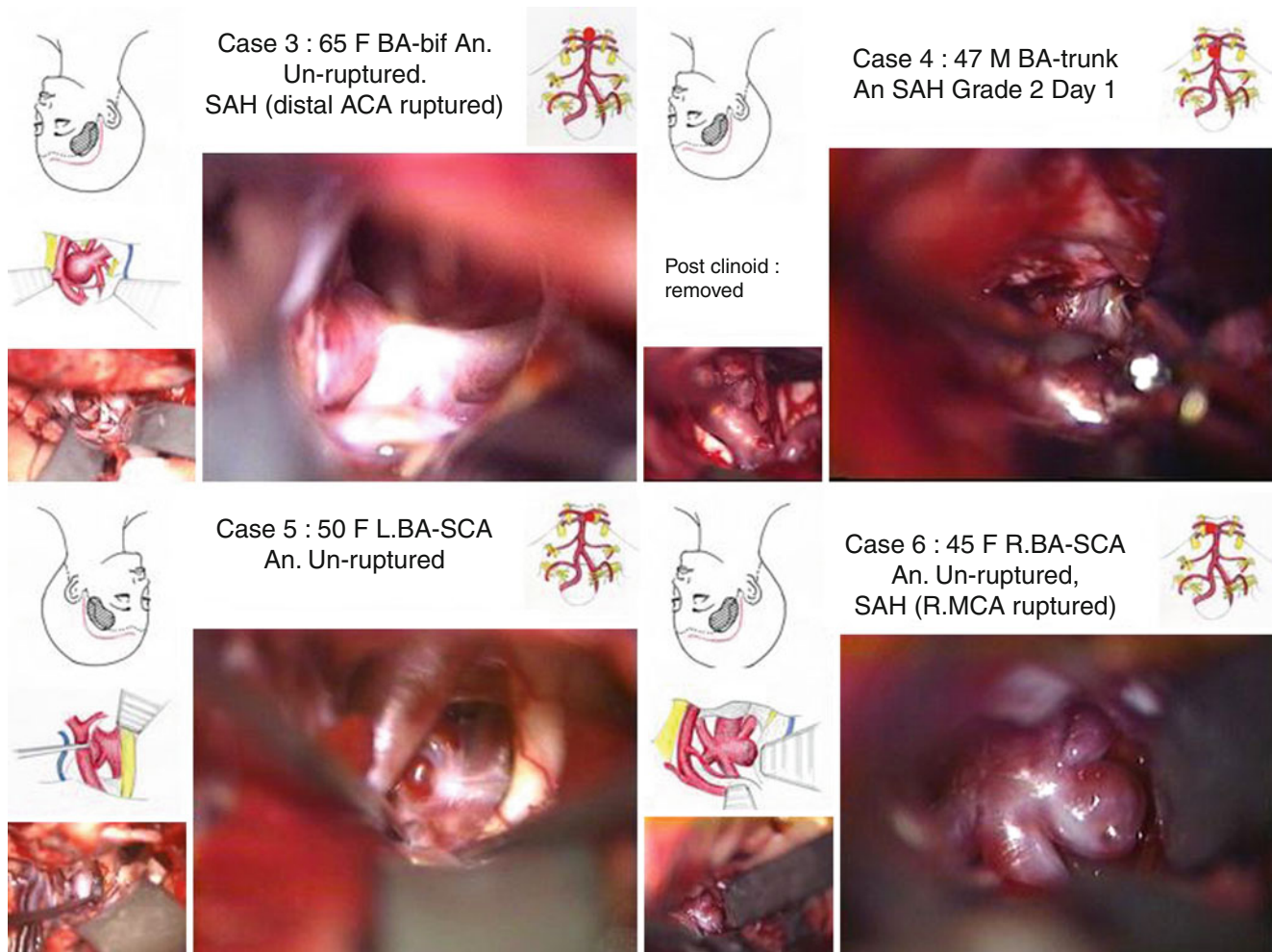


Fig. 2 *Upper left:* Intra-operative photographs of Case 3. *Upper right:* Intra-operative photographs of Case 4. *Lower left:* Intra-operative photographs of Case 5. *Lower right:* Intra-operative photographs of Case 6

However, the neck of the aneurysm was not completely obliterated (Fig. 3, upper right). The patient was referred to our hospital. We decided that her BA-SCA aneurysm was a relatively good indication for surgical clipping. A DSA taken the day before the craniotomy shows refilling of the neck. The neck of the aneurysm seemed to have enough space for clipping (Fig. 3, upper right) so we decided not to remove coils in the arterial lumen.

A modified right orbito-zygomatic temporo-polar approach [7, 8] with both anterior and posterior clinoid removal was chosen. Surgical clipping seemed to be carried

out without any problems (Fig. 3, lower left). The patency of SCA was confirmed by micro-Doppler ultrasonography. An intra-operative ICG-VA was done after placing the clip and it revealed a patent SCA. The next day, however, a high intensity area was noted in the cerebellum on DWI (Fig. 3, lower right). Two possible reasons for this were given: clipping of the aneurysm resulting in stenosis of the SCA, or a placed clip moved toward a BA. To avoid these complications, confirmation of the patency of SCA by intra-operative DSA or placing the final clip after coil removal are recommended.

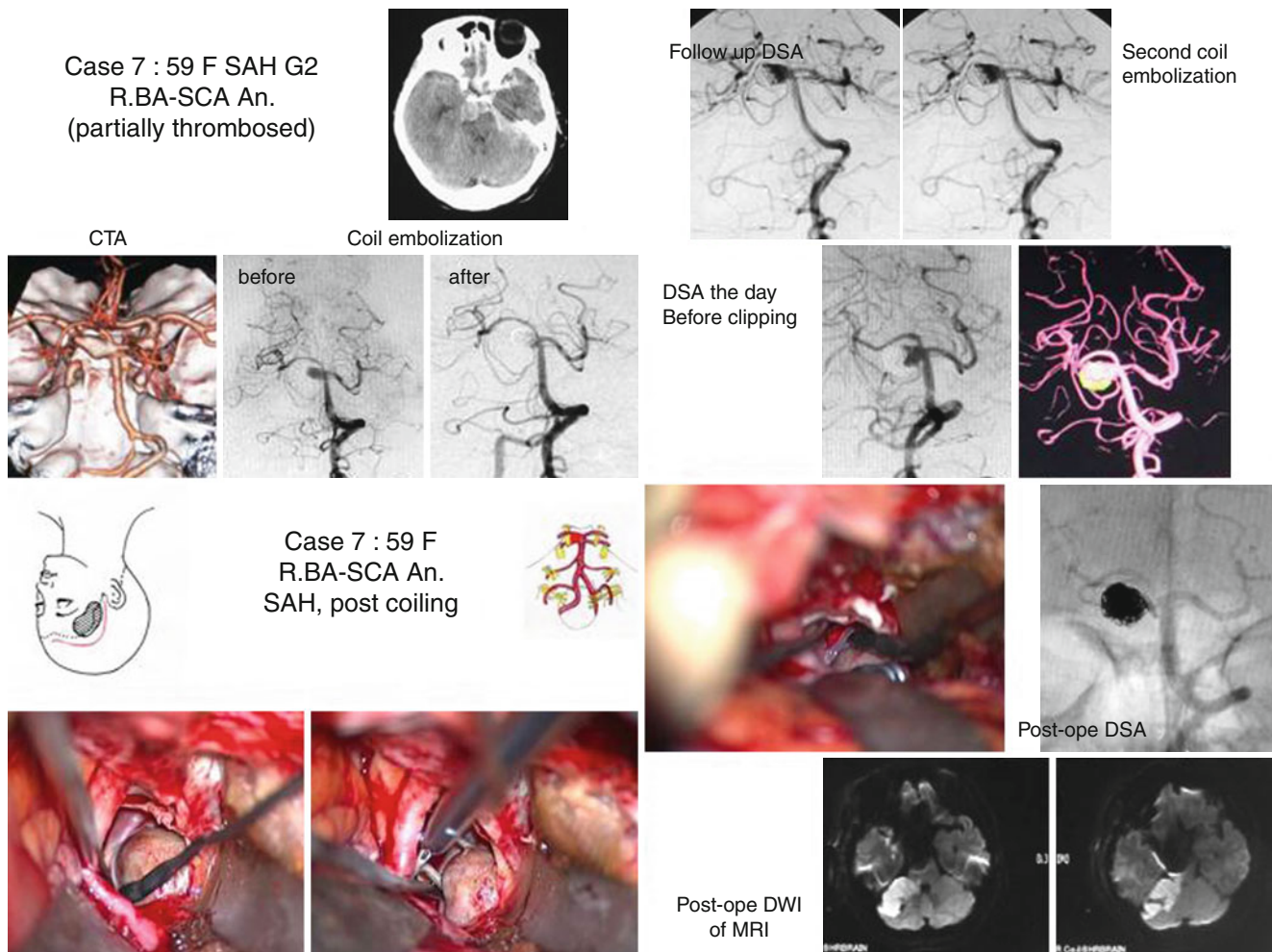


Fig. 3 Upper left: CT and DSA of Case 7. Upper right: Follow up DSA of Case 7. Lower left: Intra-operative photographs of Case 7. Lower right: Intra-operative photograph and Postoperative MRI and DSA of Case 7

Conclusion

There are several TIPS for the clipping of distal BA aneurysms. Among them, the following are very important for safe and secure clipping: First of all, patency of the perforators, P1, and SCA must always be maintained. Several modalities including micro-Doppler ultrasonography and ICG-VA should be used to confirm patency of these vessels. Each confirmation of patency of the vessels after clipping must be compared to those before clipping. Intra-operative DSA is necessary for large or giant aneurysms.

Conflict of Interest We declare that we have no conflict of interest.

References

1. Connolly W, McKhann G, Choudhi T et al (2002) Fundamentals of operative techniques in neurosurgery. Thieme, Stuttgart
2. Eskridge JM, Song JK (1998) Endovascular embolization of 150 basilar tip aneurysms with Guglielmi detachable coils: results of the Food and Drug Administration multicenter clinical trial. *J Neurosurg* 89:81–86
3. Kawase T, Toya S (1994) Anterior transpetrosal approach for basilar trunk aneurysms – further experience. In: Pasqualin A, Da Pian R (eds) *New trends in management of cerebrovascular malformations*. Springer, Austria, pp 255–260
4. MacDonald JD, Day AL (1996) Surgical approaches to aneurysms of the upper basilar artery. *Clin Neurosurg* 43:127–136
5. Nichols DA, Brown RD Jr, Thielen KR et al (1997) Endovascular treatment of ruptured posterior circulation aneurysms using electrolytically detachable coils. *J Neurosurg* 87:374–380
6. Rowe JG, Molyneux AJ, Byrne JV et al (1996) Endovascular treatment of intracranial aneurysms: a minimally invasive approach with advantages for elderly patients. *Age Ageing* 25:372–376
7. Sano K (1980) Temporo-polar approach to aneurysms of the basilar artery at and around the distal bifurcation: technical note. *Neurol Res* 2:76–81
8. Shiokawa Y, Saito I, Aoki N et al (1989) Zygomatic temporopolar approach for basilar artery aneurysms. *Neurosurgery* 25:793–797
9. Yasargil MG, Antic J, Laciga R et al (1976) Microsurgical pterional approach to aneurysms of the basilar bifurcation. *Surg Neurol* 6:83–91