Title Page

Title:

Traumatic anterior communicating artery pseudoaneurysm with cavernous sinus fistula

Authors:

Shigeyuki Sakamoto, Masaaki Shibukawa, Yoshihiro Kiura, Ryu Tsumura, Takahito Okazaki, Toshinori Matsushige and Kaoru Kurisu

Institutions:

Department of Neurosurgery, Hiroshima University Graduate School of Biomedical Sciences, 1-2-3 Kasumi, Minami-ku, Hiroshima 734-8551, Japan

Address correspondence to:

Shigeyuki Sakamoto, M.D.

Department of Neurosurgery, Hiroshima University Graduate School of Biomedical Sciences, 1-2-3 Kasumi, Minami-ku, Hiroshima 734-8551, Japan

Phone: +81-82-257-5227, Fax: +81-82-257-5229, E-mail: sakamoto@hiroshima-u.ac.jp

Running title: Traumatic AcoCF

Word count: 1454 words (Abstract: 173 words; Main text: 1281 words)

Summary

A traumatic carotid-cavernous fistula and an intracranial pseudoaneurysm are uncommon but well-known complications of head trauma. A rare subtype of arteriovenous fistula may occur from a pseudoaneurysm of the anterior communicating artery (AcoA) instead of the internal carotid artery. We describe a patient with a traumatic pseudoaneurysm of the AcoA with a cavernous sinus fistula treated with endovascular treatment. A 68-year-old man presented with a severe head injury after a fall. Coronal view of multiplanar reformatted images with contrast medium showed gradual expansion of the pseudoaneurysm of the AcoA and the enhanced area of the cavernous sinus. Five weeks after the injury, the patient had a subarachnoid hemorrhage. A cerebral angiogram showed a fistula between the pseudoaneurysm of the AcoA and the cavernous sinus. The AcoA, left anterior cerebral artery and part of the pseudoaneurysm were obliterated by coil embolization. A postoperative angiogram showed no flow through the pseudoaneurysm and the cavernous sinus fistula. A traumatic AcoA pseudoaneurysm with a cavernous sinus fistula may occur as an extremely rare complication of head injury.

Key words: anterior communicating artery; cavernous sinus; endovascular treatment; fistula; pseudoaneurysm

Introduction

An intracranial traumatic pseudoaneurysm of the anterior communicating artery (AcoA) is a rare complication of head injury [6, 13]. The formation of a fistula between a traumatic pseudoaneurysm of the AcoA and the cavernous sinus has not been reported previously. We report a patient with a fistula between a traumatic AcoA pseudoaneurysm and the cavernous sinus that was treated successfully by coil occlusion of the parent artery and part of the pseudoaneurysm.

Clinical report

A 68-year-old man was brought to our hospital after an accident in which he fell into a ditch from a height of approximately 1 meter while riding a bicycle. On arrival, his Glasgow Coma Scale score (GCS) was 3. A scalp laceration was noted on the left forehead. Computed tomography (CT) without contrast medium showed cerebral contusions in both frontal lobes, subarachnoid and intraventricular hemorrhages, and fractures of the left frontal, temporal, maxillary and sphenoid bones. The patient was managed conservatively. CT with contrast medium 2 days after the fall showed reductions in the enhancing lesion compared with the previous CT. CT angiogram (CTA) on 2 days after the accident showed an enhanced area in the intra and parasellar region (Fig. 1A). Coronal view of multiplanar reformatted (MPR) images with contrast medium showed an enhanced area of the AcoA and the cavernous sinus (Fig. 1B). We recommended cerebral angiography to confirm the lesion. However, his family refused the examination. CTA on 21 days after the accident showed a mass that seemed to lift the ACA (Fig. 1C). Coronal view of MPR images with contrast medium showed growth of the enhanced area above the

diaphragma sellae, from the AcoA to the cavernous sinus (Fig. 1D). By that stage, his GCS had improved to 10. CTA on 35 days after the accident showed an enhanced mass close against AcoA (Fig. 1E). Coronal view of MPR images with contrast medium showed further expansion of enhancement above the diaphragma sellae (Fig. 1F). We had speculated the enhanced mass as a pseudoaneurysm because the enhanced area had changed with time on CTA. Therefore, we continued recommending cerebral angiography all the time. The family of the patient finally consented to the examination. We planned cerebral angiography at 36 days after injury. In the morning of the day when we planned the cerebral angiography (at 36 days after injury), the patient suddenly developed disturbance of consciousness with a GCS of 6. CT showed subarachnoid hemorrhage with a hematoma in the left frontal lobe.

The patient was taken urgently to the angiography suite for endovascular treatment of a suspected AcoA pseudoaneurysm. An internal carotid angiogram verified a pseudoaneurysm of the AcoA, communicating with a fistula draining into the right cavernous sinus (Fig. 2A-F). The patient did not have symptoms that could be attributed directly to the fistula between the pseudoaneurysm and cavernous sinus. The pseudoaneurysm originated from the AcoA and the fistula was located in the medial wall of the cavernous sinus (Fig. 2G-I). An Excelsior SL-10 microcatheter (Boston Scientific, Natick, MA) was used for superselective embolization of the pseudoaneurysm. The microcatheter was advanced into the pseudoaneurysm through the right anterior cerebral artery (ACA), where embolization was performed using Guglielmi detachable coils (Boston Scientific). The AcoA, left ACA and part of the pseudoaneurysm were embolized. A

postoperative internal carotid angiogram showed complete obliteration of the pseudoaneurysm and fistula, and occlusion of the left ACA (Fig. 3A-C). Follow-up CT showed cerebral infarction in the territory of the left ACA. Three months after the accident, the patient was transferred to a rehabilitation hospital with moderate disability due to the initial traumatic brain injury.

Discussion

Intracranial traumatic aneurysms make up < 1% of all intracranial aneurysms [1, 11]. Traumatic pseudoaneurysms tend to occur on the distal ACA, distal middle cerebral artery, or intracavernous internal carotid artery (ICA), secondary to an impact against the falcine or bony edge [1, 2, 5, 10]. In contrast, traumatic aneurysms seldom occur on the A1 portion or AcoA [6, 13]. The mechanism leading to traumatic aneurysms of the A1 portion or AcoA may be associated with fractures of the skull base [6]. Yang et al. reviewed eight ACA aneurysms following blunt craniofacial trauma [13]. Only one of eight ACA aneurysms was located over the ACA-AcoA junction [13]. Traumatic ACA aneurysms presented with delayed rebleeding, with a delayed-onset deterioration of a neurological deficits being the most common clinical presentation [13]. Furthermore, the mortality rate for a traumatic ACA aneurysm that was not treated aggressively varies from 32 to 50% [1, 13]. Therefore, they suggested aggressive surgical or endovascular intervention whenever traumatic ACA aneurysms were diagnosed [13].

Intracranial traumatic aneurysm may be either a true aneurysm or a pseudoaneurysm. An intracranial traumatic aneurysm is commonly a pseudoaneurysm. Pseudoaneurysms are formed by a pseudowall, and develop from

blood clots after complete disruption of the vessel wall. In patients with traumatic pseudoaneurysm, rupture will occur 2-3 weeks after lysis of the clot forming the aneurysm wall, and mortality after rupture is very high [1, 2, 4, 13]. A traumatic pseudoaneurysm is considered to be difficult to treat, by either direct clipping or by endovascular aneurysmal embolization. This is due to the absence of a true collagenous layer in the aneurysm wall. Surgical or endovascular trapping or occlusion of the proximal parent artery has proved to be a fairly reliable option for most patients with a pseudoaneurysm [7, 8, 10, 11].

The formation of the fistula between the intracavernous ICA and the cavernous sinus is an uncommon but well-described complication of cranial base trauma, occurring in 0.2-0.3% of patients with craniofacial trauma [3, 12]. Traumatic arteriovenous fistulae tend to occur between the intracavernous ICA and cavernous sinus [1, 2, 5, 10]. Endovascular surgery is the current treatment of choice for both types of traumatic fistula. Detachable balloons or coils are most commonly used to occlude the fistula [9, 12]. In our case, the fistula was an incidental finding during catheter angiography without clinical relevance. However, to the best of our knowledge, no cases of fistula formation between traumatic pseudoaneurysm of the AcoA and the cavernous sinus have been reported.

In the present patient, we diagnosed the aneurysm as a pseudoaneurysm because the aneurysm shape had changed with time on CTA and MPR images. We considered that the aneurysm did not exist before the accident but the aneurysm was formed by the accident. We speculated that the mechanism of the fistula between the traumatic AcoA pseudoaneurysm and the cavernous sinus formed. Both the AcoA and cavernous sinus first received damage at the same time due to head injury,

with resulting bleeding. Blood clots were thus formed due to bleeding from the AcoA and cavernous sinus, and bleeding stopped at a stage when these blood clots were contiguous. As the blood clots dissolved, the lumen of the pseudoaneurysm and a drainage route to the cavernous sinus on skull base fracture formed simultaneously, and gradual expanded pseudoaneurysm was ruptured. Therefore, the coil occlusion of the pseudoaneurysm resolved both conditions with the AcoA pseudoaneurysm and the cavernous sinus fistula. A traumatic ACA aneurysms presented with delayed rebleeding and the high mortality when rupture [13]. We suggest intervention at early stage, as Yang et al. describe [13]. We think that the goal of the treatment was be to prevent re-bleeding from the pseudoaneurysms rather than treating the fistula in the case of a fistula between a traumatic AcoA pseudoaneurysm and the cavernous sinus.

Conclusion

We described endovascular treatment of a pseudoaneurysm of the AcoA with the cavernous sinus fistula. Although the fistula was an incidental finding during catheter angiography without clinical relevance, the fistula between a traumatic AcoA pseudoaneurysm and the cavernous sinus may occur as an extremely rare complication of head injury.

References

1. Asari S, Nakamura S, Yamada O, Beck H, Sugatani H (1977) Traumatic aneurysm of peripheral cerebral arteries. Report of two cases. J Neurosurg 46: 795-803
2. Buckingham MJ, Crone KR, Ball WS, Tomsick TA, Berger TS, Tew JM Jr (1988) Traumatic intracranial aneurysms in childhood: two cases and a review of the literature. Neurosurgery 22: 398-408
3. Fabian TS, Woody JD, Ciraulo DL, Lett ED, Phlegar RF, Barker DE, Burns RP (1999) Posttraumatic carotid cavernous fistula: frequency analysis of signs, symptoms, and disability outcomes after angiographic embolization. J Trauma 47: 275-281
4. Haddad FS, Haddad GF, Taha J (1991) Traumatic intracranial aneurysms caused by missiles: their presentation and management. Neurosurgery 28: 1-7
5. Lempert TE, Halbach VV, Higashida RT, Dowd CF, Urwin RW, Balousek PA, Hieshima GB (1998) Endovascular treatment of pseudoaneurysms with electrolytically detachable coils. AJNR Am J Neuroradiol 19: 907-911
6. Noterman J, Flament-Durand J, Hermanus N, Brotchi J (1985) Traumatic aneurysm of the anterior cerebral artery associated with a contralateral carotid-cavernous fistula: a case report. Neurosurgery 17: 807-810
7. Sakamoto S, Ohba S, Shibukawa M, Kiura Y, Okazaki T, Arita K, Kurisu K (2005) Staged bilateral vertebral artery occlusion for ruptured dissecting aneurysms of the basilar artery: a report of 2 cases. Surg Neurol 64: 456-461
8. Sakamoto S, Ohba S, Eguchi K, Shibukawa M, Kiura Y, Okazaki T, Kajihara Y, Arita K, Kurisu K (2005) Churg-Strauss syndrome presenting with subarachnoid

hemorrhage from ruptured dissecting aneurysm of the intracranial vertebral artery. Clin Neurol Neurosurg 107: 428-431

9. Siniluoto T, Seppänen S, Kuurne T, Wikholm G, Leinonen S, Svendsen P (1997) Transarterial embolization of a direct carotid cavernous fistula with Guglielmi detachable coils. AJNR Am J Neuroradiol 18: 519-523
10. Uzan M, Cantasdemir M, Seckin MS, Hanci M, Kocer N, Sarioglu AC, Islak C (1998) Traumatic intracranial carotid tree aneurysms. Neurosurgery 43: 1314-1320
11. Ventureyra EC, Higgins MJ (1994) Traumatic intracranial aneurysms in childhood and adolescence. Case reports and review of the literature. Childs Nerv Syst 10:361-379
12. Weaver KD, Ewend MG, Solander S (2003) Successful transarterial Guglielmi detachable coil embolization of posttraumatic posterior communicating artery-cavernous sinus fistula: technical note. Neurosurgery 52: 458-460
13. Yang TC, Lo YL, Huang YC, Yang ST (2007) Traumatic anterior cerebral artery aneurysm following blunt craniofacial trauma. Eur Neurol 58: 239-245

Figure legends

Fig. 1

A. Superior view of CT angiogram on 2 days after the accident showed an enhanced area in the intra and parasellar region

B. Coronal view of MPR images with contrast medium 2 days after trauma revealed an enhanced area of the AcoA and the right cavernous sinus via the intrasellar region (arrowheads) along with findings of fractured sphenoid bone (arrow).

C. Superior view of CT angiogram on 21 days after the accident showed a mass that seemed to lift the ACA

D. Coronal view of MPR images with contrast medium 21 days after trauma showed enlargement of the enhanced finding (arrow) above the diaphragma sellae in enhanced findings from the AcoA to the right cavernous sinus.

E. Anteroposterior view of subtracted CT angiogram on 35 days after the accident showed an enhanced mass close against AcoA

F. Coronal view of MPR images with contrast medium 35 days after trauma showed further expansion of enhanced findings (arrow) above the diaphragma sellae.

Fig. 2

A. Preoperative right internal carotid angiogram, anteroposterior view, showed pseudoaneurysm of the AcoA.

B. Super selective angiogram from a microcatheter advanced into the AcoA through the right ACA, anteroposterior view, revealed the pseudoaneurysm.

C. Preoperative right internal carotid angiogram, lateral view, showed pseudoaneurysm and the right cavernous sinus fistula.

D. Preoperative left internal carotid angiogram in the early phase of the anteroposterior view, showed pseudoaneurysm of the AcoA above diaphragma sellae (arrow).

E. Preoperative left internal carotid angiogram in the early phase of the anteroposterior view, showed pseudoaneurysm of the AcoA, which formed a fistula with the right cavernous sinus.

F. Preoperative left internal carotid angiogram in the late phase of the anteroposterior view, showed drainage into the pterygoid plexus through the right cavernous sinus via the AcoA pseudoaneurysm (arrows).

G. Preoperative left internal carotid angiogram in the early phase of an oblique view, showed the origin of pseudoaneurysm of the AcoA (arrowhead).

H. Preoperative left internal carotid angiogram in the early phase of the oblique view, showed drainage into the pterygoid plexus through the right cavernous sinus via the AcoA pseudoaneurysm.

I. Preoperative left internal carotid angiogram in the late phase of the oblique view, showed fistula originating from the medial wall of the right cavernous sinus (white arrows).

Fig. 3

A. Post-embolization right internal carotid angiogram on anteroposterior view, demonstrated complete obliteration of the pseudoaneurysm and cavernous sinus fistula.

B. Post-embolization right internal carotid angiogram on lateral view, showed complete obliteration of the pseudoaneurysm and the cavernous sinus fistula.

C. Post-embolization left internal carotid angiogram on anteroposterior view, showed left anterior cerebral artery occlusion.

Fig1

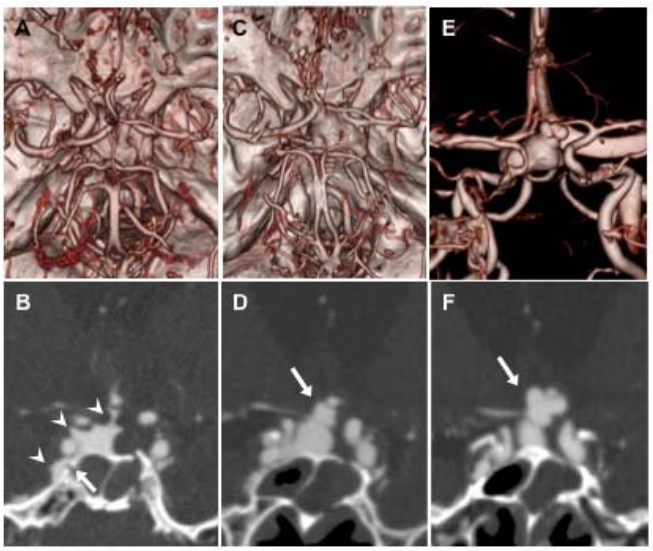

Fig2

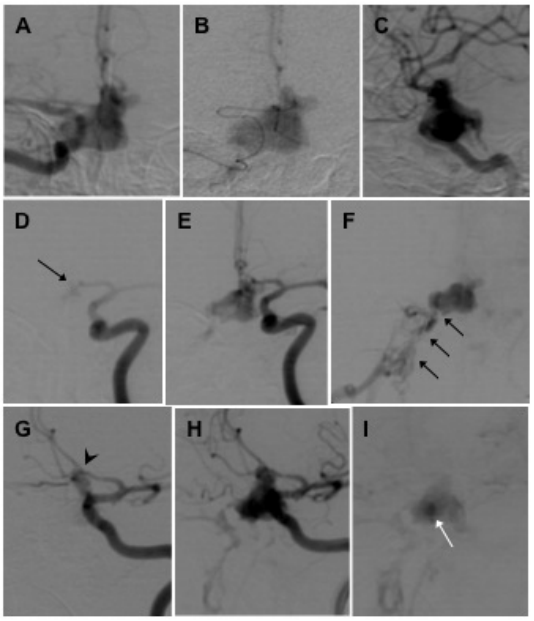

Fig3