Ruptured Proximal Anterior Cerebral Artery (A1) Aneurysm located at An Anomalous Branching of the Fronto-orbital Artery
- A Case Report -

Cerebral aneurysms are occasionally associated with anomalies of cerebral arteries, that should be recognized pre- and intra-operatively. Most of the previous reports on the anomalies of the anterior cerebral artery have been concerned with hypoplasia, fenestration, and infra-optic course of the A1, variant A1 perforators or Heubner's artery, multi-channeled anterior communicating artery, and azygos anterior cerebral artery. The author experienced a patient with a ruptured proximal anterior cerebral artery (A1) aneurysm located at an anomalous origin of the fronto-orbital artery from the A1. The fronto-orbital artery normally branches off the anterior cerebral artery just distal to the anterior communicating artery (proximal A2). An anomalous branching of the fronto-orbital artery off the A1 seems very rare. This anomalous artery could be mistaken for an unusually large medial lenticulostriate artery, aberrant frontopolar artery, or the third A2. The author reviewed the literature on anomalies of the A1 and the fronto-orbital artery. *(JKMS 1997;12:576~80)*

Key Words : *Cerebral aneurysm; Cerebral arterial anomalies*

Seung-Kuan Hong

Department of Neurosurgery,
Seoul Red Cross Hospital, Seoul, Korea

Received : June 25, 1997
Accepted : August 26, 1997

Address for correspondence
Seung-Kuan Hong, M.D.
Department of Neurosurgery, Seoul Red Cross Hospital, 164 Pyong-dong, Chongno-gu, Seoul, 110-102, Korea
Tel : (02) 398-9445, Fax : (02) 730-7390

INTRODUCTION

In the surgical approaches to the cerebral aneurysms, thorough anatomical information concerned with the adjacent vasculatures and collateral circulation as well as the aneurysm itself is indispensible. Occasionally the aneurysm is accompanied by anomalous cerebral arteries which must be recognized pre- and intra-operatively to prevent unexpected surgical complications (1, 2).

A literature review on anomalies of the anterior cerebral artery (ACA) shows reports concerned with hypoplasia, fenestration (3-7), and an infra-optic course of the A1 (8-14), variant A1 perforators or Heubner's artery, multi-chanelled anterior communicating artery (ACoA) (15), triple A2's (1), and the azygos ACA (16-20). Those anomalies may put a certain part of the artery under excessive hemodynamic stress, where an aneurysm can develop.

The author reports a rare case with a ruptured proximal ACA aneurysm located at an anomalous branching of the fronto-orbital artery off the ACA proximal to the anterior communicating artery (A1, or horizontal or pre-communicating portion), and discusses on the anomalous fronto-orbital arteries.

CASE REPORT

This 27 year-old woman had been healthy until 15 days prior to admission, when she suffered from sudden headache and vomiting. Severe headache and vomiting recurred 10 days later, and at that time she showed an attack of generalized seizure. Deteriorating to unconsciousness on the day of admission, she was transferred to a local clinic and then referred to my hospital under the impression of intracranial hemorrhage. Nothing was remarkable in her past medical and family histories.

On admission, she was stuporous with Glasgow coma scale 12 and strongly positive meningeal irritation signs (Hunt & Hess classification grade IV). A chest X-ray revealed pulmonary congestion. EKG disclosed T wave inversion and an echocardiogram showed hyperkinetic heart and pericardial effusion probably due to intravenous fluid overloading. Brain CT on admission (Fig. 1) disclosed diffuse intraventricular hematoma, moderate ventricular dilatation, and a small left mediobasal frontal intracerebral hematoma (Fischer group IV). Cerebral angiograghy on hospital day 2 (Fig. 2) showed multifocal arterial luminal narrowing probably caused by post-SAH vasospasm as well as a 3×5 mm-sized saccular aneurysm

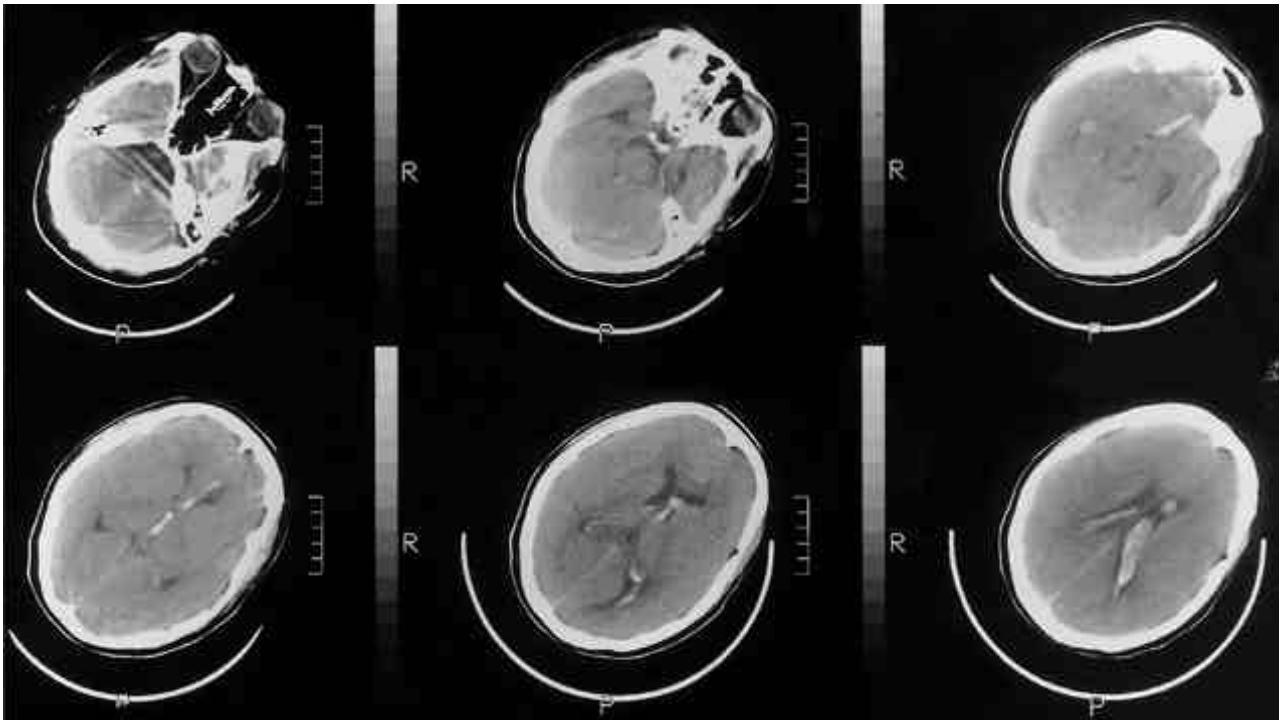

Fig. 1. Brain CT on admission shows diffuse intraventricular hemorrhage, a small intracerebral hematoma at the inferomedial part of the left frontal lobe, and moderately enlarged ventricles.

located at the middle one-third of the left A1. A small artery branched off the A1 just proximal to the neck of the aneurysm and followed the usual course of the fronto-orbital artery.

Operation

On hospital day 4 (19 days after the first and 9 days after the second bleeding), the aneurysm was approached

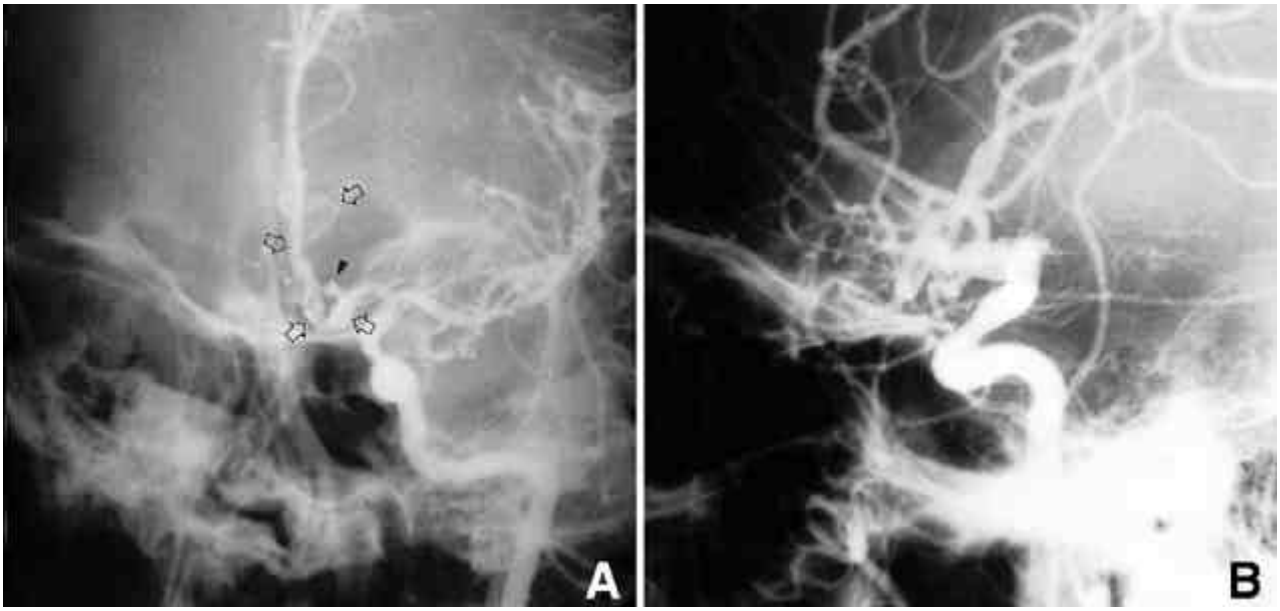

Fig. 2. Preoperative left carotid arteriogram, axial (A) and lateral (B) views demonstrate multifocal vasospasm and a 3×5 mm-sized saccular aneurysm (arrow head) located at the middle one-third of the left A1. A small artery branches off the A1 just proximal to the neck of the aneurysm and follows the usual course of the fronto-orbital artery (arrows).

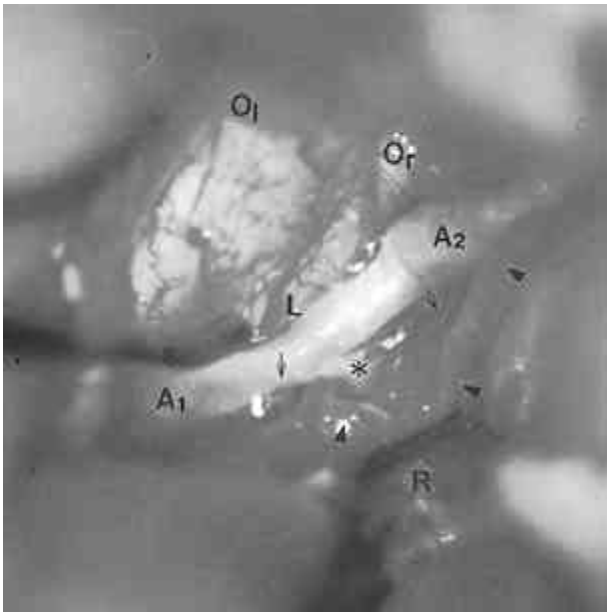

Fig. 3. Intra-operative photo exposed by left pteryonal approach. The neck of a saccular A1 aneurysm (asterisk) is located at the origin of an arterial branch off the A1. The artery follows the usual course of the fronto-orbital artery (arrow heads). The Heubner's artery is faintly seen (arrows). Note bilateral optic nerves (Ol and Or), the lamina terminalis (L), A1 and A2 portions of the anterior cerebral artery for an anatomical orientation. s=sucker, R=retractor on left frontal lobe.

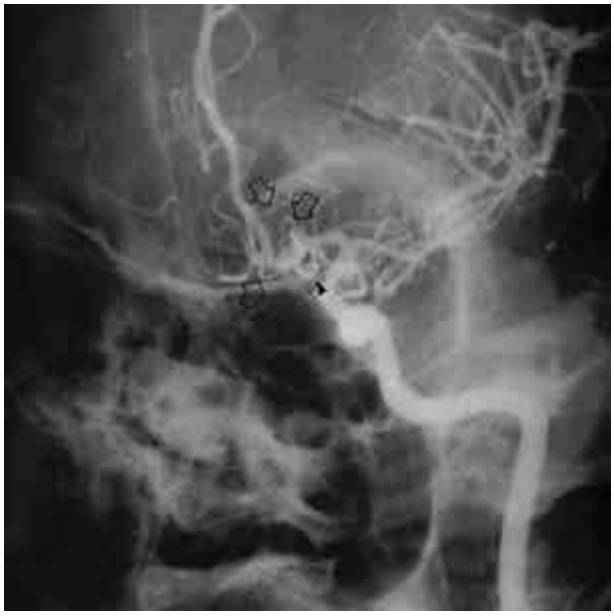

Fig. 4. Left carotid arteriogram on post-operative day 14 shows favorable aneurysm neck clipping and discloses persistent vasospasm at the supraclinoid internal carotid artery, M1, and A1. The anomalous fronto-orbital artery (arrows) branching off the A1 is well visualized. An arrow head points at the aneurysm clip.

surgically under endotracheal general anesthesia by left pteryonal craniotomy and splitting of the Sylvian fissure. Cisternal CSF was xanthochromic and there was little SAH within the Sylvian and suprasellar cisterns. A small saccular aneurysm was identified on the superior aspect of the middle one-third of the A1 just distal to where an artery much larger than lenticulostriate arteries branched off (Fig. 3). The arterial branch coursed anteromedially toward the interhemispheric fissure and was considered to be the fronto-orbital artery. The dome of the aneurysm was embedded within adjacent brain parenchyma. A 5 mm-long straight aneurysm clip was applied uneventfully to the neck of the aneurysm, and the aneurysm sac was collapsed after puncture with a fine needle. Further inspection disclosed the Heubner's artery that originated from the A1-A2 junction and coursed laterally along the A1 crossing the above-mentioned anomalous artery. For the prevention of the post-SAH hydrocephalus, the lamina terminalis was ruptured and clear CSF flowed out of the third ventricle.

Postoperative course

The patient regained clear consciousness on post-operative day (POD) 2 to be alert and well-oriented. Angiograghy on POD 14 (Fig. 4) confirmed good neck clipping of the aneurysm and revealed persistent vasospasm at the distal internal carotid and proximal anterior and middle cerebral arteries. However, she showed no clinical symptoms or signs of delayed ischemic deficits throughout her post-operative course and was discharged on POD 15 in a neurologically normal state. About 7 months post-operatively, she complained of persistent headache and showed remarkable panventricular dilatation on brain CT as well as reflux into the ventricles on radioisotope cisternogram. A lumboperitoneal shunt was inserted with successful results.

DISCUSSION

This patient had an A1 aneurysm which bled twice and caused subarachnoid and intraventricular hemorrhages and hydrocephalus. The vast majority of aneurysms affecting the ACA are located at or adjacent to the ACoA. A much smaller number of ACA aneurysms involves the part more distal to the ACoA (A2, or vertical or postcommunicating portion), and are commonly called distal ACA aneurysms. Aneurysms that develop at the ACA proximal to ACoA (A1 aneurysms) are rare (2, 21), and usually located at the origin of the perforating

arteries or at the sites affected by such congenital or acquired arterial abnormalities as fenestration, abnormal tortuosity, etc (22, 23). Sugita et al. (24) reported a giant aneurysm at the origin of the accessory middle cerebral artery from the A1. In the clinical analysis of 7 cases with A1 and 6 cases with M1 aneurysms, Sako et al. (21) suggested the role of the hemodynamic stress in aneurysm formation at these sites.

The fronto-orbital artery branches off the ACA normally at the proximal part of the A2 just distal to the ACoA and perfuses the posteromedial part of the orbital aspect of the frontal lobe. Reports on either congenital anomalies of the fronto-orbital artery or aneurysms related with that anomaly are scarce. That may be because the fronto-orbital artery has as yet attracted little clinical attention. Usually this artery is a small branch that perfuses a small region of the brain any ischemia of which results in minimal or no clinically overt problems.

Anomalous branching of the fronto-orbital artery off the A1 seems very rare. Perlmutter & Rhoton (1) did not ever comment on fronto-orbital artery anomalies in their detailed anatomical study on A1, ACoA, and Heubner's artery. Yasargil (15) made a schematic representation of common origins of medial fronto-orbital and frontopolar arteries from the proximal A2, and of medial fronto-orbital, frontopolar, and Heubner's arteries from the A1-A2 junction or from the proximal A1 that he found through the vast number of microneurosurgical operations he performed. Enomoto et al. (25) reported a patient with a ruptured saccular aneurysm of the left fronto-orbital artery itself, which was aberrantly anastomosed with the anterior ethmoidal artery. Yamaura et al. (26) reported a patient with a ruptured aneurysm located at a hair-pin curve of an anomalous A1 which was remarkably elongated along the base of the anterior cranial fossa. In that case report the authors pointed out an anomalous small artery that branched off the A1 adjacent to the neck of the aneurysm, which they considered to be different from an orbital branch of the ACA or a Heubner's artery because its origin was different from either arteries. However, the artery seems to have been the fronto-orbital artery with an anomalous origin from A1, and if this judgement is correct, this is the only previous report I could find hitherto that presents a case with a ruptured aneurysm located at the anomalous origin of the fronto-orbital artery from the A1. Among the 26 cases of the proximal ACA aneurysm reported by Suzuki et al. (22), the origin of one A1 aneurysm was from the junction of the A1 and a cortical branch; although the authors did not comment on the cortical branch in detail, the arterial branch is possibly an anomalous one in view of the fact that usually no cortical branches originate from the A1. Tsuji et al. (27) presented a case with a ruptured aneurysm involving an anomalous ACA which they called persistent primitive olfactory artery.

The fronto-orbital artery branching aberrantly off the A1 could be mistaken for an unusually large medial lenticulostriate artery, aberrant frontopolar artery, or the third A2 both on cerebral angiograms and in operation fields. The anomalous artery of this patient was larger than usual fronto-orbital arteries, and if surgically injured, clinically significant complications might have resulted. On this regard, this report may hopefully contribute to the medical community by calling attention to another rare vascular anomaly of the ACA.

REFERENCES

1. Perlmutter D, Rhoton AL Jr. *Microsurgical anatomy of anterior cerebral-anterior communicating-recurrent artery complex. J Neurosurg 1976 ; 45 : 259-72.*
2. Yasargil MG. *Microneurosurgery. Stuttgart, New York : Thieme, 1984 ; 2 : 165-231.*
3. Friedlander RM, Ogilvy CS. *Aneurysmal subarachnoid hemorrhage in a patient with bilateral A1 fenestration with an azygos anterior cerebral artery. Case report and literature review. J Neurosurg 1996 ; 84 : 681-4.*
4. Korosue K, Kuwamura K, Okuda Y, Tamaki N, Matsumoto S. *Saccular aneurysm arising from a fenestrated anterior cerebral artery. Surg Neurol 1983 ; 19 : 273-5.*
5. Minakawa T, Kawamata M, Hayano M, Kawakami K. *Aneurysms associated with fenestrated anterior cerebral arteries. Report of four cases and review of the literature. Surg Neurol 1985 ; 24 : 284-8.*
6. Ogasawara H, Inagawa T, Yamamoto M, Kamiya K. *Aneurysm in a fenestrated anterior cerebral artery - case report. Neurol Med Chir (Tokyo) 1988 ; 28 : 575-8.*
7. Yamada T, Inagawa T, Takeda T. *Ruptured aneurysm at the anterior cerebral artery fenestration. Case report. J Neurosurg 1982 ; 57 : 826-8.*
8. Bosma NJ. *Infra-optic course of anterior cerebral artery and low bifurcation of the internal carotid artery. Acta Neurochir 1977 ; 38 : 305-12.*
9. Klein SI, Gahbauer H, Goodrich I. *Bilateral anomalous anterior cerebral artery and infraoptic aneurysm. Am J Neuroradiol 1987 ; 8 : 1142-3.*
10. Maurer J, Maurer E, Perneczky A. *Surgically verified variations in the A1 segment of the anterior cerebral artery. Report of two cases. J Neurosurg 1991 ; 75 : 950-3.*
11. Nutik S, Dilenge D. *Carotid-ACA anastomosis. Case report. J Neurosurg 1976 ; 44 : 378-82.*
12. Sasaki T, Usami T, Takeda R, Nakagawara J, Sato S, Nakamura J, Suematsu K. *Three cases of infra-optic course of anterior cerebral artery. No Shinkei Geka 1984 ; 12 : 953-8.*

13. Senter HJ, Miller DJ. *Interoptic course of anterior cerebral artery associated with anterior cerebral artery aneurysm. Case report. J Neurosurg 1982 ; 56 : 302-4.*
14. Teal JS, Rumbaugh CL, Segall HD, Bergeron RT. *Anomalous branches of internal carotid artery. Neuroradiology 1973 ; 106 : 567-73.*
15. Yasargil MG. *Microneurosurgery. Stuttgart, New York : Thieme, 1984 ; 1 : 92-128.*
16. Abe S, Fujii K, Nishimura K, Kurokawa K. *Azygos anterior cerebral artery aneurysm. Report of two cases. Neurol Med Chir (Tokyo) 1985 ; 25 : 215-8.*
17. Benedetti A, Curri D. *Aneurysm of azygos anterior cerebral artery. Neurochirugia 1983 ; 26 : 56-8.*
18. Kobayashi S, Yuge T, Sugita Y, Kuratomi A, Katayama M, Iryo O, Kobayashi K, Kuboyama M, Kuramoto S. *Azygos anterior cerebral artery aneurysm associated with fenestration of the anterior cerebral artery. Kurume Med J 1986 ; 33 : 149-53.*
19. Nardi PV, Esposito S, Greco R, Massari A, Patricolo A. *Aneurysms of azygos anterior cerebral artery. Report of two cases treated by surgery. J Neurosurg Sci 1990 ; 34 : 17-20.*
20. Niizuma H, Kwak R, Uchida K, Suzuki J. *Aneurysms of the azygos anterior cerebral artery. Surg Neurol 1981 ; 15 : 225-8.*
21. Sako K, Nakai H, Hashizume A, Aizawa S, Suzuki N, Yonemasu Y. *Aneurysms located at the horizontal segment of the anterior cerebral artery or the middle cerebral artery. Neurol Med Chir (Tokyo) 1997 ; 37 : 387-91.*
22. Suzuki M, Onuma T, Sakurai Y, Suzuki J. *Twenty-six cases regarding the proximal anterior cerebral artery. No Shinkei Geka 1988 ; 16 : 701-5.*
23. Wakabayashi T, Tamaki N, Yamashita H, Saya H, Suyama T, Matsumoto S. *Angiographic classification of aneurysms of the horizontal segment of the anterior cerebral artery. Surg Neurol 1985 ; 24 : 31-4.*
24. Sugita S, Yuge T, Miyagi J, Fujimura N, Shigemori M. *Giant aneurysm at the origin of the accessory middle cerebral artery. Surg Neurol 1995 ; 44 : 128-30.*
25. Enomoto H, Goto H, Murase M. *A ruptured cerebral aneurysm of the fronto-orbital artery and the coexisting anastomosis with the anterior ethmoidal artery - a case report. No Shinkei Geka 1986 ; 14 : 203-6.*
26. Yamaura A, Takase M, Makino H. *An aneurysm of the proximal anterior cerebral artery at the olfactory bulb. Surg Neurol 1979 ; 12 : 425-7.*
27. Tsuji T, Abe M, Tabuchi K. *Aneurysm of persistent primitive olfactory artery. Case report. J Neurosurg 1995 ; 83 : 138-40.*