Since an infra-optic course of a proximal precommunicating artery was first described by Robinson and demonstrated on angiography by Isherwood and Dutton, 44 cases have been reported [1, 2]. Most cases demonstrate unilateral involvement and only 10 cases of bilateral involvement have been reported out of the 45 cases, including the case described in this report.

Although cerebral aneurysms are frequently associated with this congenital anomaly, an infra-optic course of the anterior cerebral artery (ACA) and association with aortic coarctation is rare [3]. To the best of our knowledge, this is the third case documented for an association with aortic coarctation in a patient an infra-optic course of the ACA [2, 4]. We report a case of bilateral infra-optic ACAs where a middle cerebral artery aneurysm and an aortic coarctation are associated. The clinical features, radiological findings and possible genesis of this anomaly are presented.

**Index words** : Anterior cerebral artery
Intracranial aneurysm
Aortic coarctation
Optic nerve
Tomography, X-Ray computed

A ruptured aneurysm at the bifurcation of the left middle cerebral artery with an infra-optic course of the bilateral anterior cerebral arteries was found in a 28-year-old woman. Both abnormal anterior cerebral arteries arose from the ipsilateral internal carotid arteries, at the level of the origin of ophthalmic arteries, passed underneath the ipsilateral optic nerves and turned upward at the ventral portion of the optic chiasm. In addition, an aortic coarctation was found with the use of thoracic aortography. An infra-optic course of the bilateral anterior cerebral arteries is an extremely rare anomaly. An infra-optic course of the bilateral anterior cerebral arteries is frequently associated with cerebral aneurysms and possibly with a coarctation aorta. The clinical features, radiological findings and possible genesis of this anomaly are presented.

Since an infra-optic course of a proximal precommunicating artery was first described by Robinson and demonstrated on angiography by Isherwood and Dutton, 44 cases have been reported [1, 2]. Most cases demonstrate unilateral involvement and only 10 cases of bilateral involvement have been reported out of the 45 cases, including the case described in this report.

A 28-year-old woman was admitted to our hospital after a sudden onset of severe headache and vomiting during sleeping. A physical examination of the patient revealed moderate neck stiffness. A brain computed tomography (CT) examination performed on admission...
demonstrated thick subarachnoid hemorrhage in the suprasellar, ambient and both sylvian cisterns (Fig. 1). CT angiography of the brain showed a saccular aneurysm at the bifurcation of the left middle cerebral artery (MCA) and both ACAs that originated from the ipsilateral internal carotid artery (ICA) at the level of the origin of the ophthalmic arteries. Both ACAs ran under the medial side of each optic foramen and then proceeded in a cephalic course (Fig. 2). Conventional angiography demonstrated a saccular aneurysm at the bifurcation of the left middle cerebral artery and the low bifurcation of both ICAs. Both ACAs arose from each side of the ICAs at the level of the ophthalmic artery, coursing medially and superiorly and coursing at the midline of the brain (Fig. 3). Thoracic aortography, which was performed just prior to cerebral angiography, showed the aortic coarctation located at the descending aorta, distal to the origin of the left subclavian artery (Fig. 4). Thoracic aortography also demonstrated multiple collaterals seen in the upper chest.

When the carotid and chiasmatic cisterns were opened for surgery of the left MCA aneurysm, the left A1 segment was found to originate from the left ICA at the level of the ophthalmic artery. Furthermore, the left A1 segment coursing under the left optic nerve and both distal A1 segments anterior and medial to the optic chiasm were observed (Fig. 5). Aortic surgery was performed at another institution.

Discussion

An anomalous infra-optic course of the ACA is associated with a low bifurcation of the ipsilateral internal carotid artery and the absence of a contralateral precommunicating tract. For an infra-optic course, the ACA usually arises from the intradural ICA at or near the origin of the ophthalmic artery, although an extradural origin proximal to the ophthalmic artery has also been reported (3). The A1 segment then passes medially below either the ipsilateral optic nerve or the optic chiasm. The ascending course is variable as the artery may turn superiority anterior or posterior to the optic chiasm, and may continue and ascend to the lateral side of the contralateral optic nerve or the contralateral side of the optic chiasm, or may even perforate the ipsilateral optic nerve. An anomalous vessel joins either the distal portion of the normal A1 or the anterior communicating artery (ACoA) to supply the circulation to the territory of the ACA.

An infra-optic course of ACA has a characteristic appearance as seen on conventional angiography: apparent low bifurcation of the ICA and a horizontal-medial
Fig. 3. Conventional angiography of both internal carotid arteries in the anterior posterior view (A) and lateral view of the right (B) and left (C) internal carotid arteries show a saccular aneurysm (white arrows in A and C) at the bifurcation of the left middle cerebral artery. Both anterior cerebral arteries (black arrows in A, B and C) arise from the ipsilateral internal carotid arteries at the level of the ophthalmic arteries (arrowheads in B and C), coursing medially and superiorly.

Fig. 4. Thoracic aortography shows the coarctation aorta (white arrow) at the descending aorta, distal to the origin of the left subclavian artery (black arrow).

Fig. 5. An intraoperative finding demonstrates both anterior cerebral arteries (arrows) at the medial side of the left optic nerve (ON).
course of the proximal ACA as it passes under the ipsilateral optic nerve before turning superiorly to join the normally positioned ACoA. The use of MR angiography mirrors the findings seen with conventional angiography, but a review of source images or obtaining high-spatial-resolution images of the suprasellar region provides additional information not available by the use of conventional angiography, such as the relationship of the ACA to the optic chiasm [3]. Routine MR imaging of the brain enables identification of this variation without concurrent MR angiographic sequences, showing the A1 segment between both optic nerves before the optic chiasm.

The exact embryogenesis of this vascular anomaly is unclear, but the most logical explanation seems to be related to persistence of an anatomic loop around the optic nerve of the primitive dorsal ophthalmic artery that normally disappears as the ophthalmic artery is formed [1, 5]. According to Bosma [6], the anomaly might represent persistence of the primitive maxillary artery that supplies the optic stalk and cup and terminates at the prosencephalon during the early embryonic stage.

An infra-optic course of an ACA is frequently accompanied by other vascular abnormalities such as carotid agenesis, fused pericallosal arteries, a variant of carotid artery-basilar artery anastomosis, Moyamoya disease and coarctation of the aorta. This case showed an association of aortic coarctation with the infra-optic course of the ACA in addition to a cerebral aneurysm. Most vascular diseases have a tendency to affect both the heart and brain. Intracranial aneurysms are found more often in patients with aortic coarctation as compared to the general population [7]. Aortic coarctation diagnosed in adulthood is rare, but poses special problems. Treatment with angioplasty is possible, but is complicated by aneurysms of the isthmus in 20% of cases, and currently surgery is considered as the treatment of choice.

Although association of a cerebral aneurysm and aortic coarctation is well known and association of the infra-optic course of the ACA and cerebral aneurysm is high (60%, 27/45), association of both a cerebral aneurysm and aortic coarctation in this anomaly has been rarely mentioned in recent studies [2, 4, 8]. We have tried to emphasize the importance of the recognition of the association of these three conditions in the management of the patient.

Vascular anomalies associated with intracranial aneurysms, even if rare, must be recognized in order to plan for appropriate treatment of a patient with intracranial aneurysms [1]. In addition, diagnosis of aortic coarctation should be considered in adolescent and young adult patients that present with intracranial aneurysms. Awareness of the possibility of an infra-optic course of the ACA and aortic coarctation is important in the setting of aneurysm surgery.

In conclusion, an infra-optic course of the anterior cerebral artery is an extremely rare anomaly and is frequently associated with intra-cranial aneurysms. Considering that a cerebral aneurysm can be accompanied with a coarctation aorta, it would be advantageous to predict the association of these anomalies from preoperative imaging studies.

References

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스물 여덟 살 여자 환자에서 중뇌동맥 뇌동맥류 파열과 동반된 양측 전뇌동맥의 시신경하 주행이 관찰되었다. 양측 전뇌동맥이 시상동맥 기시부 직 상방의 동측의 내경동맥에서 기시하여 시신경의 하부와 시신경교차 내측으로 진행하였다. 전뇌동맥의 시신경하 주행은 매우 드문 기형으로 종종 뇌동맥류와 동반되고 대동맥 협착과는 드물게 동반된다. 이 증례에서 방사선학적 소견과 발생학적 고찰을 하고자 한다.