

Fenestration of the Supraclinoid Internal Carotid Artery With Associated Aneurysm

—Case Report—

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Abstract

A 42-year-old woman presented with a rare case of fenestration of the supraclinoid internal carotid artery (ICA) with associated aneurysm manifesting as headache. Computed tomography (CT) found no abnormalities. Three-dimensional CT angiography showed fenestration of the left ICA with an associated aneurysm. Direct surgery was performed for the aneurysm, and the patient's postoperative course was uneventful. The present case of ICA fenestration associated with aneurysm indicates that surgical treatment should be considered for even small unruptured aneurysms arising from this location, because of the high risk of rupture.

Key words: fenestration of internal carotid artery, aneurysm, wrapping

Introduction

Fenestration of the intracranial internal carotid artery (ICA) is extremely rare, with only six cases reported to date.^{1,4,5,8,10,12)} Three of these cases were associated with aneurysms arising from the proximal portion of the fenestration.^{1,8,12)} Here, we report a case of fenestration of the left supraclinoid ICA with an associated aneurysm at the proximal end of the fenestration.

Case Report

A 42-year-old woman visited another hospital for evaluation of headache. No loss of consciousness had occurred. Computed tomography (CT) revealed no subarachnoid hemorrhage. Motor and sensory examinations, including cranial nerve function, and funduscopic examination found no abnormalities, and her headache improved over the next few days. Three-dimensional CT angiography showed fenestration of the ophthalmic segment of the left ICA and an aneurysm 4 mm in diameter arising from the fenestrated segment (Fig. 1). Angiography revealed

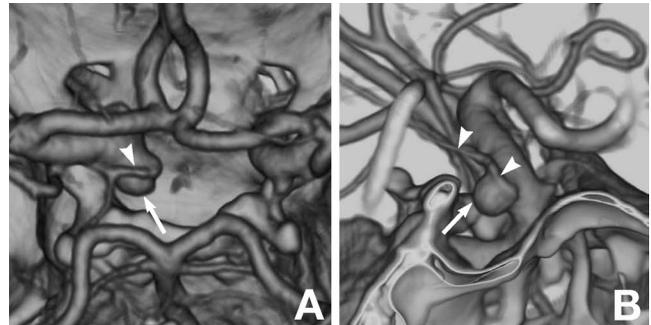


Fig. 1 Axial (A) and lateral projection (B) three-dimensional computed tomography angiograms showing fenestration of the left supraclinoid internal carotid artery (arrowheads) with an associated aneurysm (arrow) at the proximal end of the fenestration.

the same findings (data not shown).

Surgical treatment was selected with the patient's informed consent. The cervical common carotid artery was exposed to maintain proximal blood flow control, and left frontotemporal craniotomy was

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performed. The left ICA was confirmed, but the aneurysm was not identified (Fig. 2A). After partial resection of the anterior clinoid process, the fenestration of the ICA and the half-dome form of the aneurysm were confirmed (Fig. 2B). Dissection around the neck of the aneurysm was carried out

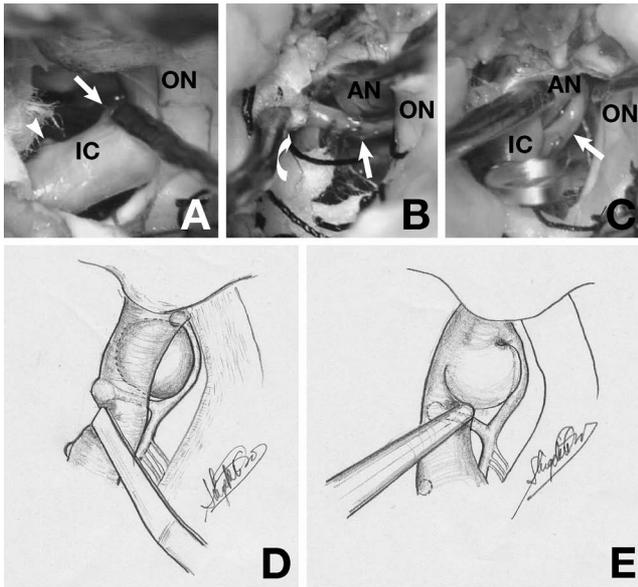


Fig. 2 A–C: Intraoperative photographs, (A) before resection of anterior clinoid process showing no visualization of the aneurysm, (B) after the partial resection of anterior clinoid process confirming the aneurysm with fenestration of the internal carotid artery, and (C) after application of the fenestrated clip demonstrating stenosis of fenestrated limb. AN: aneurysm, arrow: fenestrated limb, arrowhead: origin of anterior choroidal artery, curved arrow: posterior communicating artery, IC: internal carotid artery, ON: optic nerve. D, E: Illustrations of the operative findings.

carefully, which exposed the anatomical relationships around the aneurysm and fenestration (Fig. 2D, E). The small half-dome shaped aneurysm was located on the fenestrated portion of the ophthalmic segment of the ICA. The aneurysm was directed to the medial side of the ICA. The fenestrated limb was connected to the posterior communicating artery (PCoA), and small perforators arose from the limb and the PCoA. Various fenestrated clips were applied to the neck of the aneurysm, but the blood flow of fenestrated limb could not be maintained due to its stenosis (Fig. 2C). A fenestrated clip with the optimal length was not available at that time. We decided to perform wrapping for the aneurysm. The dome was wrapped with muscle and fibrin.

The patient's postoperative course was uneventful, and she was discharged 10 days after surgery with no complications.

Discussion

Table 1 summarizes the previous and present cases of fenestration of the intracranial ICA.^{1,4,5,8,10,12} The patients were all females aged 28 to 51 years (mean 39.9 years). The fenestration was on the right in five patients and the left in two. The fenestration began proximal to the bifurcation of the ophthalmic artery from the ICA in all cases. The fenestration ended at the bifurcation of the PCoA from the ICA in six cases^{1,5,8,10,12} and the anterior choroidal artery from the ICA in one case.⁴

Subarachnoid hemorrhage occurred in five patients,^{1,4,5,8,12} due to rupture of the aneurysm located in the fenestrated segment in three,^{1,8,12} and to rupture of anterior communicating artery and middle cerebral artery aneurysms in one each. Aneurysms were located in the fenestrated segment of the ICA in five of the seven cases, including the present case. The normal incidence of aneurysm in fenestrated segments, such as the vertebrobasilar ar-

Table 1 Summary of cases of fenestration of the supraclinoid internal carotid artery

Author (Year)	Age (yrs), Sex	Side	Location of fenestration	SAH	Associated aneurysm	Surgery
Yock (1984) ¹²	41, F	rt	near ophA	+	+	wrapping
Findlay et al. (1987) ⁴	28, F	rt	between the ophA and AChA	+	+	
Takano et al. (1991) ¹⁰	51, F	rt	between the ophA and PCoA	–	–	
Banach and Flamm (1993) ¹	37, F	lt	between the ophA and PCoA	+	+	clip
Katsuta et al. (1993) ⁵	47, F	rt	between the ophA and PCoA	+	–	
Ng et al. (2006) ⁸	34, F	rt	between the ophA and PCoA	+	+	clip and coil
Present case	42, F	lt	between the ophA and PCoA	–	+	wrapping

AChA: anterior choroidal artery, ophA: ophthalmic artery, PCoA: posterior communicating artery, SAH: subarachnoid hemorrhage.

terial system, is about 20%.⁶⁾ Therefore, ICA fenestration is frequently associated with aneurysm. Three of the four aneurysms arising from the ICA fenestrated segment ruptured, indicating a high potential to rupture.

Surgical treatment was performed in four cases, including the present case, three with and one without aneurysm rupture. Clipping,¹⁾ wrapping,¹²⁾ and a combination of clipping and coiling⁸⁾ were performed in one case each. We attempted neck clipping for the aneurysm using a fenestrated clip, but stenosis of fenestrated limb was occurred. We did not have a fenestrated clip with the optimal length at that time. Therefore, we decided to perform the wrapping with muscle and fibrin for the aneurysm. All patients showed good prognosis without aneurysm rerupture.

The association of aneurysms and fenestration may represent concurrent congenital anomalies due to embryonic vascular fusion.⁷⁾ The ICA arises from the third aortic arch at the 4- to 5-mm embryological stage, and the two intracranial ICAs are temporarily connected through small plexiform channels.⁹⁾ The fenestration of the ICA occurs at a site just distal to the origin of the ophthalmic artery, which corresponds to the site of division of the primitive ICA. Therefore, anomalous division of the ICA may result in fenestration at this site. ICA fenestrations associated with aneurysm and intracranial fenestration aneurysms show morphological similarities.¹²⁾ A histological defect was demonstrated in the muscular layer in the vessel wall at the proximal and distal ends of basilar artery fenestration aneurysm formation. However, aneurysms may be coincidental with fenestration, and develop due to the hemodynamic stress caused by fenestration of the parent artery.^{2,3,11)} The precise relationship between aneurysms and fenestrations remains to be clarified.

The present case of ICA fenestration associated with aneurysm indicates that surgical treatment should be considered for even small unruptured aneurysms arising from this location, because of the high risk of rupture.

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