

Aneurysm

Distal anterior choroidal artery aneurysms

Servet Inci, MD, PhD^{a,*}, Anil Arat, MD^b, Tuncalp Ozgen, MD^a

^aDepartments of Neurosurgery and ^bRadiology, School of Medicine, Hacettepe University, 06510 Ankara, Turkey

Received 9 October 2005; accepted 23 May 2006

Abstract

Background: Distal AChOA aneurysms are quite rare. Only 12 operated cases have been reported in the English medical literature. Treatment of these aneurysms is also difficult because of their deep location, small size, and angioarchitecture.

Methods: The authors report 2 additional patients with aneurysms, arising from the distal AChOA and located within the temporal horn of the lateral ventricle. In the first patient, the aneurysm could also be visualized with CTA, which is the first demonstration in the literature.

Results: The aneurysms were explored and resected via a transtemporal/ventricular approach in both patients. One patient was discharged as neurologically intact and the other died because of severe vasospasm.

Conclusions: The conclusions drawn from our experience and a comprehensive review of the literature include the following: (1) A distal AChOA aneurysm should be considered in patients with isolated medial temporal intracerebral hematoma with intraventricular extension. (2) These aneurysms are frequently very small (<5 mm). Therefore, they cannot be detected on initial angiograms in some cases. (3) These small aneurysms cannot be usually clipped without sacrificing the parent artery. (4) Sacrificing distal AChOA (beyond the plexal point) does not usually cause any neurological deficit, but, whenever possible, this artery should be preserved.

© 2007 Elsevier Inc. All rights reserved.

Keywords:

Aneurysm; Distal anterior choroidal artery; Surgery; Temporal horn

1. Introduction

Aneurysms of the AChOA mostly arise at the junction of the AChOA and the internal carotid artery and account for less than 5% of all intracranial aneurysms [7,21,41]. In particular, distal AChOA aneurysms are quite rare. In a large surgical series, including 1012 patients, there is no case with distal AChOA aneurysm [40]. To our knowledge, only 12 operated and 11 nonoperated cases have been reported in the English medical literature so far [1,2,4,9,11,15–20, 23,25,28,29,32,35,38,39,42]. Clinical findings and surgical approaches of distal AChOA aneurysms are different from proximal AChOA aneurysms. Their treatment is also difficult because of their deep location, small size, and angioarchi-

ture. We report 2 cases with a ruptured aneurysm originating from an intraventricular portion of the AChOA. In addition, we comprehensively review the literature related to these rare aneurysms, surgical anatomy of the AChOA, and potential approaches to the aneurysms within the temporal horn.

2. Case reports

2.1. Patient 1

This previously healthy 19-year-old woman was admitted with complaints of sudden severe headache, nausea, and vomiting on August 4, 2004. Her neurologic examination result was normal except for some slight confusion and neck stiffness. Computed tomography scans revealed a medial temporal intracerebral hematoma on the right side with an intraventricular extension.

Fluid-attenuated inversion recovery magnetic resonance imaging showed a small low-intensity area within the

Abbreviations: AChOA, anterior choroidal artery; FLAIR, fluid-attenuated inversion recovery; CTA, computed tomographic angiography; CT, computed tomography; MEP, motor evoked potential.

* Corresponding author. Fax: +90 312 311 1131.

E-mail address: servet@mailcity.com (S. Inci).

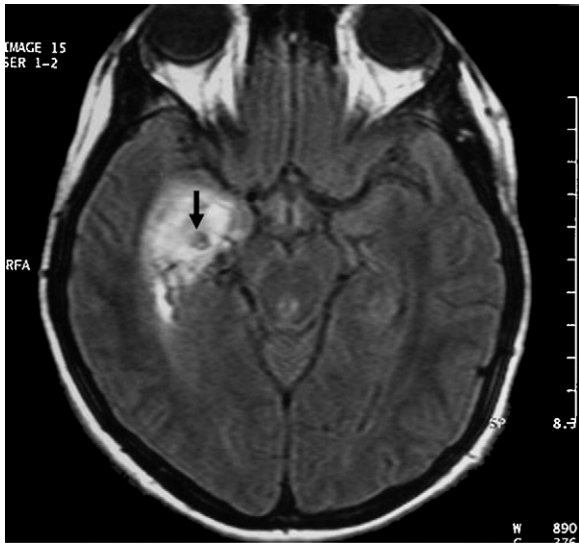


Fig. 1. Patient 1: FLAIR magnetic resonance image shows a small low-intensity area within the right medial temporal hematoma suggesting an aneurysm (arrow).

hematoma suggesting an aneurysm (Fig. 1). This small aneurysm could be demonstrated with CTA, but distal AChoA was not visualized (Fig. 2). Cerebral angiography clearly revealed a small aneurysm measuring 4×4 mm at a tiny branch of the right distal AChoA (Fig. 3). The aneurysm was located distal to the angiographic plexal point of the AChoA, indicating that it was located within the temporal horn. Early surgery was considered for prevention of rebleeding.

A right frontotemporal craniotomy including the temporal base was performed. The sylvian fissure and the carotid cistern were opened. The AChoA was explored and followed within the carotid and crural cisterns from the origin to the choroidal fissure. This was our first case of a

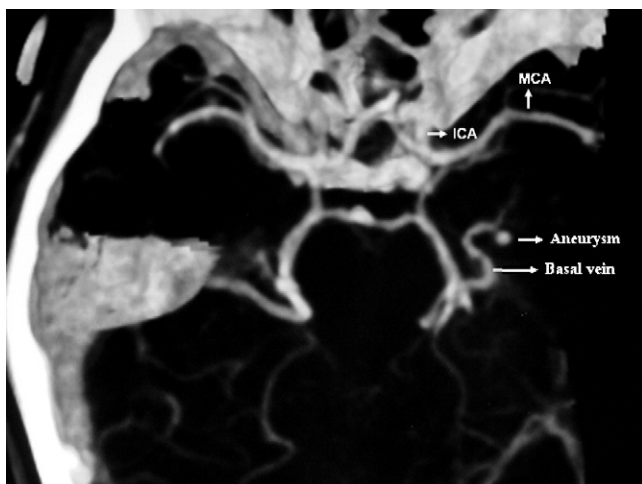


Fig. 2. Patient 1: Computed tomographic angiography demonstrates distal AChoA aneurysm. This is the first demonstration in the literature. In this study, AChoA itself could not be visualized because of the small size.

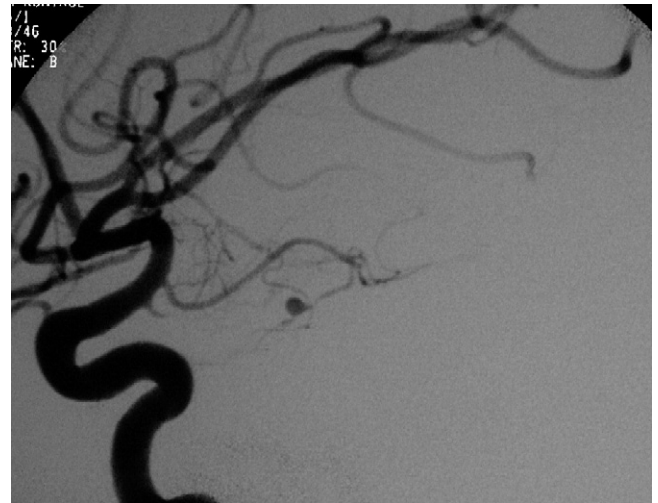


Fig. 3. Patient 1: Lateral view of the right internal carotid angiogram showing a small aneurysm at a tiny branch of the distal AChoA.

distal AChoA aneurysm. Therefore, this exploration was performed for proximal control at the most distal point of the cisternal segment, beyond the perforators of the AChoA. Thereafter, the temporal horn was entered via the inferior temporal gyrus (Fig. 4). After evacuation of the hematoma and partial resection of the choroid plexus, the aneurysm was found at the floor of the temporal horn in the subependymal layer. It was located at a tiny intraventricular branch of the distal AChoA. The total circumference of the aneurysm was carefully exposed, but attempted applications of a mini clip to the neck resulted in occlusion of the tiny parent artery. Therefore, the aneurysm was resected after the tiny parent artery was trapped with preservation of distal AChoA. The incision was closed in the usual fashion. Control angiography performed 1 day after surgery confirmed the complete

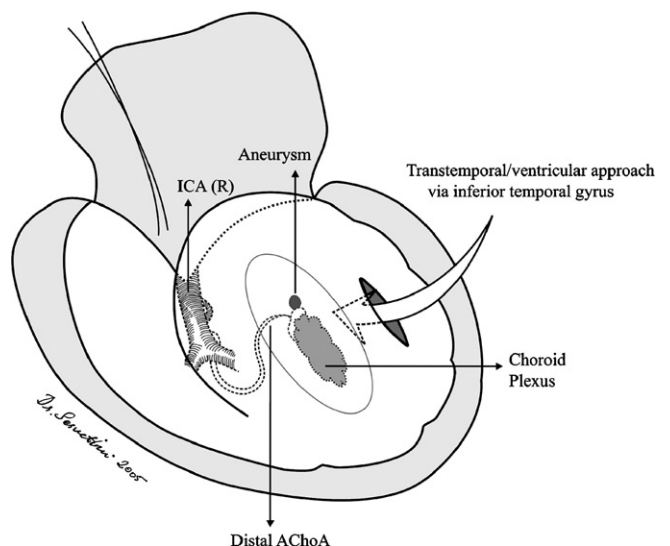


Fig. 4. Patient 1: Schematic drawing showing transtemporal-ventricular approach to a distal AChoA aneurysm.



Fig. 5. Patient 1: Postoperative angiogram revealing complete obliteration of the aneurysm.

obliteration of the aneurysm with preservation of distal AChoA (Fig. 5). The patient was neurologically intact at discharge. The histologic findings of the resected aneurysm did not show any infectious cause (Fig. 6).

2.2. Patient 2

A 37-year-old woman with a 3-year history of hypertension was brought to our emergency department because of a sudden onset of severe headache and vomiting on January 26, 2005. Neurologic examination revealed somnolence and marked meningismus. A CT scan of the brain showed the left medial temporal intracerebral hematoma with ventricular extension and diffuse subarachnoid hemorrhage (Fig. 7). Computed tomographic angiography was performed, but the



Fig. 7. Patient 2: Cranial CT showing left medial temporal intracerebral hematoma with intraventricular extension and severe subarachnoid hemorrhage.

aneurysm was not visualized. Cerebral angiography demonstrated a small aneurysm arising from the left distal AChoA (Fig. 8). It was located distal to the angiographic plexal point. In this case, proximal AChoA was not explored and the patient was directly operated on via a left transtemporal-transventricular route. During careful evacuation of the hematoma, this very small aneurysm was accidentally aspirated into the suction system. Minimal hemorrhage followed but was easily controlled with microbipolar cautery. No early postoperative complication was observed, but 2 days later the patient gradually deteriorated. Control angiography revealed diffuse vasospasm involving the left internal carotid,

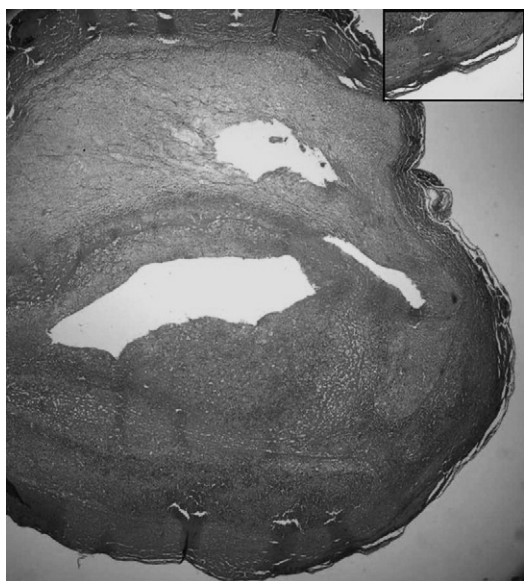


Fig. 6. Patient 1: The histology of the aneurysm (hematoxylin and eosin, original magnification $\times 40$).



Fig. 8. Patient 2: Cerebral angiogram demonstrating a small aneurysm arising from the left distal AChoA.



Fig. 9. Patient 2: Control angiogram revealing severe vasospasm involving the left internal carotid, middle, and anterior cerebral arteries.

middle cerebral, and anterior cerebral arteries (Fig. 9). Despite 3H therapy (hypertension, hypervolemia, hemodilution), the patient died on postoperative day 28th.

3. Discussion

3.1. Literature review

Anterior choroidal artery aneurysms arise at the origin of the artery in the vast majority of cases and account for less than 5% of all intracranial aneurysms [7,21,41]. In particular, distal AChoA aneurysms are quite rare. To our knowledge, only 12 operated and 11 nonoperated cases have been reported in the English medical literature before this report [1,2,4,9,11,15–20,23,25,28,29,32,35,38,39,42]. The clinical findings of these cases are summarized in Table 1. In these reports, the aneurysms were located within the temporal horn in 12 cases [4,15–17,19,25,28,29,35,38,39,42], in the atrium or body of the lateral ventricle in 7 [1,9,18,20,32], in the cisternal segment in 2 [11,23], and in the thalamus in 2 [2,18]. Interestingly, the aneurysms were not detected on initial angiograms in 5 patients (22%). This high incidence of negative initial angiogram was probably due to the small size of the aneurysms. In addition, recognizing distal AChoA can sometimes be hindered by overlapping branches of adjacent vessels on angiograms. This may also be another cause for negative initial angiograms.

Computed tomographic angiography has not been performed in previously reported cases. This technique was used in both our patients, and the aneurysm could be demonstrated in case 1. To our knowledge, this is the first

Table 1
Clinical findings of the patients with distal AChoA aneurysms in the English medical literature

Authors	Year	Age/sex	Presentation	Location of the aneurysm	Cause	Treatment	Outcome
Strully [32]	1955	27/F	Mass effect	Lateral ventricle	Idiopathic	Trapping	Poor
Caram et al [2]	1960	38/M	SAH, ICH	Thalamus	AVM	Removal of hematoma	Death
Cressman and Hayes [4]	1966	34/M	SAH, ICH	TH	Trauma	Conservative	Death
Butler et al [1]	1972	15/F	SAH, ICH	Trigone	Unknown	Trapping	Fair
Papo et al [29]	1973	57/F	SAH, IVH	TH	Atherosclerosis	Trapping	Poor
Tanaka et al [35]	1980	57/F	IVH	TH	Moyamoya	Conservative	Death
Kasamo et al [16]	1984	55/F	SAH (another aneurysm)	TH	Moyamoya	Clipping (ruptured aneurysm)	Death
Konishi et al [18]	1985	18/F	SAH	Thalamus	Moyamoya	Conservative	Good
		13/M	IVH	Lateral ventricle	Moyamoya	Conservative	Fair
		57/F	IVH	Lateral ventricle	Moyamoya	Conservative	Death
		34/F	IVH	Lateral ventricle	Moyamoya	Conservative	Death
Knuckey et al [19]	1988	46/F	SAH	TH	Atherosclerosis	Ligation	Good
Inagawa et al [15]	1990	75/F	IVH, SAH	TH	Idiopathic	Conservative	Death
Nishihara et al [28]	1993	34/F	IVH, SAH	TH	Idiopathic	Excision	Good
Hamada et al [9]	1994	48/F	IVH	Lateral ventricle	Moyamoya	Trapping	Good
Hung et al [11]	1996	35/F	SAH	Cisternal segment (superior branch)	Idiopathic	Trapping	Good
Morgenstern et al [25]	1996	33/M	Ischemic symptoms	TH	Idiopathic	Conservative	Good
Kawai et al [17]	1997	19/M	IVH	TH	Moyamoya	Conservative	Fair
Yoneoka et al [42]	1998	69/M	IVH	TH	Idiopathic	Clipping	Poor
Matsuura et al [23]	2000	42/M	Ischemic symptoms	Cisternal segment	Dissection	Conservative	Good
Yanaka et al [39]	2000	8/F	IVH	TH	AVM	Trapping	Good
Lee et al [20]	2001	48/M	ICH, IVH	Trigone	Moyamoya	Trapping	Good
Kwok-chu Wong [38]	2003	62/F	ICH, IVH	TH	Moyamoya	Clipping	Good
Present cases	2005	19/F	ICH, IVH	TH	Idiopathic	Trapping	Good
		37/F	ICH, SAH	TH	Idiopathic	Trapping	Death

AVM indicates arteriovenous malformation; ICH, intracerebral hematoma; IVH, intraventricular hematoma; SAH, subarachnoid hemorrhage; TH, temporal horn.

demonstration in the literature. However, we think that the gold standard is still conventional angiography for diagnosis of these small aneurysms.

3.2. Pathogenesis

The small distal aneurysms usually remind us of the infectious cause. The medical histories were not significant for infection in our cases. In addition, routine hematological and biochemical examination, electrocardiogram, chest x-ray, and intraoperative findings were normal. Furthermore, histologic findings of the aneurysm (case 1) did not support infectious theory. In some cases, these aneurysms may be secondary to moyamoya disease, tumor embolus, arteriovenous malformation, or trauma (Table 1). In our cases, there was no historical, radiologic, or clinical evidence to support any of the above etiologies either.

Therefore, the aneurysms were presumed to be idiopathic. In the literature, these aneurysms were associated with moyamoya disease in 10 cases [9,16–18,20,35,38]. Other etiologic factors were arteriovenous malformation in 2 cases [2,39], atherosclerosis in 2 [19,29], trauma in 1 [4], and unknown in 1 [1]. There were 6 cases of idiopathic origin reported [11,15,25,28,32,42], as in our case.

3.3. Vascular anatomy

Anatomic and angiographic knowledge are very important in the evaluation and treatment of distal AChOA aneurysms. The AChOA arises from the posterior wall of the internal carotid artery just distal to the posterior communicating artery. Rarely, it has been found to arise from the posterior communicating artery or carotid bifurcation [8,13,24]. The AChOA mostly arises as a single vessel. True duplication of this artery is a rarity. According to the anatomical study of Saeki and Rhoton [31], incidence of double AChOA is 4%. The frequency of angiographic visualization of the AChOA has been reported to be between 92% and 100% [26,37]. Its course is best studied with lateral and Towne's projections.

The AChOA has 2 main segments: cisternal and plexal [8,24,30]. The cisternal segment extends from the origin to the choroidal fissure. In most cases, the cisternal segment has a gentle S-shaped curve on lateral angiogram [37]. The length of this segment is approximately 24 mm [8,30]. The branches of this segment supply the optic tract, cerebral peduncle, lateral geniculate body, uncus, hippocampus, dentate gyrus, and posterior limb of the internal capsule [7,30,31,41]. However, the exact AChOA territory may show large variations [12].

The plexal segment begins at the choroidal fissure and continues posteriorly within the temporal horn, usually as a single trunk. The point where the artery enters the temporal horn at the choroidal fissure is known as angiographic plexal point. This point is frequently recognized as an abrupt deflection in course approximately 18 to 26 mm posterior to the internal carotid artery [27]. This point is also located approximately 4 cm posterior to the temporal tip

[14]. The AChOA frequently splits into the medial and lateral plexal branches (bifurcation of the AChOA) within the temporal horn [3,24]. In 1990, Takahashi et al [37] analyzed 216 consecutive carotid angiograms from 108 patients. According to this large study, incidence of visualization of the medial branch is 97% and that of the lateral branch 64%. The blood supply from the plexal segment feeds mainly the choroid plexus of the temporal horn [7,20,28,38]. Distal branches of the AChOA beyond the temporal horn may supply the choroid plexus of the atrium and body of the lateral ventricle, rarely extending to the foramen of Monro, where it anastomoses with branches of the medial posterior choroidal artery [8,27,30].

The AChOA anastomoses with branches of the posterior communicating and posterior cerebral arteries, especially posterior choroidal arteries [8,13,36]. The richest anastomotic network is localized on the lateral geniculate body and inside the choroid plexus [24].

3.4. The AChOA syndrome

The AChOA syndrome was first described by Foix et al in 1925 (quoted in Refs [5,7,13,33,36]). When complete, this syndrome includes contralateral hemiplegia, hemianesthesia, and homonymous hemianopia. The most constant neurologic deficit is hemiplegia, which is caused by the involvement of the pyramidal tract in the posterior limb of the internal capsule. Hemianesthesia and homonymous hemianopia may be temporary and incomplete. In the AChOA syndrome, the neurologic picture may also be associated with other symptoms, including pseudobulbar mutism [10], pathologic crying [5], and disorders of speech in dominant hemisphere lesions [33].

3.5. Surgery

We would like to discuss 2 surgical points concerning these cases. The first point is sacrificing of the plexal segment. Most distal AChOA aneurysms in the literature are located at the plexal segment itself as in our second case. In this situation, the aneurysms cannot be usually clipped without sacrificing the parent artery because of the fragile nature and very small size of the parent artery. Although occlusion of the cisternal segment most probably results in contralateral hemiplegia [7,33,41], this procedure is usually well tolerated on the plexal segment because of the rich anastomotic network [13,19,20,28,39]. However, there is a controversy concerning the participation of the plexal segment (beyond choroid plexus) in the vascularization of vital neural structures. In 1999, Marincovic et al [22] studied the surgical anatomy of the perforating branches of the AChOA. According to this microanatomic study, the most distal perforator of the AChOA, known as the capsulothalamic artery, originates close to the lateral geniculate body, just in front of the temporal horn. Thus, no perforators arise from the plexal segment. Therefore, ligation or trapping can be performed in those lesions distal to the plexal point (intra-ventricular segment of the AChOA). In contrast, according to

the anatomical studies of Fujii et al [8] and Morandi et al [24], some distal branches of the plexal segment may supply the thalamus. However, according to a recent anatomical study of Cosson et al [3], the AChoA is a source of lateral thalamic vascularization only by its cisternal branches. As a result, sacrificing of distal AChoA within the temporal horn may carry some risk of ischemia to its distal branches. Therefore, a reliable intraoperative monitoring is needed to perform safer and more precise surgery. For this purpose, the recently developed MEP can be used to avoid the complications due to blood flow insufficiency of the AChoA during surgery [34]. Although many authors have trapped the plexal segment and resected these aneurysms without any neurologic damage [19,20,28,39], we believe that, whenever possible, this artery should be preserved.

The second point is surgical approach. For aneurysms in the temporal horn, 2 operative approaches have been described. The transtemporal-ventricular route has been used in most operated cases [18,28]. This approach provides good exposure. By this approach, however, intraventricular hematoma can hide the parent artery and proximal control cannot be obtained at an early stage. In addition, detection of these small aneurysms may be difficult within the temporal horn. For this purpose, the use of frameless stereotactic guidance may be very useful for these small aneurysms which are frequently embedded in the brain tissue as in our first case. In the alternative approach, the sylvian fissure can be widely opened and the AChoA can be followed from the origin to the temporal horn. After the plexal point is identified, the choroidal fissure is opened, entering the temporal horn along the AChoA. This approach is more suitable for aneurysms in the crural cistern or choroidal fissure. But the aneurysm may be within the brain tissue or subependymal location. In this situation, further dissection may be dangerous because of the narrow operating field and potential injury to the basal vein, which is formed by the confluence of the anterior and middle cerebral veins and passes very close to the AChoA [6,24]. Fig. 2 demonstrates this close relationship.

Endovascular treatment may be an alternative for these aneurysms. We preferred open surgery because transcatheter techniques would have required an antegrade approach, potentially endangering the proximal AChoA. Endovascular parent artery occlusion with liquid embolic agents carries a risk of unintentional reflux of the embolic agent, which would have been devastating.

3.6. Conclusion

The conclusions drawn from our experience and a review of the literature include the following: (1) A distal AChoA aneurysm should be considered in patients with isolated medial temporal intracerebral hematoma with intraventricular extension. (2) These aneurysms are frequently very small (<5 mm). Therefore, they cannot be detected on initial angiograms in some cases. (3) These small aneurysms cannot be usually clipped without sacrificing the parent

artery. (4) Sacrificing distal AChoA (beyond the plexal point) does not usually cause any neurologic deficit, but, whenever possible, this artery should be preserved.

References

- [1] Butler AB, Partain RA, Netsky MG. Primary intraventricular hemorrhage. *Neurology* 1972;27:675-86.
- [2] Caram PC, Sharkley PC, Alvord Jr EC. Thalamic angioma and aneurysm of the anterior choroidal artery with intraventricular hematoma. *J Neurosurg* 1960;17:347-52.
- [3] Cosson A, Tatu L, Vuillier F, et al. Arterial vascularization of the thalamus: extra-parenchymal arterial groups. *Surg Radiol Anat* 2003; 25:408-15.
- [4] Cressman MR, Hayes GJ. Traumatic aneurysm of the anterior choroidal artery. Case report. *J Neurosurg* 1966;24:102-4.
- [5] Derex L, Ostrowsky K, Nighoghossian N, et al. Severe pathological crying after anterior choroidal artery infarct. Reversibility with paroxetine treatment. *Stroke* 1997;28:1464-6.
- [6] Erdem A, Yasargil MG, Roth P. Microsurgical anatomy of the hippocampal arteries. *J Neurosurg* 1993;79:256-65.
- [7] Friedman JA, Pichelmann MA, Piepgrass DG, et al. Ischemic complications of surgery for anterior choroidal artery aneurysms. *J Neurosurg* 2001;94:565-72.
- [8] Fujii K, Lenkey C, Rhoton Jr AL. Microsurgical anatomy of the choroidal arteries. Lateral and third ventricles. *J Neurosurg* 1980;52: 165-88.
- [9] Hamada J, Hashimoto N, Tsukahara T. Moyamoya disease with repeated intraventricular hemorrhage due to aneurysm rupture. Report of two cases. *J Neurosurg* 1994;80:328-31.
- [10] Helgason C, Wilbur A, Weiss A, et al. Acute pseudobulbar mutism due to discrete bilateral capsular infarction in the territory of the anterior choroidal artery. *Brain* 1988;111:507-24.
- [11] Hung KS, Lee TC, Lui CC. Aneurysm of superior branch of anterior choroidal artery mimicking carotid bifurcation aneurysms. Case report. *Acta Neurochir* 1966;138:1464-7.
- [12] Hupperts RM, Lodder J, Heuts-van Raak EPM, et al. Infarcts in the anterior choroidal artery territory. Anatomical distribution, clinical syndromes, presumed pathogenesis and early outcome. *Brain* 1994; 117:825-34.
- [13] Hussein S, Renella RR, Dietz H. Microsurgical anatomy of the anterior choroidal artery. *Acta Neurochir* 1988;92:19-28.
- [14] Ikeda K, Shoin K, Mohri M, et al. Surgical indications and microsurgical anatomy of the transchoroidal fissure approach for lesions in and around the ambient cistern. *Neurosurgery* 2002;50: 1114-9.
- [15] Inagawa T, Matsuda Y, Kamiya K, et al. Saccular aneurysm of the distal anterior choroidal artery. *Neurol Med Chir (Tokyo)* 1990;30: 498-502.
- [16] Kasamo S, Asakura T, Yamamoto Y, et al. Unilateral moyamoya disease associated with multiple aneurysms. A case report and review of the literature. *Neurol Med Chir (Tokyo)* 1984;24:30-4.
- [17] Kawai K, Narita K, Nakayama H, et al. Ventricular hemorrhage at an early stage of moyamoya disease. Case report. *Neurol Med Chir (Tokyo)* 1997;37:184-7.
- [18] Konishi Y, Kadowaki C, Hara M, et al. Aneurysms associated with moyamoya disease. *Neurosurgery* 1985;16:484-91.
- [19] Knuckey NW, Epstein MH, Haas R, et al. Distal anterior choroidal artery aneurysm: intraoperative localization and treatment. *Neurosurgery* 1988;22:1084-7.
- [20] Lee JK, Lee JH, Kim SH, et al. Distal anterior choroidal artery aneurysm in a patient with moyamoya disease: case report. *Neurosurgery* 2001;48:222-5.
- [21] Locksley H. Natural history of subarachnoid hemorrhage, intracranial aneurysms and arteriovenous malformations. Based on 6368 cases in the cooperative study. *J Neurosurg* 1966;25:219-39.

- [22] Marinkovic S, Gibo H, Brigante L, et al. The surgical anatomy of the perforating branches of the anterior choroidal artery. *Surg Neurol* 1999;52:30–6.
- [23] Matsuura H, Otawa Y, Suzuki M, et al. Dissecting aneurysm of the anterior choroidal artery: angiographical and MR imaging findings. *Surg Neurol* 2000;53:334–6.
- [24] Morandi X, Brassier G, Darnault P, et al. Microsurgical anatomy of the anterior choroidal artery. *Surg Radiol Anat* 1996;18:275–80.
- [25] Morgenstern LB, Hankins LL, Grotta JC. Anterior choroidal artery aneurysm and stroke. *Neurology* 1966;47:1090–2.
- [26] Morello A, Cooper IS. Arteriographic anatomy of the anterior choroidal artery. *Am J Roentgenol Radium Ther Nucl Med* 1955;73:748–51.
- [27] Morris P. *Practical neuroangiography*. Baltimore: Williams & Wilkins; 1997. p. 117–63.
- [28] Nishihara J, Kumon Y, Matsuo Y, et al. A case of distal anterior choroidal artery aneurysm: case report and review of the literature. *Neurosurgery* 1993;32:834–7.
- [29] Papo I, Salvolini U, Caruselli G. Aneurysm of the anterior choroidal artery with intraventricular hematoma and hydrocephalus. *J Neurosurg* 1973;39:255–60.
- [30] Rhoton Jr AL. The supratentorial arteries. *Neurosurgery* 2002; 51(Suppl 1):53–120.
- [31] Saeki N, Rhoton Jr AL. Microsurgical anatomy of upper the basilar artery and the posterior circle of Willis. *J Neurosurg* 1977;46:563–78.
- [32] Strully KJ. Successful removal of intraventricular aneurysm of the choroidal artery. *J Neurosurg* 1955;12:317–21.
- [33] Suzuki H, Fujita K, Ehara K, et al. Anterior choroidal artery syndrome after surgery for internal carotid artery aneurysms. *Neurosurgery* 1922;31:132–5.
- [34] Suzuki K, Kodama N, Sasaki T, et al. Intraoperative monitoring of blood flow insufficiency in the anterior choroidal artery during aneurysm surgery. *J Neurosurg* 2003;98:507–14.
- [35] Tanaka Y, Takeuchi K, Akai K. Intracranial ruptured aneurysm accompanying moyamoya phenomenon. *Acta Neurochir* 1980;52: 35–43.
- [36] Takahashi S, Ishii K, Matsumoto K, et al. The anterior choroidal artery syndrome: II. CT and/or MR in angiographically verified cases. *Neuroradiology* 1994;36:340–5.
- [37] Takahashi S, Suga T, Kawata Y, et al. Anterior choroidal artery. Angiographic analysis of variations and anomalies. *AJNR Am J Neuroradiol* 1990;11:719–29.
- [38] Kwok-chu Wong G, Boet R, Poon W. Ruptured distal anterior choroidal artery aneurysm presenting with right intracerebral hematoma: clipping aided by subpial uncal resection. *J Clin Neurosci* 2003;10:689–91.
- [39] Yanaka K, Tsuboi K, Fujita K, et al. Distal anterior choroidal artery aneurysm associated with an arteriovenous malformation. Intraoperative localization and treatment. *Surg Neurol* 2000;53:546–51.
- [40] Yasargil MG. *Microneurosurgery*, vol. II. New York, Georg-Thieme Verlag; 1984. p. 99–108.
- [41] Yasargil MG, Yonas H, Gasser JC. Anterior choroidal artery aneurysms: their anatomy and surgical significance. *Surg Neurol* 1978;9:129–38.
- [42] Yoneoka Y, Ezuka I, Takai N, et al. Ruptured distal anterior choroidal artery aneurysm presenting with casting intraventricular hemorrhage. *Acta Neurochir* 1998;140:185–9.

Commentary

This is a paper on the aneurysm of the distal AChoA and is well documented. As the authors describe on their first case, a 2-step approach, pterional approach for securing the proximal anterior choroidal artery to proximal control followed by temporal transcortical approach, is a good and safe alternative, especially in the case of ruptured aneurysm.

Kazuhiro Hongo, MD

Department of Neurosurgery

Shinshu University School of Medicine

Matsumoto 390-8621, Japan

The authors described 2 cases of distal AChoA aneurysms, which are very rare, and reviewed the previous reported literature. The pathogenesis of the small distal aneurysms is infection, trauma, or vascular abnormality associated with moyamoya disease or arteriovenous malformation. The 2 aneurysms that the authors reported seem to be idiopathic from the histologic findings and hematologic examinations. Although they successfully treated the first case, the second case was lost because of cerebral vasospasm. The occlusion of the AChoA causes irreversible severe and permanent hemiparesis. Therefore, preservation of the blood flow of the AChoA during surgery is extremely important. The authors stated that the occlusion of the artery beyond the plexal point did not cause complications. Although I agree with them, premature rupture sometimes forces the proximal segment of the artery to occlude temporarily.

Therefore, reliable intraoperative monitoring is needed to perform safer and more precise surgery. The recently developed MEP can be used to avoid infarction due to blood flow insufficiency of the AChoA during surgery.

In their conclusion, the authors summarized the important points for the management of these aneurysms. We have to consider the possibility of a distal AChoA aneurysm when an isolated medial temporal intracerebral hematoma with intraventricular extension is shown on CT.

Namio Kodama, MD

Department of Neurosurgery

Fukushima Medical School

Fukushima 960-12, Japan