

Distal Anterior Cerebral Artery Aneurysms: Clinical Features and Surgical Outcome

Aneurysms of the distal anterior cerebral artery (DACA) are rare and their surgical treatments present some unique difficulties from a technical standpoint. In this report, we presented our experiences of cases with DACA aneurysms, and analyzed the clinical features and prognostic factors affecting the final outcomes. Among 770 cases of intracranial aneurysms operated from 1990 to 1998, 19 cases of DACA aneurysms (2.5%) were studied retrospectively. The characteristic findings were female preponderance (M:F=1:2.8), common multiple aneurysms (57.9%), and frequent intracerebral hemorrhage (ICH) on initial brain CT scan (42.1%). All patients were operated via interhemispheric approach. Intraoperative aneurysmal rupture was developed only in 3 cases (15.8%), and had no relationship with the final outcome. Fifteen out of 19 patients (78.9%) showed favorable outcome with a mortality rate of 5.3%. The follow-up data suggest that the initial ICH on brain CT scan portend a poor prognosis.

Key Words: Anterior Cerebral Artery; Intracranial Aneurysm; Cerebral Hemorrhage; Pericallosal Aneurysm

Taek Hyun Kwon, Hung Seob Chung,
Dong Jun Lim, Jung Yul Park, Youn Kwan Park,
Hoon Kap Lee, Jung Keun Suh

Department of Neurosurgery, College of Medicine,
Korea University, Seoul, Korea

Received: 17 October 2000

Accepted: 8 January 2001

Address for correspondence

Taek Hyun Kwon, M.D.
Department of Neurosurgery, Korea University
Guro Hospital, 80 Guro-dong, Guro-gu, Seoul
152-703 Korea
Tel: +82.2-818-6061, Fax: +82.2-863-1684
E-mail: ns806@ns.kumc.or.kr

INTRODUCTION

Aneurysms of the distal anterior cerebral artery (DACA) are rare and comprise about 3 to 5% of all intracranial aneurysms (1). These aneurysms are known to have a worse prognosis than aneurysms of other locations. The results of the cooperative studies revealed that the mortality rate was 81.2% for DACA aneurysms when the patients were not surgically treated (2), and that the mortality rate and morbidity rate for 32% and 42.3%, respectively, even in surgically-treated patients (3). Such surgical difficulties of DACA aneurysms may be due to the narrow working space in the interhemispheric fissure, dense adhesion between cingulate gyri, difficulty in controlling parent artery, a broad-based and/or a sclerotic neck in these aneurysms, as well as frequent associations with multiple aneurysms and other vascular anomalies (4). Accordingly, the characteristics of these aneurysms have not been the subject of much investigation, because the incidence has been low and the number of cases experienced by each surgeon has been limited. In this report, our experiences with DACA aneurysms are presented and discussed focusing on their

clinical features and the surgical outcomes.

MATERIALS AND METHODS

Of those 770 patients who had been diagnosed as and operated for intracranial aneurysms at Korea University Hospital from 1990 to 1998, 19 patients with DACA aneurysms were studied retrospectively. These patients were clinically classified according to Hunt-Hess grades. As opposed to other aneurysms, it is known that in cases with DACA aneurysms, there is a difference in surgical outcome between grade II and III (5, 6). Therefore just like those of Snyckers and Drake (7), grades I-II and grades III-V were regarded as "good" and "poor" grades, respectively. In addition, the surgical outcome was scored according to the Glasgow Outcome Scale classifying the result into "good recovery", "moderate disability", "severe disability", "persistent vegetative state", or "death". Among them, "good recovery" and "moderate disability" were judged as a favorable outcome. Statistical analysis was made by using chi-square test and Mann-Whitney rank sum test. The clinical summary of our cases is

Table 1. Summary of 19 cases with DACA aneurysms

Case No.	Age (yr) /Sex	Preoperative HH grade	ICH on brain CT	Ruptured aneurysm	Size	Side (R/L)	Multiple aneurysm	Events	GOS
1	24/F	III	ICH	+	Medium	L	-	Vasospasm, intraoperative rupture	M
2	64/F	IV	-	-	Small	L	Lt MCA	Vasospasm	S
3	40/F	II	-	+	Medium	R	-	-	G
4	72/F	II	ICH	+	Medium	L	-	Intraoperative rupture	G
5	52/F	II	-	+	Small	L	-	-	G
6	63/F	I	-	+	Medium	L	-	Wrapping	G
7	45/F	II	-	-	Medium	L	Rt A-com, Lt MCA	Vasospasm	G
8	67/M	IV	ICH	+	Large	L	Lt Acho	Vasospasm, rebleeding	D
9	49/F	II	-	-	Small	R	Lt P-com, A-com, MCA	-	G
10	53/F	II	-	-	Small	R	Rt P-com, A-com	-	G
11	67/F	II	-	-	Small	R	Lt MCA	-	G
12	58/F	II	ICH	+	Small	L	-	Rebleeding	S
13	43/F	II	-	-	Small	R	Lt A-com, Rt MCA	-	G
14	38/M	III	ICH	+	Small	L	-	Vasospasm	M
15	61/M	II	ICH	+	Small	L	Rt A-com	Vasospasm	G
16	60/M	V	ICH	+	Small	R	-	-	S
17	47/F	III	ICH	+	Small	L	Lt MCA	Intraoperative rupture	G
18	40/F	II	-	-	Small	R	Rt P-com	-	G
19	45/M	II	-	-	Small	R	Lt MCA, Acho, Rt P-com, ICA, Acho, MCA	-	G

HH, Hunt and Hess grading scale; GOS, Glasgow outcome scale; G, good recovery; M, moderate disability; S, severe disability; D, dead; Acho, anterior choroidal artery; A-com, anterior communicating artery; ICA, internal carotid artery; MCA, middle cerebral artery; P-com, posterior communicating artery; ICH, intracerebral hemorrhage; Small, <6 mm; Medium, 6-14 mm; Large, 15-24 mm.

presented in Table 1.

RESULTS

Characteristics with respect to age and sex

Of 770 cases with intracranial aneurysms, there were a total of 19 cases of DACA aneurysms showing a prevalence of 2.5%. Among them, 5 were male and 14 were female revealing higher incidence in female (M:F ratio=1:2.8). The mean age was 52.3 yr (ranging from 24 to 72 yr of age), which was not significantly different from those of other cerebral aneurysms.

Radiological findings

All patients showed subarachnoid hemorrhage (SAH) in preoperative CT findings, and intracerebral hemorrhage (ICH) on callosal area or medial frontal lobe was observed in 8 cases (42.1%). With respect to the location, 13 cases (68.4%) had aneurysms at the pericallosal-callosomarginal bifurcation, which was the most frequent region (Fig. 1). Eight had aneurysms in the right side and 11 had in the left side, showing no distinctive differences. As to the size, thirteen cases had small aneu-

rysms (diameter, <6 mm), 5 cases had medium-sized aneurysms (diameter, 6-14 mm), and 1 case had a large aneurysm (diameter, 15-24 mm). Giant aneurysm was not observed. Characteristically, of the total of 19 cases, 11 cases (57.9%) showed multiple aneurysms: 6 cases had two aneurysms; 3 cases had three aneurysms; 1 case had four aneurysms; 1 case had seven aneurysms. Nevertheless, of these cases with multiple aneurysms, only three cases (27.3%) had DACA aneurysms that were

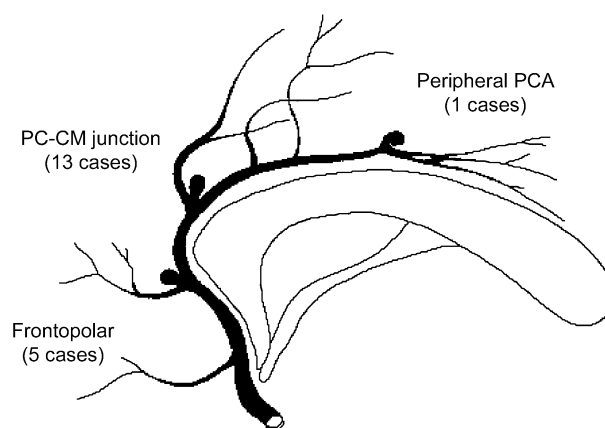


Fig. 1. Schematic illustration of the location of 19 DACA aneurysms. PCA, pericallosal artery; PC-CM, pericallosal-callosomarginal.

directly responsible for the hemorrhage—a relatively very small proportion.

Clinical features

Of the total of 19 cases, 13 cases (68.4%) showed grades I-II (“good” grade) and 6 cases (31.6%) showed grades III-V (“poor” grade) on admission. Among the 11 cases without evidences of intracerebral hemorrhage (ICH) in the brain CT findings, 10 cases had “good grade” and only one case showed “poor” grade. On the contrary, of the remaining 8 cases with ICH, 4 cases had “good” grade and 4 cases had “poor” grade, indicating negative clinical implications of ICH. Clinically significant vasospasm was developed in six cases. Among them, four showed ICH on brain CT. In addition, two cases had developed preoperative rebleeding, and both of whom had ICH in the CT findings.

Operation

In all cases, we performed the operations using the interhemispheric approach without delay unless there were special limiting factors at our hospital. Although there were differences somewhat depending on patient referrals and so on, operations were performed for most cases within two weeks from the ictus. In cases with incidental DACA aneurysms, one-stage operation if possible has been the rule. However, in some cases, especially with poor operative conditions, staged operations were performed. Although the right side approach, which manipulates the non-dominant hemisphere, has been the general rule, the left side approach was performed in 8 cases due to multiple aneurysms (5 cases), embedded aneurysmal dome in the right frontal lobe (2 cases), and left frontal ICH (1 case). In all cases except for one, for which wrapping was carried out, clipping was performed in the surgery. Four cases required a temporary clipping of the parent artery during the surgery. Three cases developed an aneurysmal rupture during the dissecting procedure, all of which had shown ICH in the initial brain CT.

Surgical outcome

Fifteen cases (87.9%) showed a favorable surgical outcome with 13 cases of good recovery and 2 cases of moderate disability. Three cases showed severe disability and the mortality rate was 5.3% with a single death. Thirteen cases with “good” grade standing prior to surgery resulted in good recovery except for one. On the contrary, only one case out of six with “poor” grade standing showed good recovery, showing a close cor-

relation between the preoperative clinical grade and the final surgical outcome. In addition, three out of 8 cases in which ICH was observed in the brain CT showed good recovery while 10 out of 11 cases without ICH showed good recovery. This reveals unfavorable surgical outcome in patients with ICH prior to the surgery. Moreover, while only 6 out of those 11 cases in which DACA aneurysms were the cause of SAH showed good recovery, 7 out of 8 incidental aneurysmal cases showed good recovery. Such better surgical outcomes in patients with incidental aneurysms would be partly owed to the fact that they showed more favorable preoperative clinical status, and that none of them revealed ICH in the brain CT prior to the surgery. Nevertheless, among the three cases that had a rupture during the surgery, two cases had a good recovery and one case had moderate disability, indicating that the presence of a rupture during the surgery did not largely affect the final outcome.

DISCUSSION

DACA aneurysm is one of the rare aneurysms occurring in the anterior circulation. Mostly the incidence has been less than 5%; 2.1% by Cooperative study (2), 2.6% by McKissock *et al.* (8), 3.4% by Yasargil and Carter (4), 4.5% by Laitinen and Snelmann (9). This study also showed an incidence of 2.5%.

Our experiences of cases with DACA aneurysms revealed several characteristics. Firstly, we confirmed that this type of aneurysm is more common in women with a male to female ratio of 1 to 2.8. Although there have been conflicting reports that men are more prone to such an ailment (4, 9, 10) or there are no differences according to sex (11), most studies have characteristically reported higher incidences among women (5, 12-16).

Secondly, multiple cerebral aneurysms were frequent. Of all the aneurysms, multiple cerebral aneurysms generally comprise about one fifth. However, DACA aneurysms show much higher incidences of multiple aneurysms than others. Hernesniemi *et al.* (11) reported an incidence of 46.4%, Ohno *et al.* (17) reported 42.9%, and Yasargil and Carter (4) reported 38.5%. A higher incidence of multiple aneurysms up to 58% was observed in this study. Also, it has been reported that DACA aneurysm was the more frequent cause of hemorrhage among the cases accompanying multiple aneurysms. Hernesniemi *et al.* (11) noted 20 such cases (51.3%) among 39 cases with multiple aneurysms while Ohno *et al.* (17) reported ten such cases (55.6%) among 18 cases with multiple aneurysms, asserting that DACA aneurysm was the frequent cause of hemorrhage. Unlike the previous studies, however, the result of this study showed

that only three (27.3%) out of 11 cases with multiple aneurysms were DACA aneurysms as the underlying cause of hemorrhage.

Thirdly, the sizes of the aneurysms were not large. According to the report by Ohno et al. (17), 36 (73.5%) out of 49 cases had a small aneurysm of 5 mm or less, and Inci et al. (13) also described that most aneurysms of his series were 10 mm or less in size. In our investigation, the small aneurysms of 6 mm or less comprised 13 out of 19 cases while there was only one case with an aneurysm larger than 15 mm, and no giant aneurysms. In addition, there were no differences in characteristic between the ruptured aneurysms and the incidental unruptured aneurysms. Accordingly, considering the characteristic of easy rupture even for a small-sized aneurysm, a DACA aneurysm must not be overlooked and need a definitive treatment even if it is incidentally discovered in unruptured state.

Lastly, ICH is more frequent in DACA aneurysms compared with those aneurysms in other areas (15). Hamilton and Falconer (18) reported that they observed ICH in all six cases of DACA aneurysms. Furthermore, Yasargil and Carter (4), Snyckers and Drake (7), and Mann et al. (14) reported the frequencies of ICH to be 46.2%, 48%, and up to 73%, respectively. Of our 19 cases, ICH was observed in 8 cases (42.1%). This may be due to the close apposition of frontal lobe and corpus callosum to aneurysms and the limited subarachnoid space adjacent to these aneurysms. In the meanwhile, Thomas and Paterson (19) observed ICH in 50% of their patients, which did not affect the final outcome. However, Wisoff and Flamm (6) noted that the patients of "good" grade did not have ICH, while ICH and clinically significant vasospasm were observed in the grade III-IV patients. According to our study, four cases out of six that experienced significant vasospasm had ICH, and the preoperative rebleeding occurred only in two patients with both vasospasm and ICH. With respect to the surgical outcome, among eleven cases without ICH, ten cases showed good recovery. On the contrary, among eight cases with ICH, only three cases showed good recovery. Although there was no statistical significance due to inadequacy in number of the cases, ICH showed negative implications for both the clinical course and the final surgical outcome.

Snyckers and Drake (7) noted an aneurysmal rupture during the surgery as an important characteristic of DACA aneurysms. In their series, DACA aneurysm cases showed rupture frequency of 50% during surgery, while aneurysms other than DACA showed only 13%. In this regard, DACA aneurysm was asserted to be a surgical challenge. Nevertheless, advances in surgical techniques and in anesthesia have largely overcome these limiting

factors. Inci et al. (13) reported occurrences of a rupture during surgery in only 21% of his cases, and Sindou et al. (16) and Wisoff and Flamm (6) reported no rupture during surgery. In our study, we experienced only three cases (15.8%) out of 19 that resulted in a rupture during surgery. Moreover, the rupture did not largely affect the final outcome.

Compared to other aneurysms, DACA aneurysms are known to have poor clinical course and prognosis even to be referred to as a 'malignant aneurysm' (14). In the past, they showed a very high morbidity and mortality rates. However, with the help of further understanding of the relationship between DACA aneurysm and the surrounding vessels and appropriate microsurgical techniques, surgical treatment with a significantly low morbidity and mortality rates has become possible.

REFERENCES

1. Fisher RG, Ciminello V. *Pericallosal aneurysms*. *J Neurosurg* 1966; 25: 512-5.
2. Nishioka H. *Report on the cooperative study of intracranial aneurysms and subarachnoid hemorrhage: Section VII, Part 1. Evaluation of the conservative management of ruptured intracranial aneurysms*. *J Neurosurg* 1966; 25: 574-92.
3. Skultety FM, Nishioka H. *Report on the cooperative study of intracranial aneurysms and subarachnoid hemorrhage: Section VIII, Part 2. The results of intracranial surgery in the treatment of aneurysms*. *J Neurosurg* 1966; 25: 683-704.
4. Yasargil MG, Carter LP. *Saccular aneurysms of the distal anterior cerebral artery*. *J Neurosurg* 1974; 39: 218-23.
5. de Sousa AA, Dantas FL, de Cardoso GT, Costa BS. *Distal anterior cerebral artery aneurysms*. *Surg Neurol* 1999; 52: 128-35.
6. Wisoff JH, Flamm ES. *Aneurysms of the distal anterior cerebral artery and associated vascular anomalies*. *Neurosurgery* 1987; 20: 735-41.
7. Snyckers FD, Drake CG. *Aneurysms of the distal anterior cerebral artery. A report on 24 verified cases*. *S Afr Med J* 1973; 47: 1787-91.
8. McKissock W, Paine KWE, Walsh LS. *An analysis of the results of treatment of ruptured intracranial aneurysms. Report of 772 consecutive cases*. *J Neurosurg* 1960; 17: 762-76.
9. Laitinen L, Snelmann A. *Aneurysms of the pericallosal artery. A study of 14 cases verified angiographically and treated mainly by direct surgical attack*. *J Neurosurg* 1968; 29: 447-58.
10. Yoshimoto T, Uchida K, Suzuki J. *Surgical treatment of distal anterior cerebral artery aneurysms*. *J Neurosurg* 1979; 50: 40-4.
11. Hernesniemi J, Tapaninaho A, Vapalahti M, Niskanen M, Kari A, Luukkonen M. *Saccular aneurysms of the distal anterior*

- cerebral artery and its branches. Neurosurgery 1992; 31: 994-9.*
12. Becker DH, Newton TH. *Distal anterior cerebral artery aneurysms. Neurosurgery 1979; 4: 495-503.*
 13. Inci S, Erbenli A, Ozgen T. *Aneurysms of the distal anterior cerebral artery. Report of 14 cases and a review of the literature. Surg Neurol 1998; 50: 130-9.*
 14. Mann KS, Yue CP, Wong G. *Aneurysms of the pericallosal-callosomarginal junction. Surg Neurol 1984; 21: 261-6.*
 15. Martinez F, Blundo C, Chiappetta F. *Surgical treatment of the distal anterior cerebral artery aneurysms. J Neurosurg Sci 1996; 40: 189-94.*
 16. Sindou M, Pelissou-Guyotat I, Mertens P, Keravel Y, Athayde AA. *Pericallosal aneurysms. Surg Neurol 1988; 30: 434-40.*
 17. Ohno K, Monma S, Suzuki R, Masaoka H, Matsushima Y, Hirakawa K. *Saccular aneurysms of the distal anterior cerebral artery. Neurosurgery 1990; 27: 907-12.*
 18. Hamilton JG, Falconer MA. *Immediate and late results of surgery in cases of saccular intracranial aneurysms. J Neurosurg 1959; 16: 514-41.*
 19. Thomas DGT, Paterson A. *Proceedings: results of surgical treatment of pericallosal aneurysms. J Neurol Neurosurg Psychiatry 1975; 38: 826.*