HAYDARPAŞA NUMUNE MEDICAL JOURNAL

DOI: 10.14744/hnhj.2020.18894
Haydarpasa Numune Med J 2022;62(3):248–252

hnhtipdergisi.com

ORIGINAL ARTICLE

Surgical Strategies for Distal Anterior Cerebral Artery Aneurysms

Ali Arslan, İsmail İştemen

Department of Neurosurgery, Adana City Training and Research Hospital, Adana, Türkiye

Abstract

Introduction: Distal anterior cerebral artery (DACA) aneurysms are rare and possess different features in terms of surgical treatment and follow-up. We present our clinical experience about DACA aneurysms in this manuscript.

Methods: Retrospective analysis of 411 patients who were operated in our clinic for intracranial aneurysm between April 2015 and May 2019 was presented. These patients were evaluated in terms of age, sex, clinical and radiological features, grade of the aneurysm according to the World Federation of Neurological Surgeons, surgical strategies, prognostic factors affecting surgical results, and patient discharge scores named as modified Rankin scores (mRSs).

Results: In our study, 21 DACA aneurysms were detected and gender distribution was observed in the form of 10 male and 10 female patients. Twenty had saccular aneurysm and one had infundibular aneurysm. Eleven of 20 patients had multiple aneurysms and 17 had subarachnoid hemorrhage. It was detected incidentally in three patients. When patients were evaluated according to the aneurysm diameter, 19 had aneurysms of 3–7 mm in diameter and two had aneurysms of 8 mm in diameter. Frontotemporal approach was performed for 11 patients with multiple aneurysms, whereas interhemispheric approach was used for nine patients with isolated DACA aneurysms. mRS was 0 for 15 patients, 1 for two patients, 5 for two patients, and 6 for one patient (exitus).

Discussion and Conclusion: Although DACA aneurysms are small in size, they should be treated surgically or endovascularly. Coexistence with multiple aneurysms is frequent. Elder age and coexistence with multiple aneurysms are poor prognostic factors.

Keywords: Distal anterior cerebral artery aneurysms; multiple aneurysm; surgical outcome; surgical treatment.

Distal anterior cerebral artery (DACA) aneurysms are rare and include about 1.5–9% of all aneurysms in the cerebral circulation[1,2]. It is usually localized in the pericallosal and callosomarginal division. Aneurysm dome is small in size, has a broad neck, and is embeds between the cerebral hemispheres[3,4]. These features make difficult to preserve the main artery in endovascular therapy and microsurgery. Interhemispheric approach is most commonly used technique in surgery of DACA aneurysms. The foremost challenge encountered in this approach is the presence of the aneurysm dome where proximal control cannot be ensured. In case of early rupture, hemorrhages that are difficult to deal with may occur. Planning the surgery of patients, the strategy should be well defined, the shortest way to reach the aneurysm should be preferred and necessary manipulations for proximal control should be planned before surgery. In this study, we discuss our experience in DACA aneurysms based on radiological features of the aneurysm, surgical strategies applied, and surgical results.

Correspondence (İletişim): İsmail İştemen, M.D. Adana Sehir Egitim ve Arastirma Hastanesi, Beyin Cerrahisi Bolumu, Adana, Türkiye
Phone (Telefon): +90 505 277 53 59 **E-mail (E-posta):** drismailistemen@gmail.com
Submitted Date (Başvuru Tarihi): 06.06.2020 **Accepted Date (Kabul Tarihi):** 23.07.2020

Materials and Methods

In total, 411 patients with cranial aneurysm treated in our clinic between April 2015 and May 2019 were retrospectively evaluated; 20 of them were patients with DACA aneurysm (4.86%). Endovascular treatment was performed for 58 of 411 patient. Localization of aneurysms was assessed according to Lehecka (Fig. 1)[5].

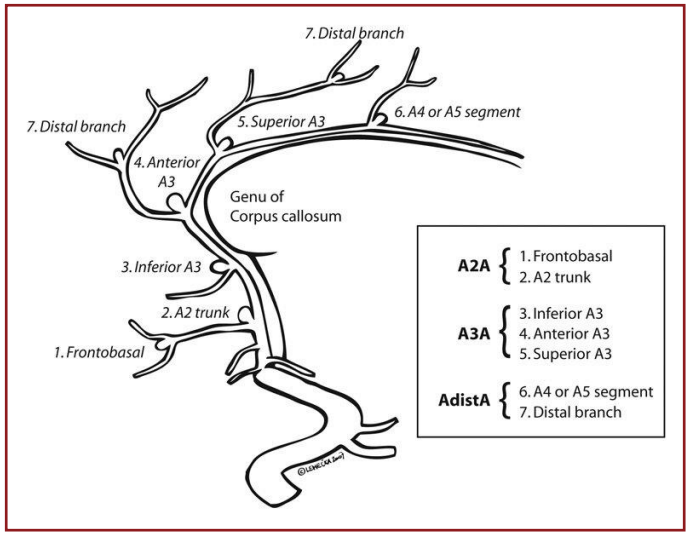

Figure 1. Sites of distal anterior cerebral artery aneurysms.

Patients were evaluated in terms of age, sex, localization and diameter of aneurysm, coexisting aneurysms, surgical approach forms, preoperative Glasgow Coma Scale, the World Federation of Neurological Surgeons (WFNS) grade, and post-operative modified Rankin scores (mRSs) and complications. Data of the patients are summarized in Table 1.

Each patient was appraised as multidisciplinary with an endovascular surgical team for the best treatment. Microsurgery was preferred in 11 patients due to multiple aneurysms and in the remaining nine patients because of the difficulty in maintaining the parent artery. Surgery was performed as early as possible to eliminate the risk of hemorrhage. Wide frontotemporal approach was used for patients with multiple aneurysms, and interhemispheric approach was used for patients with isolated DACA aneurysms. In total, 20 patients with DACA aneurysms were clipped. Wrapping was performed to infundibular aneurysm. Eleven patients with multiple aneurysms had 23 aneurysms apart from the DACA aneurysm. Sixteen of them were clipped and seven of them were treated endovascularly.

Table 1. Physical, neurological examination, and radiological findings of patients

Age/sex	İnitial GCS	WFNS	Anv diameter	Localization	SAH	Multiple anv	mRS
52/M	13	2	3 mm, 6 mm	A3+A4	+	R and L MCA bif	0
72/W	12	4	6 mm	A3	+	R MCA M1, R, and L ICA	5
51/M	13	2	3 mm	A3	+	Acom A	0
42/M	13	2	6 mm	A3	+	-	0
49/M	13	2	6 mm	A3	+	-	0
61/M	13	2	7 mm	A3	+	-	0
57/M	13	3	5 mm	A4	+	-	0
59/W	14	2	6 mm	A3	+	L PcomA, R MCA bif.	1
62/W	13	3	7 mm	A3	+	AcomA, R MCA bif.	0
56/W	13	2	5 mm	A3	+	AcomA, L MCA bif	1
52/W	13	2	3 mm	A3	+	-	0
50/M	12	4	8 mm	A3	+	-	0
59/W	13	2	7 mm	A3	+	-	0
44/M	13	3	5 mm	A3	+	L Pcom, R MCA bif	0
64/M	14	2	4 mm	A3	+	-	0
63/M	14	2	8 mm	A3	+	-	0
69/W	15	1	6 mm	A3	-	R and L MCA M1	1
79/W	15	1	5 mm	A3	-	AcomA, R and L MCA bif	5
65/W	15	1	5 mm	A3	-	AcomA, L MCA M1	0
87/W	14	2	6 mm	A3	+	R ICA, R MCA	6

AcomA: Anterior communicating artery; Anv: Aneurysm; Bif: Bifurcasyo; DACA: Distal anterior cerebral artery; GCS: Glasgow Coma Scale; ICA: Internal carotid artery; L: Left; R: Right; M: Men; W: Women; MCA: Middle cerebral artery; mRS: Modified Rankin scale; PComA: Posterior communicating artery; SAH: Subarachnoid hemorrhage; WFNS: World Federation of Neurological Surgeons.

Results

Clinical Properties

In this study, 20 patients (10 women and 10 men) between 42 and 87 years were evaluated. The mean age was 59 years. Seventeen patients presented with subarachnoid hemorrhage (SAH) and the initial WFNS score was 2 in 12, 3 in 3, and 4 in 2.

Radiological Properties

In total, 20 patients were diagnosed with DACA aneurysms. SAH was found in 17 patients. All patients had saccular aneurysms and one of them was accompanied by infundibular aneurysm. Furthermore, 18 of the aneurysms were located in the pericallosal-callosomarginal artery division (86%); two of them were located in the A4–A5 level (9%); and the remaining one was located in the proximal area of the frontopolar branch (5%). Some patients with SAH were accompanied by intraventricular or intracerebral hemorrhage (ICH) (Fig. 2). In addition, 13 aneurysms were located in the right hemispheres, whereas eight were located in the left hemispheres.

The diameter of the aneurysms was 3–8 mm (mean diameter 4.8 mm). Totally, 11 patients had coexisting aneurysms (Fig. 3). During the surgical treatment of these patients, all coexisting aneurysms were treated by clipping during the same session or endovascular treatment in other session.

Surgical Approaches

Interhemispheric approach was performed for nine patients with isolated DACA aneurysm, and frontotemporal approach was performed for 11 patients with multiple aneurysms. In addition, 13 patients underwent surgery on the right side and seven patients underwent surgery on the left side. Many of the aneurysms localized on the opposite sides in patients with multiple aneurysms were clipped with unilateral approach during the same session. Endovascular intervention was performed on those who were not suitable for clipping.

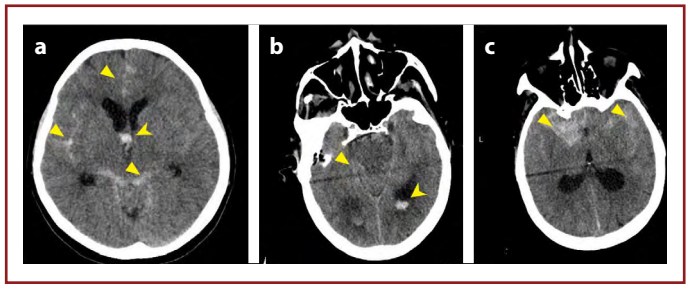

Figure 2. (a, b) Subarachnoid hemorrhage (SAH) with intraventricular hemorrhage; **(c)** isolated SAH.

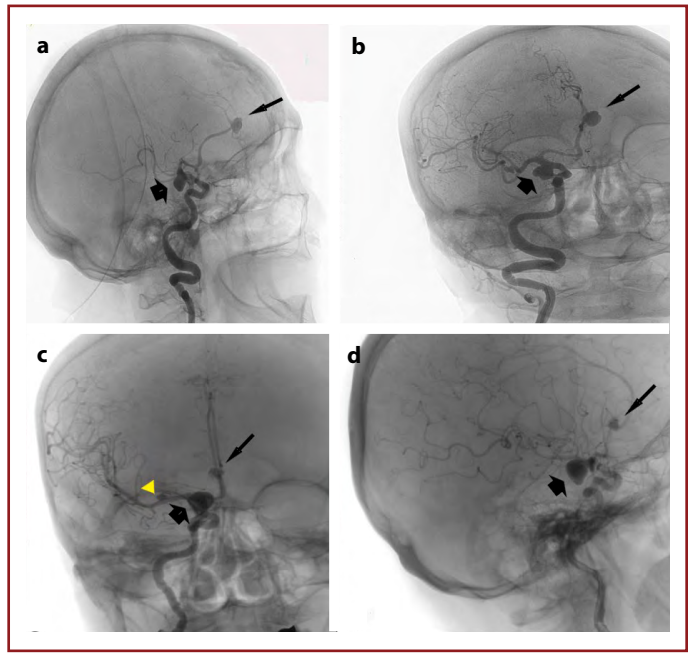

Figure 3. Angiographic properties of multiple aneurysms in distal anterior cerebral artery (DACA). **(a, b)** DACA (long arrow) and internal carotid artery (ICA) (thick arrow) aneurysms, **(c, d)** middle cerebral artery (yellow arrow), DACA (long arrow), and ICA (thick arrow) aneurysms.

Surgical Results

In total, 15 of the patients were discharged with 0 mRS and two of them were discharged with 1 mRS. Two patients were sent to palliative care center with 5 mRS. One elder patient had multiple aneurysms and had SAH died. Postoperative vasospasm was observed in three of 20 patients. Medical treatments such as intra-arterial nimodipine improved the symptoms of these patients.

Perioperative Hydrocephaly and Shunt

Ventricular drainage was implemented to one patient with multiple aneurysms during hospitalization and one patient developed shunt-dependent hydrocephaly 1 month following surgery.

Discussion

Considering vast literature series, the incidence of DACA aneurysms is estimated to be 1.5–9% of all intracranial aneurysms[1,2,6,7]. Incidence in our series was 4.86%. Although higher incidence of DACA aneurysms is observed in women,[2,8] the number of women and men was equal in our series and a few other studies[1,9]. Most DACA aneurysms are saccular and localized at the pericallosal-callosomarginal bifurcation on the corpus callosum genus[2,8,10]. Aneurysms located on the pericallosal and frontopolar artery junction and the distal of the pericallos-

al-callosomarginal bifurcation are rare[2,7,11]. In our series, 20 DACA aneurysms were saccular and one accompanying was infundibular. They were located at pericallosal-callosomarginal artery in 19 patients, pericallosal frontopolar division in one patient, and A4–A5 level in one patient. DACA aneurysms are generally small in size[1,2,4,6,8,12,13]. Ohno et al.[6] detected that 36 of 49 patients had aneurysms that are 5 mm and/or smaller in size. In the series of Lehecka et al.,[14] it was shown that 51% of ruptured DACA aneurysms were smaller than 7 mm in terms of diameter. Therefore, incidentally detected DACA aneurysms must be treated and this condition should not be overlooked.

According to the previous studies, DACA aneurysm is seen with ICH 17–73% more frequently than aneurysms in other sites of the brain arteries[7,8,15,16]. In a study which reported by Lehecka et al.,[11] ICH rate in ruptured DACA aneurysms was reported as 53% compared with the other study which has ICH rate of 25% in ruptured aneurysms. In our series, none of the 20 patients had ICH. This high ICH rate in other studies conducted by other groups may be caused by the tight connection between the narrow pericallosal cistern and adjacent brain surfaces. In a study reported by Thomas and Paterson, no direct relation was observed between clinical results and ICH[9]. Wisoff and Flamm emphasized that lack of ICH is correlated with better outcomes, and patients with ICH and clinical vasospasm had worse outcomes[17].

The relationship between DACA aneurysms and multiple aneurysms is well known fact, which was reported as 46.4% by Hernesniemi et al.,[18] 42.9% by Ohno et al.,[6] and 38.5% by Yasargil et al.[2] In our series, 11 patients (55%) had multiple aneurysms. In a study reported by Petr et al.,[7] mortality rate was reported as 6%. In our study, two patients with clinically worse outcomes (mRS 5) and one exitus patient had no ICH, however, they had multiple aneurysms and were elder in age. We believe that existence of multiple aneurysm and elder age had negative impact on the discharge scores of patients.

Compared with different aneurysms in other localizations, it was observed that surgical intervention was difficult due to certain specific factors for DACA aneurysms[1,2,7,8,14,17,19,20]. Requirement of deep approach through the interhemispheric gap, lack of anatomic landmarks, tight cohesions, and aneurysm dome commonly embedded into the brain tissue surface are some challenges of surgical treatment of DACA aneurysms. Furthermore, widely settling of DACA aneurysms on the branch arteries close to the base due to their morphological properties is another challenge of their surgical treatment. Aneurysm dome generally projecting toward the surgeon's field of vision may cause the aneurysm to rupture before its neck is detected. These aneurysms can rupture even if the frontal lobe surface and falx retraction is performed gently[2,10]. Therefore, intraoperative rupture is a common complication. In our series, interhemispheric approach was used for nine patients with isolated DACA aneurysm, and wide frontotemporal approach was used for 11 patients with multiple aneurysms. Intraoperative rupture was only seen in one patient.

Endovascular treatment of DACA aneurysms is difficult due to their small size, relatively broad neck, and proximity of the origin of the branches to the base. Moreover, distal location of the aneurysm and small diameter of main vein are the other adversities. Some authors reported that they obtained convincing results following coiling of DACA aneurysm[4,21]. In addition, microsurgery clipping is the primary treatment method for DACA aneurysms despite their intraoperative difficulties, however, endovascular treatment can be considered an alternative for surgical treatment.

Conclusion

DACA aneurysms are generally smaller in diameter. They are more related to multiple aneurysms compared with aneurysms in other sites. Microsurgery clipping is a safe and effective method for treatment. Factors that negatively affect the prognosis of the patients are age, multiple aneurysms, ICH, re-hemorrhage, intraventricular hemorrhage, and existence of pre-operative hydrocephaly. Despite all developments in microsurgery techniques and anesthesia, DACA aneurysms still have high rate of morbidity and mortality compared to other supratentorial aneurysms. In addition, the experience and skills of the neurosurgeon, condition of the surrounding veins, and relationship among DACA aneurysms are important for surgical treatment of these aneurysms. Even if DACA aneurysms with small diameters are detected, they should be treated with early microsurgery.

Ethics Committee Approval: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions: Concept: A.A.; Design: İ.İ.; Data Collection or Processing: A.A.; Analysis or Interpretation: İ.İ.; Literature Search: İ.İ.; Writing: A.A.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study received no financial support.

References

1. Otani N, Takasato Y, Masaoka H, Hayakawa T, Yoshino Y, Yatsushige H, et al. Clinical features and surgical outcomes of ruptured distal anterior cerebral artery aneurysms in 20 consecutively managed patients. J Clin Neurosci 2009;16:802–6.
2. Yaşargil MG, Carter LP. Saccular aneurysms of the distal anterior cerebral artery. J Neurosurg 1974;40:218–23. [CrossRef]
3. Kawashima M, Matsushima T, Sasaki T. Surgical strategy for distal anterior cerebral artery aneurysms: Microsurgical anatomy. J Neurosurg 2003;99:517–25. [CrossRef]
4. Menovsky T, van Rooij WJ, Sluzewski M, Wijnalda D. Coiling of ruptured pericallosal artery aneurysms. Neurosurgery 2002;50:11–5. [CrossRef]
5. Lehecka M, Porras M, Dashti R, Niemelä M, Hernesniemi JA. Anatomic features of distal anterior cerebral artery aneurysms: A detailed angiographic analysis of 101 patients. Neurosurgery 2008;63:219–29. [CrossRef]
6. Ohno K, Monma S, Suzuki R, Masaoka H, Matsushima Y, Hirakawa K. Saccular aneurysms of the distal anterior cerebral artery. Neurosurgery 1990;27:907–13. [CrossRef]
7. Petr O, Coufalová L, Bradáč O, Rehwald R, Glodny B, Beneš V. Safety and efficacy of surgical and endovascular treatment for distal anterior cerebral artery aneurysms: A systematic review and meta-analysis. World Neurosurg 2017;100:557–66.
8. Steven DA, Lownie SP, Ferguson GG. Aneurysms of the distal anterior cerebral artery: Results in 59 consecutively managed patients. Neurosurgery 2007;60:227–34. [CrossRef]
9. Thomas DG, Paterson A. Results of surgical treatment of pericallosal aneurysms. J Neurol Neurosurg Psychiatry 1975;38:826. [CrossRef]
10. Cohen JE, Rajz G, Itshayek E, Shoshan Y, Umansky F, Gomori JM. Endovascular management of traumatic and iatrogenic aneurysms of the pericallosal artery. Report of two cases. J Neurosurg 2005;102:555–7. [CrossRef]
11. Lehecka M, Dashti R, Hernesniemi J, Niemelä M, Koivisto T, Ronkainen A, et al. Microneurosurgical management of aneurysms at A3 segment of anterior cerebral artery. Surg Neurol 2008;70:135–52. [CrossRef]
12. Kwon TH, Chung HS, Lim DJ, Park JY, Park YK, Lee HK, et al. Distal anterior cerebral artery aneurysms: Clinical features and surgical outcome. J Korean Med Sci 2001;16:204–8. [CrossRef]
13. Kassell NF, Torner JC, Haley EC Jr, Jane JA, Adams HP, Kongable GL. The international cooperative study on the timing of aneurysm surgery. Part 1: Overall management results. J Neurosurg 1990;73:18–36. [CrossRef]
14. Lehecka M, Niemelä M, Seppänen J, Lehto H, Koivisto T, Ronkainen A, et al. No long-term excess mortality in 280 patients with ruptured distal anterior cerebral artery aneurysms. Neurosurgery 2007;60:235–40. [CrossRef]
15. Chhabra R, Gupta SK, Mohindra S, Mukherjee K, Bapuraj R, Khandelwal N, et al. Distal anterior cerebral artery aneurysms: Bifrontal basal anterior interhemispheric approach. Surg Neurol 2005;64:315–20. [CrossRef]
16. Kiyofuji S, Sora S, Graffeo CS, Perry A, Link MJ. Anterior interhemispheric approach for clipping of subcallosal distal anterior cerebral artery aneurysms: Case series and technical notes. Neurosurg Rev 2020;43:801–6. [CrossRef]
17. Wisoff JH, Flamm ES. Aneurysms of the distal anterior cerebral artery and associated vascular anomalies. Neurosurgery 1987;20:735–41. [CrossRef]
18. 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.
19. Carvi y Nievas MN. The influence of configuration and location of ruptured distal cerebral anterior artery aneurysms on their treatment modality and results: Analysis of our casuistry and literature review. Neurol Res 2010;32:73–81. [CrossRef]
20. Dinc C, Iplikcioglu AC, Bikmaz K. Distal anterior cerebral artery aneurysms: Report of 26 cases. Neurol Med Chir (Tokyo) 2006;46:575–80. [CrossRef]
21. Keston P, White PM, Horribine L, Sellar R. The endovascular management of pericallosal artery aneurysms. J Neuroradiol 2004;31:384–90. [CrossRef]