

Aneurysms of the distal anterior cerebral artery: a clinical series

Tętniaki tętnicy mózgu przedniej w odcinku dystalnym: analiza kliniczna

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Abstract

Background and purpose: Distal anterior cerebral artery (DACA) aneurysms, also called pericallosal or A2 aneurysms, are rare and comprise about 1.5 to 9% of all intracranial aneurysms. In this study, a series of 10 patients with DACA aneurysms who were surgically treated in our clinic is presented and discussed, focusing on their clinical features and surgical outcomes.

Material and methods: A total of 344 patients with cerebral aneurysms were operated on in our clinic and 10 patients (2.9%) with DACA aneurysms were studied retrospectively. All patients underwent a computed tomography (CT) scan followed by four-vessel digital subtraction angiography (DSA).

Results: Initial CT revealed intracerebral haematoma (ICH) in 7 patients (70%) and in 2 of them the haematoma was over 3 cm in diameter. The pericallosal-callosomarginal bifurcation was the most common location in 9 patients (90%). Four cases (40%) showed multiple aneurysms. The mean waiting time for the operation was 4.8 days. Surgical clipping was performed in all the cases. Multiple aneurysms required two different craniotomies in the same session. The patients with ICH over 3 cm in diameter, in addition to poor preoperative grade, are likely to have a poor outcome, and so clinical grade is the definite factor affecting the surgical outcome of patients.

Conclusions: DACA aneurysms are usually small and bleeding occurs irrespective of their size because of the lack of resistant arachnoid membranes at the level of the pericallosal cisterns. All DACA aneurysms, even if very small in size or discovered incidentally, should be aggressively treated because of the high tendency to rupture.

Key words: cerebral aneurysm, distal anterior cerebral artery, pericallosal artery, surgical treatment.

Streszczenie

Wstęp i cel pracy: Tętniaki tętnicy mózgu przedniej w odcinku dystalnym (*distal anterior cerebral artery* – DACA), określane również jako tętniaki tętnicy okołospoidłowej lub A2, są rzadkie i stanowią 1,5–9% wszystkich tętniaków śródczaszkowych. W pracy przedstawiono objawy kliniczne i wyniki leczenia chirurgicznego w serii 10 pacjentów z DACA leczonych w ośrodku autorów.

Materiał i metody: W ośrodku autorów operowano dotąd 344 pacjentów z tętniakami mózgu; przeanalizowano retrospektywnie dane 10 pacjentów (2,9%) z tętniakami DACA. U wszystkich chorych wykonano tomografię komputerową (TK) głowy, a następnie czteronaczyniową cyfrową angiografię subtrakcyjną naczyń mózgowych.

Wyniki: Obecność krwiaka śródmózgowego stwierdzono w pierwszej TK u 7 chorych (70%) – u 2 średnica krwiaka przekraczała 3 cm. Najczęstszą lokalizacją tętniaka było miejsce podziału na tętnicę okołospoidłową i spoidłowo-brzezną (9 pacjentów, 90%). W 4 przypadkach (40%) stwierdzono tętniaki mnogie. Średni czas do operacji wyniósł 4,8 dnia. We wszystkich przypadkach wykonywano chirurgiczne klipowanie tętniaka. W przypadkach tętniaków mnogich konieczne było wykonanie drugiej kraniotomii podczas tego samego zabiegu. Większe prawdopodobieństwo niekorzystnego wyniku leczenia dotyczy, oprócz chorych z niekorzystną punkcją kliniczną przed zabiegiem, również pacjentów z krwiakiem śródmózgowym o średnicy > 3 cm. Stopień w ocenie klinicznej jest jednoznacznym czynnikiem określającym wynik leczenia chirurgicznego.

Wnioski: Tętniaki DACA są zwykle małe, a krwawienie pojawia się niezależnie od ich rozmiaru, ze względu na brak stawiających opór błon pajęczynówki na poziomie zbiorników

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okołospoidłowych. Wszystkie tętniaki DACA, nawet małe lub stwierdzone przypadkowo, powinny być leczone zdecydowanie, ze względu na ich dużą skłonność do pęknięcia.

Słowa kluczowe: tętniak mózgu, dystalny odcinek tętnicy mózgu przedniej, tętnica okołospoidłowa, leczenie chirurgiczne.

Introduction

Distal anterior cerebral artery (DACA) aneurysms, also called pericallosal or A2 aneurysms, are rare and comprise about 1.5 to 9% of all intracranial aneurysms [1-6]. DACA refers to the segment of the anterior cerebral artery (ACA) distal to the segment of the anterior communicating artery (ACoM). DACA aneurysms are known to have a poor clinical course and prognosis, even being referred to as malignant aneurysms [7]. Various technical difficulties and some unique problems during surgery may result in a less favourable outcome, including difficulty in establishing proximal control, narrow surgical corridor in the interhemispheric fissure, and sometimes firm adhesions that make the dissection of the aneurysm extremely difficult. 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 the present study, a series of 10 patients with DACA aneurysms who were surgically treated in our clinic over a 12-year period is presented and discussed, focusing on their clinical features and surgical outcomes.

Material and methods

A total of 344 patients with cerebral aneurysms were operated on in our clinic in the period of 1994-2006 and 10 patients (2.9%) with DACA aneurysms were studied retrospectively (Table 1). There were 7 females (70%) and 3 males (30%) with a mean age of 54 years (range 27 to 84 years). Their male-female ratio was 1 : 2.3. One patient had her aneurysm discovered incidentally, and the remaining patients presented with subarachnoid haemorrhage. None of the aneurysms was of mycotic or traumatic origin. The patients were clinically classified according to Hunt-Hess grades. According to this classification, 6 patients were grade I (60%), 2 patients were grade II (20%), one case was grade 0 (10%) and the other one was grade III (10%).

All patients underwent a computed tomography (CT) scan followed by four-vessel digital subtraction angiography (DSA). The haemorrhage was mostly located in the interhemispheric space. Initial CT revealed intracerebral haematoma (ICH) in 7 patients (70%) and in 2 of them the haematoma was over 3 cm in diameter. All aneurysms in our series were saccular and the pericallosal-callosomarginal bifurcation was the most common location in 9 patients (90%). In 1 case, it was located at the bifurcation of the frontopolar artery. All patients had their aneurysms on the right side. As to the size, 6 cases (60%) had small aneurysms (diameter < 6 mm), 3 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, 4 cases showed multiple aneurysms (40%): 2 cases had an additional aneurysm on the ipsilateral middle cerebral artery (MCA) and the others had one on the ACoM. No associated vessel anomaly was found except for hypoplasia of A1 in 1 case.

Results

In all cases, we performed the operations using the interhemispheric approach with a frontal paramedian craniotomy anterior to the coronal suture. The frontopolar aneurysm was treated through a basal frontal parasagittal craniotomy for the interhemispheric approach with bicoronal skin incision. None in this series were operated on in the acute phase of bleeding and the mean waiting time for the operation was 4.8 days (range 3-6 days). Delay of surgery was mainly because of delayed referral. In our series, we found that 56% (5) of ruptured distal ACA aneurysms were small, 33% (3) were medium and 11% (1) were large. Two patients had angiographic vasospasm and only 1 patient progressed to clinically significant vasospasm. Surgical clipping was performed in all the cases. Multiple aneurysms required two different craniotomies in the same session. Intraoperative premature rupture occurred in 2 cases, both of them clipped successfully. In one, temporary clip application was performed and it did not affect the final outcome.

The surgical outcome was scored according to the Glasgow Outcome Scale (GOS). Nine cases resulted in good recovery (90%) and 1 case showed moderate disability (10%). That case had only postoperative morbidity (mild hemiparesis) related to vasospasm and she experienced complete resolution of symptoms after a year. The remaining 9 patients who would have been graded as normal (GOS score = 5) felt that they were able to return to work or to their previous life style without modifications at the 6-month follow-up. All patients underwent postoperative DSA, usually 8 weeks after the surgery. Inappropriate clip application was detected in 1 patient (case 10) and reoperated (Fig. 1). Long-term follow-up was carried out either by clinical examination or telephone interview.

Discussion

Distal anterior cerebral artery aneurysm is a rare aneurysm, occurring in the anterior circulation. Mostly the incidence has been less than 5% [1-3,8]; this study also showed an incidence of 2.9%. These aneurysms are frequently associated with additional aneurysms of the cerebral circulation. 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.* reported an incidence of 46.4% [9], Ohno *et al.* reported 42.9% [4], Yasargil and Carter reported 38.5% [6] and Kwon *et al.* reported 58% [1]. In our series, this incidence was 40% and they were located on the MCA and AComA. We agree that every patient with DACA aneurysm should be evaluated for additional aneurysms in the cerebral circulation.

Distal anterior cerebral artery aneurysms are usually small. We found 6 aneurysms (60%) measuring from 3 to 6 mm, 3 aneurysms were medium in size (30%) and only one was large (10%). None of them was giant. The rare incidence of them can be explained by their tendency to rupture before they become large. Bleeding occurs irrespective of their size because of the lack of resistant arachnoid membranes at the level of the pericallosal cisterns [10]. A review found that 67% of ruptured DACA aneurysms were less than 6 mm [4]. Therefore, we also recommend early surgery for small incidental aneurysms due to this early bleeding tendency.

Most DACA aneurysms are saccular and the majority are located at the pericallosal-callosomarginal artery bifurcation on the genu of the corpus callosum [2,6]. Aneurysms at the junction of the pericallosal and fron-

Table 1. Summary of 10 cases with distal anterior cerebral artery aneurysms

Case No.	Age (years)/sex	Ruptured aneurysm	Preoperative Hunt-Hess grade	ICH on CT scan	Aneurysm size	Side (R/L)	Location	Coexisting aneurysm	Events	Glasgow Outcome Scale*
1	27/F	Yes	I	No	Small	Right	PC-CM	-		5
2	84/F	Yes	II	< 3 cm	Medium	Right	PC-CM	MCA	Vasospasm	4
3	66/M	Yes	I	< 3 cm	Small	Right	PC-CM	AComA		5
4	47/M	Yes	I	No	Small	Right	FP	-		5
5	55/F	Yes	I	< 3 cm	Small	Right	PC-CM	AComA	Intraoperative rupture	5
6	42/F	No	0	No	Small	Right	PC-CM	-		5
7	70/F	Yes	I	< 3 cm	Small	Right	PC-CM	MCA	Intraoperative rupture	5
8	39/M	Yes	II	> 3 cm	Medium	Right	PC-CM	-	Vasospasm	5
9	41/F	Yes	III	> 3 cm	Large	Right	PC-CM	-	Vasospasm	5
10	42/F	Yes	I	< 3 cm	Medium	Right	PC-CM	-	Re-operation	5

ICH – intracerebral haematoma, CT – computed tomography, PC – pericallosal artery, CM – callosomarginal artery, FP – frontopolar artery, AComA – anterior communicating artery
*Glasgow outcome scale score: 5 – good recovery, 4 – moderate disability

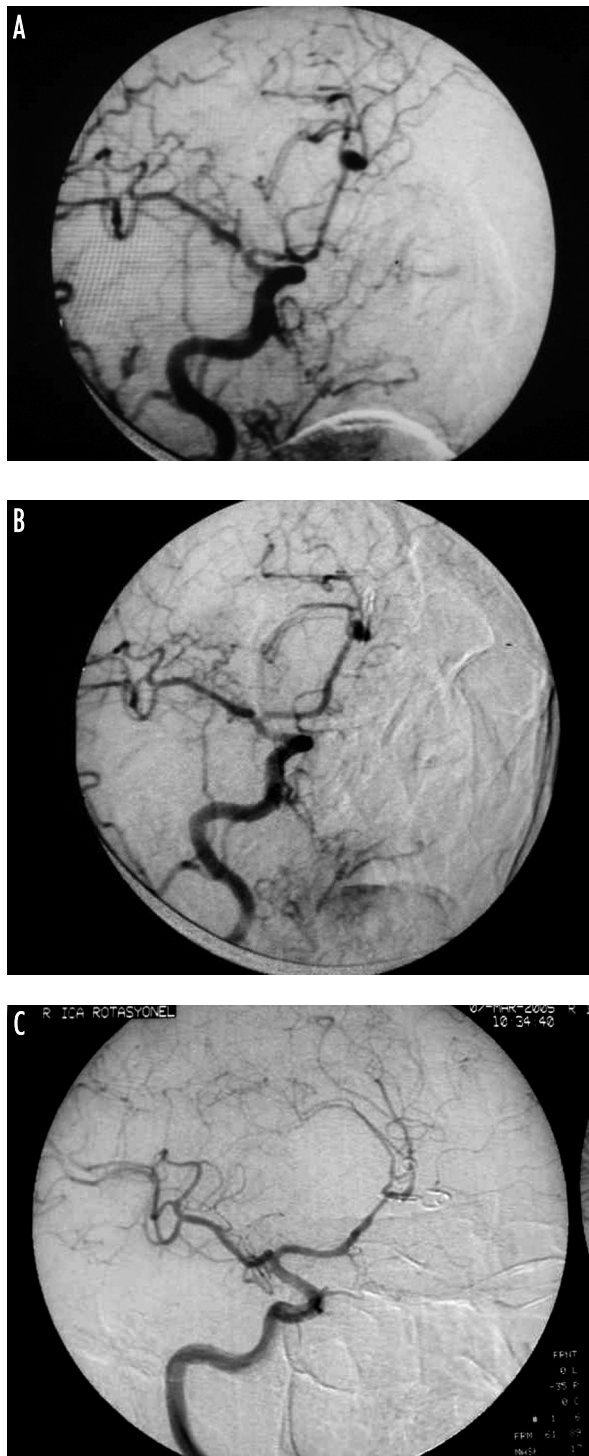


Fig. 1. Preoperative angiogram of the right carotid artery showing the aneurysm at the pericallosal-callosomarginal artery bifurcation on the genu of the corpus callosum (1A). Postoperative control angiogram showing the inappropriate clip application (1B); after reoperation it reveals no residual filling of the clipped distal anterior cerebral aneurysm (1C)

topolar arteries and the distal pericallosal and callosomarginal bifurcations are rare. All aneurysms in our series were saccular and the pericallosal-callosomarginal bifurcation was the most common location in 9 cases (90%).

Distal anterior cerebral artery aneurysms present some unique difficulties in surgery related either to the aneurysm itself or to the surgical approach. These include the narrowness of the working space in the interhemispheric fissure and callosal cistern, the possibility of dense adherence between the cingulate gyri, and the frequency of broad-based and sclerotic aneurysms in this location. Another potential difficulty is that the dome of the aneurysm may adhere to the pial layer or even extend into the cingulate gyrus, making retraction of the frontal lobe dangerous because it could cause premature rupture before identification of the vascular anatomy. In our series, two cases (20%) developed an aneurysmal rupture during the dissecting procedure and one required temporary clipping of the parent artery during the surgery. The rupture did not greatly affect their final outcome.

In the literature, a number of surgical approaches have been described for DACA aneurysms. Fukushima *et al.* recommended the unilateral interhemispheric key hole for anterior midline aneurysms [11]. The standard pterional approach with resection of the gyrus rectus has been used for fronto-basal or proximally located aneurysms [9,12]. DeSouza *et al.* described three different approaches to DACA aneurysms, all of them performed through a unilateral bone flap which varied from frontobasal to parietal depending on the location of the aneurysm [2]. Traynelis and Dunker used a small anterior callosotomy to obtain proximal control of the feeding artery [13]. Despite so many surgical techniques, most authors at present favour the unilateral (either I-, C- or U-shaped flaps) frontal paramedian craniotomy with an interhemispheric approach. In all cases, we performed the operations using this approach. During the procedure cingulate resection or partial callosal resection, along either the commissure or the genu, is recommended to gain control of the anterior cerebral artery proximal to the origin of the callosomarginal artery so as to improve the exposure without causing disconnection syndrome [13]. We did not perform resection of the genu of the corpus callosum in any patient. We agree that minimal retraction of the brain and preservation of the bridging veins will reduce the risk of postoperative complications.

The other debatable factor affecting the mortality and morbidity may be the presence of other aneurysms, and either two-stage surgery in two different sessions [2,3] or two craniotomies at the same sitting [6,8] are recommended. In our series, we performed two different craniotomies in the same session in four cases with multiple aneurysms. We agree that performing two craniotomies in the same sitting does not increase surgical morbidity and mortality, while clipping of multiple aneurysms would facilitate aggressive hyperdynamic therapy in the postoperative period without danger of rupture from an untreated aneurysm.

Lastly, the presence of intracerebral haematoma (ICH) related to rupture of DACA aneurysms is more frequent compared with those aneurysms in other areas and has been reported at between 48 and 73% in the literature [4-6,14]. In our series, it was 70%, but most of them (71.4%, 5 haematomas out of 7) were small (< 3 cm) haematomas. Miyazawa *et al.* reported that patients with ICH of diameter greater than 3 cm had a poor outcome [15]. Thomas and Paterson observed ICH in 50% of their cases, which did not affect the final outcome [16]. However, Wisoff and Flamm noted that patients of a good grade did not have ICH, while ICH and clinically significant vasospasm were observed in the grade III and IV patients [5]. According to our study, 3 patients out of 7 who had ICH preoperatively experienced significant vasospasm and their preoperative grades were II, II and III according to the Hunt-Hess classification. With respect to the surgical outcome, only one showed moderate disability postoperatively. Although there was no statistical significance due to an inadequate number of cases, ICH showed negative implications for both the clinical course and the final surgical outcome. We agree that patients with ICH over 3 cm in diameter, in addition to poor preoperative grade, are likely to have a poor outcome, and so clinical grade is the definite factor affecting the surgical outcome of patients.

Despite the use of advanced technology, endovascular occlusion of DACA aneurysm is demanding because of their small size, relatively wide neck, branches originating close to the base, small calibre of the parent artery, and distal location of the aneurysm. In a few small series, the rate of total occlusion was lower than that with microsurgical clipping and such series are too small to evaluate the long-term clinical outcome after coiling of DACA aneurysms. Thus the high incidence of ICH in patients with ruptured DACA aneurysms also favours microsurgery [17-22].

Conclusions

1. Distal anterior cerebral artery aneurysms, although infrequent, pose a challenge for the practising neurosurgeon, with higher morbidity and mortality compared with other aneurysms of the anterior circulation.
2. All DACA aneurysms, even if very small or discovered incidentally, should be aggressively treated because of the high tendency to rupture. In the past, they showed very high morbidity and mortality rates. However, with the help of further understanding of the vascular anatomy and appropriate microsurgical techniques, surgical treatment with significantly low morbidity and mortality rates has become valid.

Disclosure

Authors report no conflict of interest.

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