Distal Anterior Cerebral Artery Aneurysms
—Report of 26 Cases—

Cem DINC, Ahmet Celal IPLIKCIOGLU, and Kerem BIKMAZ

Neurosurgery Clinic, Ministry of Health Okmeydani Education and Research Hospital, Istanbul, Turkey

Abstract
Distal anterior cerebral artery (ACA) aneurysms are rare, and constitute approximately 1.5% to 9% of all intracranial aneurysms. They show some unique features compared with other aneurysms in the cerebral circulation and are frequently treated with a different technique. Twenty-six of 364 patients with cerebral aneurysms treated at our department between 1996 and 2004 had distal ACA aneurysms (7.1%). Twenty-three of the 26 patients were treated through an anterior interhemispheric approach and two with a pterional approach. All saccular aneurysms were successfully clipped except one which was embolized after the surgery. The only fusiform aneurysm spontaneously thrombosed and resolved with parent artery occlusion. Two of the 26 patients had multiple aneurysms. The surgical mortality was 8%. Distal ACA aneurysms have higher mortality and morbidity than other anterior circulation aneurysms. They should be aggressively treated even if very small because of the tendency to rupture. Endovascular treatment is an alternative in the management of these aneurysms. The most important factors affecting the outcome are grade on admission and the neurosurgeon’s experience.

Key words: aneurysm, distal anterior cerebral artery, interhemispheric approach

Introduction
Distal anterior cerebral artery (ACA) refers to the segment of the ACA distal to the anterior communicating artery. Aneurysms of the distal ACA account approximately 1.5% to 9% of all aneurysms in the cerebral circulation, and are usually located at the pericallosal-callosomarginal bifurcation. Aneurysms of the anterior circulation are generally treated through a pterional approach, but aneurysms of the distal ACA are best treated through an interhemispheric approach. Various technical difficulties and some unique problems during surgery may result in less favorable outcome, including difficulty in establishing proximal control, narrow surgical corridor in the interhemispheric fissure, and arid and sometimes firm adhesions that make the dissection extremely difficult.

The present study describes a series of 26 patients with 27 distal ACA aneurysms who were treated in our hospital over an 8-year period.

Clinical Materials and Methods
A total of 364 patients with cerebral aneurysms were treated at our department between 1996 and 2004. Twenty-six of these 364 patients had distal ACA aneurysms (7.1%), 14 men and 12 women aged from 25 to 72 years (mean 47.9 years), who were treated for 27 distal ACA aneurysms (Table 1). Only two cases were incidentally discovered (Yasargil grade 0a), whereas the others manifested as subarachnoid hemorrhage. The hemorrhage was mostly located in the interhemispheric space (Fig. 1). Initial computed tomography (CT) revealed intracerebral hematoma (ICH) in four patients. The aneurysms were located at the pericallosal-callosomarginal bifurcation in 13 cases (Fig. 2), the pericallosal artery in eight, and the callosomarginal artery in six. No associated vessel anomaly was found in any patient. Twenty-six of the 27 aneurysms were saccular. Only one fusiform aneurysm spontaneously thrombosed and resolved with parent artery occlusion. None of the aneurysms was mycotic or traumatic in origin. One patient had an additional aneurysm on the ipsilateral middle cerebral artery (MCA). One patient had four aneurysms, two located on the bilateral pericallosal arteries in mirror positions, and the other two locat-
Table 1  Twenty-six patients with distal anterior cerebral artery (ACA) aneurysms

<table>
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<tr>
<th>Case No.</th>
<th>Age (yrs)/Sex</th>
<th>Grade on admission*</th>
<th>ICH</th>
<th>Distal ACA aneurysm</th>
<th>Aneurysm size (mm)</th>
<th>Preoperative deficit</th>
<th>Multiple aneurysms</th>
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<td>saccular</td>
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*According to Yasargil subarachnoid hemorrhage scale. GOS: Glasgow Outcome Scale, ICH: intracerebral hematoma, MCA: middle cerebral artery.

Fig. 1  Cranial axial computed tomography scan demonstrating hemorrhage in the interhemispheric fissure with subarachnoid hemorrhage.

Fig. 2  Lateral carotid angiograms showing typical distal anterior cerebral artery aneurysms.

ed on the right MCA. Only a few cases of mirror aneurysms located on the pericallosal artery are known.15,17,23) The 23 patients in grade 2b or better were treated within 4 days of the bleeding. The other two patients in grade 3b were treated 14 days after the bleeding.
Fig. 3 Postoperative lateral carotid angiogram revealing no residual filling of the clipped distal anterior cerebral artery aneurysm.

Results

Surgical clipping was successfully performed in 24 of the 25 patients. One aneurysm could not be clipped intraoperatively, so was embolized postoperatively. One patient in grade 3b with hemiparesis died 4 days after the surgery of cardiopulmonary arrest. Another patient in grade 2a died on the 2nd postoperative day of ICH in the frontal region. The surgical mortality was 8%. One patient was admitted with nonspecific complaints. Cranial CT showed a mass lesion in the frontal region. Magnetic resonance imaging and digital subtraction angiography showed a giant fusiform distal ACA aneurysm that later thrombosed and resolved. One patient developed mild upper limb weakness and another developed seizures which were controlled with diphenylhydantoin. Four patients had preoperative hemiparesis, which did not change after surgery in two patients and improved in one patient. One patient with preoperative seizures had no additional seizures in the 36-month follow-up period. One patient developed hydrocephalus in the postoperative period which resolved after serial lumbar punctures.

Interhemispheric and pterional approaches were performed depending on the aneurysm locations according to the lateral view of digital subtraction angiography. Two frontobasal aneurysms were treated through a pterional craniotomy. Aneurysms on the genu of the corpus callosum were treated via a frontobasal craniotomy and high frontal parasagittal approach with bicornal skin incision. Aneurysms distal to the genu of the corpus callosum were treated via high frontal parasagittal craniotomy for an interhemispheric approach with bicornal skin incision. Multiple aneurysms required two different craniotomies in the same session. All patients underwent postoperative digital subtraction angiography, usually 4 weeks after the surgery. No residual filling was detected in any of the patients (Fig. 3). Long-term follow up was achieved either by clinical examination or telephone interview.

Discussion

Distal ACA aneurysms account for about 1.5% to 9% of all intracranial aneurysms, and 7.1% in our series. Although female predominance is reported, we observed a slight male predominance (14 males, 12 females). These aneurysms are frequently associated with additional aneurysms of the cerebral circulation. Multiple aneurysms occurred in 49.2%, 50%, and 55% of such cases. A series of 72 patients with distal ACA aneurysms included 44.4% with multiple aneurysms. There is a special association with MCA aneurysm. In contrast, our series included only two patients (7.7%) with multiple aneurysms. However, we agree that every patient with distal ACA aneurysm should be evaluated for additional aneurysms in the cerebral circulation.

Distal ACA aneurysms are frequently associated with congenital anomalies of the ACA. The most common patterns have been described. Interestingly, we did not notice any vascular variation in our patients.

Most distal ACA aneurysms are saccular and the majority are located at the pericallosal-callosomarginal artery bifurcation on the genu of the corpus callosum. Aneurysms at the junction of the pericallosal and frontopolar arteries and the distal pericallosal and callosomarginal bifurcations are rare. Aneurysms located either proximal or distal to the genu are often related to trauma, infection, or vascular anomalies. Our series did not include any mycotic or traumatic aneurysm. All aneurysms in our series were saccular except one, and the pericallosal-callosomarginal bifurcation was the most common location in 13 aneurysms (48.1%). Other aneurysms were located on the callosomarginal artery and the pericallosal artery with incidences of 22.2% and 29.6%, respectively.

Giant distal ACA aneurysms are extremely rare as these aneurysms tend to rupture when still small. Only a few cases of large and giant distal ACA aneurysms are known. A review found 67% of ruptured distal ACA aneurysms were less than 5 mm. Direct surgery is recommended for small incidental aneurysms due to this early
bleeding tendency. Morbidity and mortality may be related to the preoperative state. Conservative treatment of distal ACA aneurysms carries a very bad prognosis based on the natural history of the disease. Therefore, we also recommend early surgery for this particular group of aneurysms.

Difficulties at surgery include the narrowness of the interhemispheric fissure and the callosal cistern, the possibility of dense adherences between the cingulate gyri, the difficulty in establishing proximal control, and the high frequency of broad-based and sclerotic aneurysms in this location, particularly those involving the origin of the branching arteries. Even gentle retraction of the falx or medial surface of the frontal lobe can cause aneurysm rupture. The dome of the aneurysm projects toward the surgeon and is mostly exposed before the neck is seen, so intraoperative rupture is a frequent complication. Intraoperative rupture has occurred in up to 50% of these lesions. In one series, intraoperative rupture occurred in 10 of the 54 aneurysms. The morbidity is approximately 20%. In our series, the main problem encountered during the operation was proximal control of the aneurysm. However, we did not experience any premature rupture. We were not able to expose and clip the aneurysm in one patient due to pial adherence to the opposite cingulate gyrus. Subsequently, this aneurysm was embolized by an endovascular procedure.

Distal ACA aneurysms are usually treated through an interhemispheric approach. If the aneurysm is located at the lower part of the A2 segment then either a pterional or a subfrontal approach may be the choice of treatment. The interhemispheric approach with partial systematic resection of the genu of the corpus callosum was proposed for improving the surgical exposure. In our series, we performed the anterior interhemispheric approach, with bifrontal skin incision ranging from frontobasal to high frontal depending on the location of the aneurysm, in all our patients except in two. We did not perform partial resection of the genu of the corpus callosum in any of the patients.

The occurrence of ICH is not a good sign for the outcome of the patients. Patients with ICH over 3 cm in diameter, in addition to poor preoperative grade, are likely to have a poor outcome. Clinical grade is a definite factor affecting the surgical outcome of patients. Size of aneurysm and timing of the operation are other important factors that may affect the outcome. The most important factor affecting the mortality and morbidity may be the presence of other aneurysms. Two stage surgery in two different sessions is important for multiple aneurysms to diminish the mortality, although one stage surgery was also recommended. The morbidity and mortality depend on the grade of the patient on admission. Low grade patients, especially nonruptured grade 0 patients, have the best outcome. Surgical mortality is higher (up to 32%) for distal ACA aneurysms than other aneurysms in the cerebral circulation. In our series, there were only two patients in grade 0 and three in grade 1. This may explain why our mortality (8%) was slightly higher.

Endovascular treatment of ruptured distal ACA aneurysms should be considered as an alternative method to surgical clipping. Eleven of 12 ruptured distal ACA aneurysms were occluded completely by endovascular treatment using detachable coils. Endovascular treatment of distal ACA aneurysms is feasible and has good outcome despite the technical difficulties and high procedure-related rupture rate.

Our patients of Turkish ethnicity had some unusual features of low multiple aneurysm rate, no mycotic or traumatic aneurysm, and no vascular anomaly. We conclude that, despite all improvements in the microsurgical techniques and knowledge of surgical anatomy, distal ACA aneurysms still have higher morbidity and mortality compared to aneurysms in other locations. The skill and experience of the neurosurgeon is very important for the outcome. All distal ACA aneurysms, even if very small, should be aggressively treated as soon as possible because of the high tendency to rupture early. Endovascular treatment is always an alternative treatment option in the management of these aneurysms.

References


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Distal ACA Aneurysms


Commentary

This report describes a series of 26 patients of whom 25 individuals underwent surgery for clipping a distal anterior cerebral artery aneurysm that had ruptured in the majority of cases. Considering that these aneurysms are treated by endovascular coil embolization in many neurovascular centers around the world, it is important for neurosurgeons to learn from the experiences gained from such a series. However, the reader of this article is left with several unanswered but important questions. The authors mentioned that one patient (presumably No. 17) died on the second postoperative day of intracerebral hemorrhage in the frontal region without giving any explanation for this obviously surgery-related mortality. Why did they not re-explore to evacuate the hematoma? Did the bleeding occur due to an incorrect initial clip placement in this aneurysm measuring 11 mm in diameter? Furthermore, it was described that one aneurysm could not be exposed and clipped due to pial adherence to the contralateral cingulate gyrus. However, similar adherences may be a common finding in other
locations too, and the problem can be solved with a proper microsurgical technique. This patient subsequently underwent endovascular coil obliteration. It remains unclear whether the procedure was done in the same department or elsewhere. This would be of interest, though, because we may expect that the availability of such a service in the same department would strongly influence the choice for one treatment modality or the other. Aside from these questions, I wish to commend the authors for the good surgical results presented here. This article should encourage other neurosurgeons to continue treating aneurysms with microsurgical clipping procedures as this expertise should remain in their hands also in the future.

Helmut Bertalanffy, M.D.
Department of Neurosurgery
Philipps University Hospital
Marburg, Deutschland

The authors have raised several points, mostly well made and relevant, relating to the presentation and management of distal anterior cerebral artery aneurysms. Their series of cases is typical in the proportion of distal ACA to all aneurysms, but not in the sex distribution with slightly more males in this series, and not in the proportion with multiple aneurysms.

Technical points in the approach to these aneurysms, and the reasons for difficulty at operation such as lack of proximal control, are suggested. Another point to be raised in the surgical approach is the sometimes extreme difficulty in finding the aneurysm, especially when there are many adhesions between the hemispheres. I have occasionally seen procedures abandoned because of this. A stereotactically guided approach should be strongly considered for all these patients.

These aneurysms have also acquired a reputation, probably deserved, for the occasional development of very severe symptomatic delayed vasospasm, and for very sudden onset of deterioration when this occurs. This is perhaps surprising in view of the comparatively distal location of these aneurysms, but less so when one sees such large amounts of subarachnoid blood as in Figure 1, and in view of the frontal location of the blood.

Nicholas W. C. Dorsch, M.D., F.R.C.S., F.R.A.C.S.
Department of Neurosurgery
Westmead Hospital
Sydney, Australia

Distal ACA aneurysms are relatively rare among all intracranial aneurysms. There are many anatomical variations and pathological conditions, like azygous ACA, persistent anatomical communication between right and left ACA, anterior communicating artery complex, and dissecting aneurysm. Most neurosurgeons are not so familiar with distal ACA aneurysms. The authors discussed several problems of distal ACA aneurysms, for example, multiple aneurysms in Turkish people, etiology of fusiform aneurysm, premature rupture and treatment modality. I agree with the author’s conclusion that the skill and experience of the neurosurgeon is very important for the outcome. Endovascular treatment is always an alternative treatment option in the management of these aneurysms.

Kiyotaka Fujii, M.D.
Department of Neurosurgery
Kitasato University School of Medicine
Sagamihara, Kanagawa, Japan