Endovascular Treatment of Distal Anterior Cerebral Artery Aneurysms: Single-Center Experience and a Systematic Review


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ABSTRACT

SUMMARY: In this study, a single center’s experience of 20 patients and a systematic review and a meta-analysis of 16 studies, including 279 patients/aneurysms, assessed the safety and efficacy of endovascular treatment of distal anterior cerebral artery aneurysms. The authors conclude that endovascular treatment of distal anterior cerebral artery aneurysms is associated with high angiographic occlusion rates, but the complication rates are higher compared with other aneurysms in the circle of Willis.

ABBREVIATIONS: DACA = distal anterior cerebral artery; GOS = Glasgow Outcome Scale

Distal anterior cerebral artery (DACA) aneurysms are rare, representing approximately 1–9% of all intracranial aneurysms.1 Endovascular treatment of these aneurysms presents a number of challenges. Earlier studies have reported high rates of arterial dissection, intraoperative rupture, and incomplete occlusion rates for endovascular treatment of DACA aneurysms.2–5 Despite these initial challenges, further refinements in endovascular techniques made coil embolization emerge as a promising therapeutic option for aneurysms at this location.6,7 To clarify the safety and efficacy of endovascular treatment of DACA aneurysms, we report our experience in conjunction with a systematic review and meta-analysis of the literature.

MATERIALS AND METHODS

After institutional review board approval, we performed a retrospective analysis of all consecutive adult patients who underwent attempted endovascular treatment of intracranial aneurysms involving the DACA at a tertiary referral center (Mayo Clinic, Rochester, Minnesota) between January 1999 and September 2012. All patients provided approval for the use of their medical records for retrospective analysis. Patients were identified through a search of angiographic reports and clinical records. The following data were collected for each patient: demographic characteristics, angiographic features, clinical presentation, and outcomes. Among the angiographic features, aneurysm size (maximum dimension as measured by 3D digital subtraction angiography), rupture status, location, and incidence of azygos variant were evaluated. The CT appearance of all patients with SAH was assessed by use of the Fisher scale, and the clinical status at admission for patients with subarachnoid hemorrhage was assessed by use of the Hunt and Hess Scale. Clinical outcome for all patients was assessed by use of the Glasgow Outcome Scale (GOS). Details about the endovascular procedure included use of adjuncts (balloon-assisted and stent-assisted coiling), intraoperative complications, and degree of immediate angiographic occlusion.

Outcomes and Complications

Radiologic outcomes for endovascular coiling were stratified into 3 levels, on the basis of the degree of angiographic aneurysm filling evaluated immediately after the completion of the endovascular procedure and at last follow-up: 1) complete occlusion (100%), defined as a lack of angiographic filling of the sac and the neck or nearly complete occlusion (>90%), defined as no filling of the sac but with small residual neck filling; 2) incomplete occlusion (<90%), defined as persistent angiographic filling of a portion(s) of the sac, and 3) failed occlusion, defined as an aneurysm that could not be embolized, without any coil introduced or left in the aneurysm. Studied periprocedural complications (within 30 days of treatment) included intraoperative rupture, parent artery occlusion, transient ischemic attack, vasospasm, and stroke.

Literature Review

A comprehensive review of the literature was performed by use of the keywords “aneurysms,” “pericallosal,” “distal anterior cerebral artery,” “DACA,” and “endovascular” to search the PubMed,
Outcomes were pooled across studies by use of the Sturiale Dec 2013 www.ajnr.org

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Ruptured DACA aneurysms cause intracerebral hemorrhage (in addition to SAH) in more than one-half of cases and are associated with worse outcome after rupture when compared with aneurysms in other locations.\textsuperscript{16,19} Complications associated with endovascular treatment of these aneurysms are not rare and probably related to a higher level of technical difficulty because of distal location, morphology (with frequent partial Incorporation of the parent artery in the neck), and higher association with anatomic variations. These challenges may explain the relatively higher procedure-related complication rates compared with aneurysms in more common locations reported by some investigators.\textsuperscript{1–4} Keston et al\textsuperscript{2} demonstrated higher rates of periprocedural rupture and incomplete coiling of DACA aneurysms when compared with other circle of Willis aneurysms. In the International Study of Unruptured Intracranial Aneurysms (ISUIA), endovascular treatment of unruptured circle of Willis aneurysms was associated with a perioperative mortality rate of 2% and an overall morbidity/mortality rate of 9.3%.\textsuperscript{20} In a series of 600 circle of Willis aneurysms, Brinjikji et al\textsuperscript{26} demonstrated an intraoperative rupture rate of nearly 2% for unruptured aneurysms and 5% for ruptured aneurysms. In this series, combined procedure-related morbidity and mortality were 5% and 6% for unruptured and ruptured aneurysms, respectively. In our systematic review, the overall periprocedural rupture rate was nearly 7%, with a procedure related morbidity rate of 8%, markedly higher than that reported for treatment of other circle of Willis aneurysms.

Early case series of coiling for ruptured pericallosal aneurysms reported low success rates and high technical difficulty.\textsuperscript{3,18} Pierot et al\textsuperscript{41} reported a coiling success rate of only 25% (2/8 patients) and concluded that endovascular therapy was at best an adjunct to surgery.\textsuperscript{4} However, with refinement of endovascular therapy, subsequent case series have reported higher technical success rates.\textsuperscript{3,15,17} In a recently published series of 22 patients with DACA aneurysms by Cavalcanti et al,\textsuperscript{23} complete/near complete occlusion rate was 95% and 1 patient had an intraoperative rupture. In their review of the literature, recently published series reported occlusion rates of 80–100%, with a procedural related morbidity rate of 9% and mortality rate of 9%. Intraoperative rupture in both their series and systematic review was approximately 5%. Our meta-analysis has similar outcomes compared with the systematic review by Cavalcanti et al\textsuperscript{23}; we found aneurysmal occlusion rates of 86%, iatrogenic rupture rates of 7%, procedure-related morbidity rates of 8%, and mortality rates of 9%.

Although complication rates for endovascular treatment of DACA aneurysms remain a concern, previous studies have demonstrated that patients with ruptured pericallosal aneurysms have significantly better outcomes when treated with coiling over clipping. In a study of 86 patients (54 clipped and 32 coiled) harboring pericallosal aneurysms, Hui et al\textsuperscript{42} demonstrated that patients with ruptured pericallosal aneurysms fared better with endovascular therapy, with a better chance of complete recovery. Surgical and endovascular treatments of unruptured pericallosal aneurysms have similar results and outcome.

Our study has several methodologic limitations. Primarily, the available evidence is observational, nonrandomized, and non-comparative. Data in the published literature are collected retrospectively and details such as stratification of outcomes by clinical status at admission are often lacking. In addition, it is difficult to differentiate procedure-related mortality from mortality secondary to complications of SAH. Thus, it is likely that mortality secondary to treatment of pericallosal aneurysms is lower than reported in this study. The quality of evidence (confidence) is limited because of imprecision, heterogeneity, and methodologic limitations with the use of the GRADE framework (Grading of Recommendations, Assessment, Development and Evaluation).\textsuperscript{24–26} Our systematic review and case series has several strengths. We followed a comprehensive systematic review process and searched multiple data bases in an attempt to improve the precision of estimates derived from our own data. We believe that these results represent the best available evidence regarding endovascular treatment for aneurysms in an uncommon location. The outcomes reported here reflect an average incidence to be expected for this procedure across multiple settings and institutions.

**CONCLUSIONS**

Endovascular coiling of DACA aneurysms is associated with immediate occlusion rates of 85% and a low recurrence rate at follow-up. However, endovascular treatment of DACA aneurysms is also associated with complication rates higher than those reported for endovascular treatment of aneurysms in other locations.

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