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Mirror Distal Anterior Cerebral Artery Aneurysms in a Subarachnoid Hemorrhage Patient

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Abstract

Background: Mirror distal anterior cerebral artery aneurysms (DACAAs) are a rare finding in subarachnoid hemorrhage (SAH) patients, and only few cases have been reported.

Case Description: A 40 year-old male patient was admitted for sudden-onset headache, nausea/vomiting, and transient right arm hypaesthesia. A computed tomography (CT) revealed a SAH with intracerebral hemorrhage (ICH) within the interhemispheric fissure, but CT-angiography failed to identify any aneurysms. A consecutive digital subtraction angiography with 3D-reconstructions revealed mirror DACAAs with a diameter of 1.5 mm on the A3 segments. The definite rupture site, however, remained unidentifiable. After interdisciplinary consultation, endovascular treatment was favored and complete occlusion of both DACAAs was achieved by coiling without stenting. During coiling of the right DACAAs, a thrombus in the right callosomarginal artery formed, and treatment with abciximab (ReoPro®) was initiated to dissolve the thrombus. Post-treatment, the patient showed right leg plegia; CT scans, however, did not reveal any ischemia, ICH increase, or vasospasm. Over the following days, the leg paresis improved and the patient was ever more mobilized. He was eventually transferred for further rehabilitation 16 days after hemorrhage. The leg paresis had recovered to a grade 3/5.

Conclusions: Rapid identification of the rupture site in SAH patients with multiple aneurysms is crucial for initiating optimal treatment. In patients with mirror aneurysms in close proximity to each other, this, however, is not easily accomplishable and may thereby complicate treatment decisions. Although clipping has been the standard for DACAAs occlusion, coiling should be taken into consideration as a viable alternative.

Highlights

- Mirror distal anterior cerebral artery aneurysms (DACAAs) are a rare finding in subarachnoid hemorrhage (SAH) patients.
- The identification of the rupture site in SAH patients with multiple aneurysms is crucial for initiating optimal treatment. In patients with mirror DACAAs, however, this may not always be accomplishable by computed tomography and/or digital subtraction angiography, and may even be a challenge during microsurgical clipping.
- Ruptured DACAAs are often associated with ICH and patients' typical symptoms often consist of cognitive deficits and uni- or bilateral leg paresis.
- Although microsurgical clipping has been the gold standard for DACAAs occlusion, endovascular treatment should be taken into consideration as a viable treatment alternative.

Key words: Coil embolization; Endovascular treatment; Intracerebral hemorrhage; Mirror aneurysms; Outcome; Distal anterior cerebral artery aneurysms; Subarachnoid hemorrhage

Abbreviations and Acronyms: CT, Computed tomography; CT-A, Computed tomography angiography; DACAAs, Distal anterior cerebral artery aneurysm; DSA, Digital subtraction angiography; ICH, Intracerebral hemorrhage; PCOM, posterior communicating artery; SAH, SAH, Subarachnoid hemorrhage; WFNS, World Federation of Neurosurgical Societies

Introduction

Distal anterior cerebral artery aneurysms (DACAAs) can be considered a rather rare entity; approximately only 5% of all intracranial aneurysms can be found in this specific region.^{1,2} It has been estimated that 27-44% DACAAs patients harbor multiple intracranial aneurysms, which is higher than for aneurysms in other locations, and 4% of patients have been found to display mirror DACAAs.²⁻⁵ In acute subarachnoid hemorrhage (SAH), this can sometimes prove to be a problem since the source of bleeding may not be definitely identifiable in those cases. This can be especially problematic in patients, in whom an occlusion/treatment of all aneurysms is not feasible by a single treatment modality or within one treatment session.

In this case report, we present a rare case of a patient with mirror DACAAs, who suffered a SAH with associated intracranial hemorrhage (ICH). We provide a detailed depiction and discussion of the patient's signs and symptoms, radiologic findings, treatment considerations as well as the course of treatment.

Case description

Patient presentation and imaging

A 40 year-old male, non-smoker was admitted to our hospital's emergency department due to sudden-onset headache, nausea/vomiting, and a transient hypaesthesia of the right upper extremity. On initial examination, the patient's Glasgow Coma Scale was 15 and no focal-neurological deficit was recorded. An immediately performed cranial computed tomography (CT) including CT-angiography (CT-A) revealed a SAH, clinically corresponding to a World Federation of Neurosurgical Societies grade I, and an interhemispheric ICH; however, no aneurysms could be detected on CT-A (Fig. 1a). We followed with a digital subtraction angiography (DSA), which showed small, bilateral mirror DACAAs located on the A3 segments with a maximum diameter of 1.5 mm each (Fig. 1a and 1b, Fig. 2a and 2b). The exact rupture site, however, remained unidentifiable. No other intracranial aneurysms or vascular anomalies were found.

Aneurysm occlusion

We decided to proceed with endovascular treatment of the mirror DACAAAs. The right-sided aneurysm was occluded first by coil embolization, followed by coiling of the left aneurysm; no stenting of the aneurysms' neck was required. During the coiling procedure of the right-sided aneurysm, a thrombosis of the callosomarginal artery was detected and treatment with abciximab (ReoPro®) was initiated, immediately dissolving the thrombus. At the end of the procedure, complete occlusion of both aneurysms (Raymond-Roy Occlusion Classification class I) was recorded (Fig. 2c). Endovascular treatment was initially favored over clipping because the space-occupying effect of the ICH was only limited, and the patient showed no neurological deficit on admission.

Postinterventional course and outcome

After aneurysm occlusion, the patient was transferred to the neurosurgical intensive care unit and intravenous abciximab treatment was continued for twelve hours. After the procedure the patient's sedation was slowly reduced and he could be extubated approximately 1.5 hours after aneurysm conclusion. According to our in-house protocol for vasospasm prophylaxis, we started with per os nimodipine (6x 60 mg daily) treatment. Upon post-extubation neurological evaluation, the patient showed a monoplegia of the right leg without any other new deficits. A CT scan showed no increase of the ICH, no ischemia, and only minimal enlargement of the ventricular temporal horns. Over the next hours and days, the patient's leg paresis slowly but constantly started to improve. On the day six after the SAH, however, the patient showed fluctuating deteriorations of the leg paresis, clinically suspicious of vasospasm. A CT and CT-A scan was performed, which failed to detect any relevant vasospasm or ischemia (Fig. 3a and 3b). The patient's nimodipine medication was changed to intravenous administration (dose: 2mg/h) and strict blood pressure management (i.e. systolic blood pressure >170 mm Hg) was initiated. Over the following days, the patient's condition stabilized and the leg paresis then showed constant improvement. The patient was transferred to the normal ward, where intensive

physiotherapy was conducted. At day 16, the patient was transferred to rehabilitation unit; he was able to walk with help and the leg paresis had improved to grade 3/5. The nimodipine medication was continued until day 21. Follow-up DSA was scheduled to be performed in six months' time.

Discussion

Although DAACAs have been found to be associated with other aneurysms, it is a rare finding that a patient will suffer from mirror aneurysms in this distinct location, and only a few similar cases have been reported in detail (Table 1).⁶⁻⁹ Our depicted case, confronted us with several challenges with regard to deciding on the patient's optimal course of treatment, which deserve further discussion. On the one hand, the patient suffered from mirror DAACAs, which were in very close proximity to each other. Thus, it was not possible for us to identify the source of hemorrhage. On the other hand, treatment decisions were further complicated by an associated ICH.

The correct identification of the rupture site/hemorrhaged aneurysm in a patient with multiple aneurysms is of utmost importance in order to initiate optimal treatment and achieve swift aneurysm occlusion. The most indicative findings for the most probably ruptured aneurysm are the distribution of blood within the subarachnoid space/cistern as well as the location of an associated ICH, if present. As seen in our presented case, these parameters may prove difficult to interpret, if the aneurysms are located in close proximity to each other. Other factors, which may be used as indicators with this regard, are the aneurysms' size/volume, angioarchitecture, and multilobulated morphology. In patients with multiple intracranial aneurysms and reported that larger size >7 mm and irregular, complex morphology were found to be the strongest predictors for aneurysm rupture.¹⁰ Digital subtraction angiography may provide more detailed depiction of the aneurysm's anatomy than CT-A and help with treatment planning. In our patient, however, neither CT-A nor DSA were able to identify the ruptured aneurysm. In such a case, all aneurysms requiring treatment ought to be occluded in one sitting, if feasible, as performed in our patient.

Microsurgical clipping as well as endovascular coiling provide a specific risk-/benefit profiles, and their respective advantages and disadvantages should be carefully counterbalanced against each other. One major advantage of microsurgical clipping is,

that removal of an associated ICH within the interhemispheric fissure may be additionally performed. It is hereby important to note, that DACAAs tend to bleed into the adjacent brain parenchyma in case of rupture and consecutive SAH, and 28-53% of patients will suffer from an associated ICH.^{2,11,12} Most commonly, the ICH will affect the frontal lobes, the corpus callosum and/or the cingulate gyrus, thereby causing typical clinical symptoms such as cognitive deficits, akinetic mutism, and uni- or bilateral leg paresis, as seen in our patient.¹³⁻¹⁵ Reasons for the high incidence of an associated ICH, may be the small volume/space within the interhemispheric cistern as well as the close proximity of the aneurysm sac to the adjacent brain tissue. Prior data have shown that, although an associated ICH was found to be predictive for unfavorable outcome in patients with ruptured DACAAs, patients with ICH did, however, show relatively good overall clinical status.² Removal of the hematoma might lead to faster recovery of the patient and remission of associated neurological symptoms caused by space-occupying blood clots. Moreover, it may also reduce the risk of secondary vasospasm.⁶ In most cases, both distal anterior cerebral arteries and associated aneurysms can quite readily be accessed by an unilateral interhemispheric approach; if need be, however, the lower part of the falx can additionally be resected in order to gain further exposure. Nonetheless, clipping of DACAAs does pose specific challenges to the surgeon due to their often deep interhemispheric locations and overall lack of space during aneurysm dissection. Furthermore, great attention must be given to preservation of all larger bridging veins in order to avoid secondary venous infarctions, and retraction of the often edematous and vulnerable brain parenchyma, especially in SAH patients, should be kept to a minimum. From our experience, neuronavigation can be of great help to plan the craniotomy and the optimal trajectory to the aneurysm. Having said that, endovascular treatment may prove difficult to the rather small parent artery, often broad-necked aneurysms, and distal location.

We believe that, in this specific case an attempt of ICH removal during clipping might have been associated with a considerable risk for the following reasons: 1) The hematoma extended quite far posteriorly along the corpus callosum (Fig. 3a), and only the anterior part could have been easily removed during the clipping procedure, 2) the interhemispheric fissure does only provide for limited space and extensive manipulation, especially in SAH patients, might cause additional neurological damage, and 3) the space-occupying effect of the ICH was judged as only moderate. Moreover, since the complete

occlusion of both DACAAAs was deemed achievable by the neurointerventionalists, it was not regarded as an absolute necessity to determine which one of the DACAAAs had actually ruptured, which again could have been more likely determined by microsurgical clipping the aneurysms. Our patient eventually showed good improvement of his neurological status, and follow-up imaging showed no increase of the hematoma or ischemia; thus, affirming our initial treatment decisions.

Conclusions

Thus far, only few SAH patients with mirror DACAAAs have been reported and their optimal treatment remains challenging. As depicted in our patient, due to the aneurysms close proximity to each other, the identification of the rupture site could not be definitely identified. Furthermore, the associated ICH, a common feature of ruptured DACAAAs, further complicated treatment decisions. The optimal treatment for all complex aneurysm cases, ought to be interdisciplinary discussed and agreed on. Although microsurgical clipping has been the gold standard for DACAA occlusion, treatment of these aneurysms is nowadays also feasible by modern endovascular techniques. Thus, endovascular treatment does constitute a viable treatment alternative and should therefore also be taken into consideration.

Conflicts of interest

The authors report no conflicts of interest and no specific funding was applied.

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Figures

The initial CT scan showed a SAH with an associated ICH in the interhemispheric fissure; CT-A, however, failed to reveal any aneurysms (Fig. 1a). Digital subtraction angiography (Fig. 1b and 1c) including 3D-reconstructions (Fig. 2a and 2b) eventually showed mirror DACAAAs in the patient's A3 segments and coil embolization achieved complete occlusion of both aneurysms (Fig. 2c). Follow-up CT and CT-A scans showed no ischemia, increase of the ICH, or relevant vasospasms (Fig. 3a and 3b).

Table 1 – Prior case reports on mirror distal anterior cerebral artery aneurysms

Study:	Patients:	Other vascular anomaly:	SAH/WFN S grade:	ICH:	Symptoms:	Treatment:	Rupture site identified:	Outcome/Complications:
Mizunari et al., 2011	n=1	None	Yes, WFNS II	Yes	Headache	2x Clipping	N.A.	Long-lasting vasospasm, but no new deficit
Mori et al., 1995	n=1	None	Yes, WFNS I	No	Headache	2x Clipping	Yes	No new deficit
Singh et al., 2018	n=1	None	Yes, WFNS IV	Yes	Headache, initial LOC	2x Clipping	Yes	New hemiparesis
Sousa et al., 2002	n=2	PCOM aneurysm; None	Yes, WFNS II; Yes, WFNS V	Yes; Yes	Headache;	2x Clipping; 2x Clipping;	Yes; Yes	Transient paraparesis but no permanent new deficit; Death

DACAA, Distal anterior cerebral artery aneurysm; ICH, Intracerebral hemorrhage; LOC, Loss of consciousness; PCOM, posterior communicating artery; SAH, Subarachnoid hemorrhage; WFNS, World Federation of Neurosurgical Societies

Abbreviations: CT, Computed tomography; CT-A, Computed tomography angiography; DACAA, Distal anterior cerebral artery aneurysm; DSA, Digital subtraction angiography; ICH, Intracerebral hemorrhage; PCOM, posterior communicating artery; SAH, SAH, Subarachnoid hemorrhage; WFNS, World Federation of Neurosurgical Societies