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Transcirculation Approach for Matricidal Carotid Cavernous Aneurysm: Not a Good Choice – A Case Report of Unsuccessful Endovascular Treatment of Matricidal Carotid Cavernous Aneurysm

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Keywords
Aneurysm · Cerebral revascularization · Stents

Abstract
Matricidal carotid cavernous aneurysm (CCA) is a rare and dangerous condition. The treatment failure of the endovascular approach like flow diversion, coiling, or stent-coiling is relatively high with considerable morbidity and mortality. The transcirculation approach is an alternative treatment option, but in case of matricidal CCAs, the results are not well documented in the literature. The authors present a complicated case of an unsuccessful transcirculation approach for matricidal CCA finally treated with sacrifice of the parent artery and high-flow bypass.

Introduction

Carotid cavernous aneurysms (CCAs) account for 2–13% of all intracranial aneurysms [1, 2]. They differ, however, from aneurysms from the subarachnoid location by clinical presentation and natural history. CCAs typically cause pain and cranial nerve palsy. In the case of rupture, most patients usually develop a carotid cavernous fistula [3] or, less frequently, SAH [4] epistaxis [5]. About 18% of patients are asymptomatic [4], and 67% of those patients will have no deterioration during a 4-year follow-up [4]. Mortality is significantly lower than that of other aneurysms, but morbidity remains high.

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CCAs pose considerable challenges. Surgical reconstruction of CCAs is complicated because of its location within the cavernous sinus, burdening patients with high morbidity. Consequently, an endovascular approach or indirect bypass surgery is preferred. CCAs are often giant wide-neck aneurysms where coiling or stent-coiling is often not sufficient. In those cases, the endovascular technique of flow diversion is often helpful. Nowadays, most wide-neck CCAs are treated with flow diversion with outstanding results [5–7]. Some CCAs grow to such large sizes (called matricidal aneurysms) that they may compromise the parent internal carotid artery (ICA). The treatment failure of matricidal CCAs is high, in some cases reaching up to 28% [1]. Those patients require an individual therapeutic approach and a collaborative team. We present a complicated case of a patient with matricidal CCA, which was finally resolved by ICA sacrifice with high-flow bypass.

Case

A 68-year-old female patient developed partial oculomotor nerve palsy on her left eye. Computed tomography (CT) angiography revealed a giant wide-neck aneurysm of the cavernous segment on the left internal carotid artery (ICA). The first endovascular attempt to implant a flow diversion device (FDD) failed. The interventional radiologist could not bridge the aneurysm with a microcatheter by the orthograde approach due to a stenosis in the outflow segment of the left ICA distal to the aneurysm (Fig. 1). Because the patient was fine after the procedure, the aneurysm was approached in a retrograde fashion from the right ICA via AComA 1 month later. The microcatheter was successfully introduced through the right ICA and aneurysm to the C1 segment of the left ICA. The tip of the catheter was caught by another lasso catheter inserted into the left ICA. However, any attempt to pass the left catheter through the aneurysm by pulling on the right one was unsuccessful. The outflow stenosis of the left ICA made any attempt (to bridge the aneurysm and implant the stent) unsuccessful (Fig. 2). The procedure was therefore concluded by performing a balloon occlusion test of the left ICA with adequate collateral blood supply on angiography without clinical presentation (Fig. 3). In such circumstances, deconstructive treatment by occluding the left ICA with the coiling of the aneurysm seemed to be safe and planned for the next session. Unfortunately, shortly after the procedure, the patient became unconscious and had to be intubated. A CT angiography scan revealed subarachnoid hemorrhage with a contrast leak from the A1 segment of the left anterior cerebral artery (ACA). An immediate coiling of the segment was performed (Fig. 4). Because the patient developed acute hydrocephalus, an external ventricular drain was inserted. The patient slowly recovered and extubated after 3 weeks. At the time of discharge, the patient suffered from psychomotor slowing, and oculomotor nerve palsy remained unchanged. There was no sign of ischemic brain stroke, but a small low-density spot in the left head of the caudate was detected by CT scan.

Because of the extremely complicated course of any endovascular treatment attempt, we changed from an aggressive to a wait-and-watch strategy. After 7 months, the patient was referred back to our department. Suddenly, the patient developed a headache, right-sided hemiparesis, global aphasia, ophthalmoplegia, chemosis, ptosis, and ocular bruit. CTA showed a thrombosed aneurysm with a pathological filling of the orbital veins. DSA revealed the direct carotid cavernous fistula with a typical venous outflow to the petrosal and cavernous sinus and the ophthalmic vein (Fig. 5). Because the A1 segment of the left ACA was occluded by previous emergency coiling, the collateral blood flow was weak, and occlusion of the left ICA without bypass was no longer an option. Thus, a high-flow ECA-MCA bypass using radial artery interposition graft and clipping of the M1 segment of the MCA was performed. Subsequently, imminent coiling of the aneurysm and occlusion of the left ICA were done

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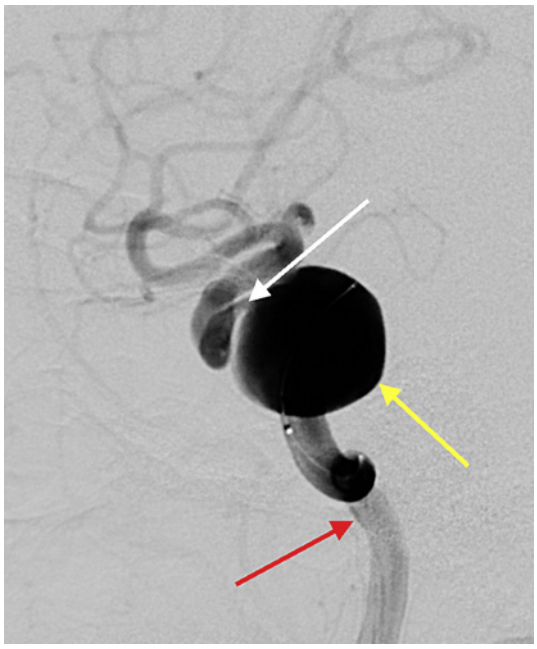

Fig. 1. DSA: lateral view. A giant wide-neck matricidal CCA (yellow arrow) of the left ICA (red arrow) is depicted with a moderate-outflow stenosis (white arrow).

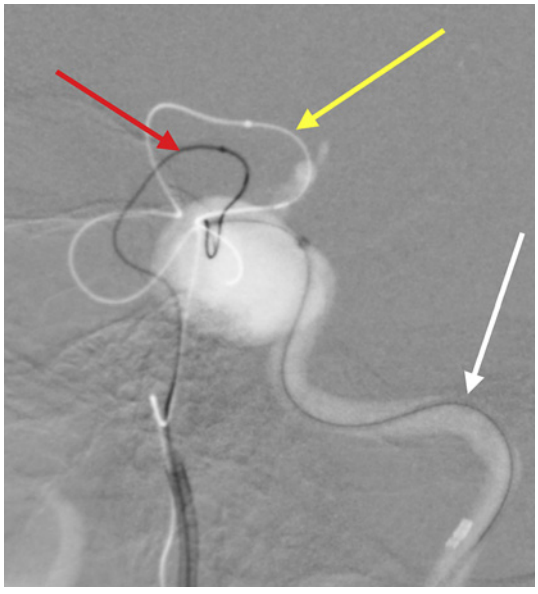

Fig. 2. DSA: anteroposterior view, road map. The yellow arrow points at the passive catheter introduced in a transcirculation fashion into the AN. The red arrow points at the position of the active catheter while pulling the lasso catheter (white arrow) through the outflow stenosis. A substantial change of arterial anatomy during the unsuccessful procedure on the image is well depicted – compare the position of passive versus active catheter. As a consequence of these anatomical changes, a bleeding from torn-off perforator occurred.

endovascularly. DSA showed only low blood flow in the arterial graft (Fig. 6). The patient was monitored in the intensive care unit. Aspirin (100 mg per day) and enoxaparin (0.4 mL per day) were administered. The targeted mean arterial pressure was 110–120 mm Hg. Following the procedure, the patient was hemodynamically unstable, treated with catecholamines and intensive volume therapy. The next day, the patient had a Glasgow Coma Scale (GCS) of 3 but recovered within 6 days to GCS 15. At discharge from our department, the patient suffered from disorientation, mild global aphasia, memory deficit, and complete third-nerve palsy. After intensive rehabilitation, the patient fully recovered from aphasia, memory deficit

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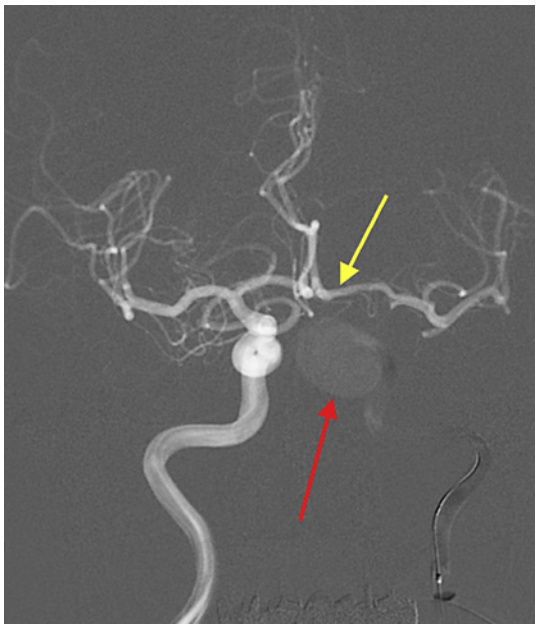

Fig. 3. DSA: anteroposterior view. Balloon occlusion test with good filling of left anterior and middle cerebral arteries (yellow arrow) from the right ICA via the anterior communicating artery. Matricidal CCA (red arrow).

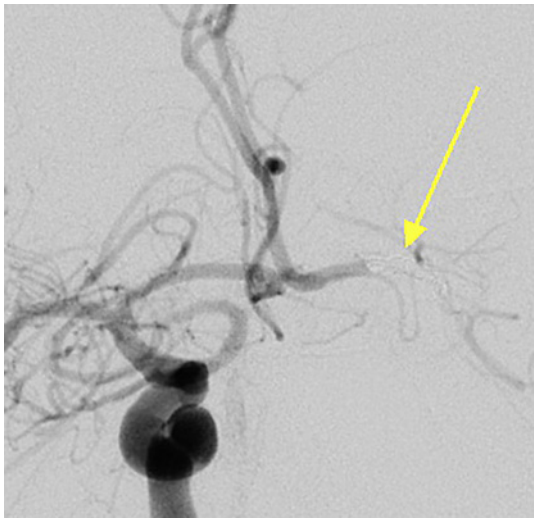

Fig. 4. DSA: anteroposterior view. Occlusion of the A1 segment of ACA (yellow arrow).

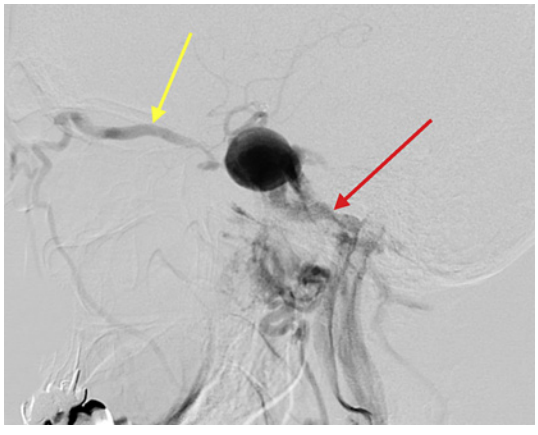

Fig. 5. DSA: lateral view. Angiographic image of direct carotid-cavernous fistula. Ophthalmic vein (yellow image), inferior petrous sinus (red arrow).

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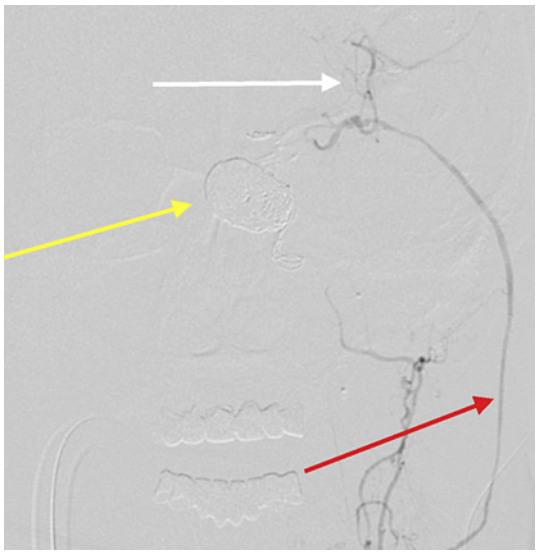

Fig. 6. DSA: anteroposterior view. Coiled matricidal CCA (yellow arrow), confined filling of bypass (red arrow), filling of the middle cerebral artery (white arrow).

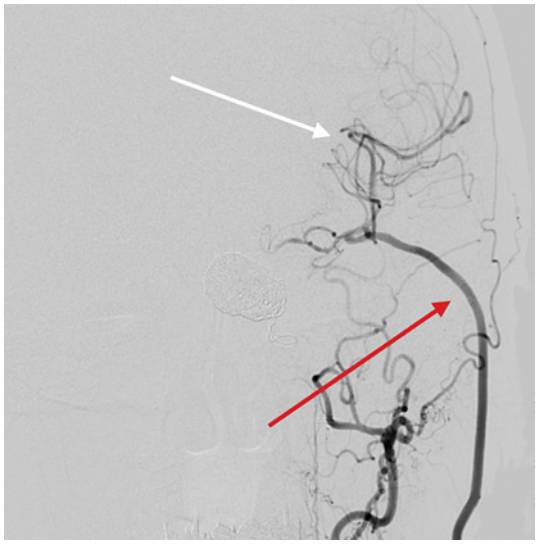

Fig. 7. DSA: anteroposterior view. Angiography showing a more significant filling of the high-flow bypass (red arrow) and the middle cerebral artery (white arrow).

improved partially, but oculomotor palsy remained unchanged at the last follow-up (6 months after bypass surgery). DSA and CTA indicated good blood flow in the arterial graft with significant blood filling of the middle cerebral artery branches (Fig. 7, 8).

Discussion

Matricidal CCAs are rare, and the literature on the treatment of CCAs is sparse. Notable, matricidal CCAs cause stenosis of the parent ICA different from that caused by atherosclerotic stenosis. The stenosis is elastic and does not respond to angioplasty or stenting [1]. Dacus et al. treated 40 patients with matricidal CCAs [1]. The attempt of flow diversion in 20 patients failed in 6 cases (30%), and the mortality reached 15% (3

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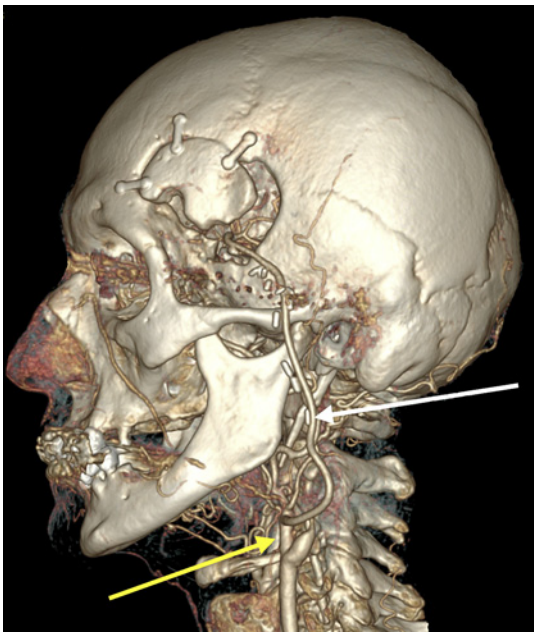

Fig. 8. CTA; 3D reconstruction shows filling of the left ICA and high-flow bypass.

patients) after FDD implantation. These data are far worse than those of other intracranial aneurysms. Matricidal CCAs should be detected early and treated based on individual location and structure.

Neuro-ophthalmic symptoms are the most common presentation in patients with CCAs. Isolated third-nerve palsy is a common presentation detectable in 12% of patients [4]. The treatment, however, does not have any significant impact on the post-procedural nerve deficit. Yet, many patients (44%) with ocular misalignment do not have subjective diplopia after 4 years [4].

Not the clinical presentation but the size and structure of the aneurysm were relevant for the intervention. For the wide-neck CCA, the therapist has to decide whether to implant FDD or sacrifice the artery with or without a bypass. Dacus et al. recommend performing balloon test occlusion in case of severe aneurysmal stenosis over 70% [1]. In our patient, the stenosis was moderate (60%), and therefore, we decided to implant FDD, but because it failed, we performed a second attempt using a transcirculation approach. Regrettably, that led to rupture and occlusion of the A1 segment of ACA, excluding the option of simple ICA sacrifice without bypass for the future. The second attempt led to more extensive treatment and harmed the patient as well. A new modality of treating aneurysms is a woven endobridge device. It is suitable for aneurysm measuring 9–10 mm in width and 9.5–10.5 mm in height [8]. The matricidal aneurysm size was, however, larger (width 34 mm and height 25 mm) than proposed criteria. Therefore, the woven endobridge device was not, in this case, indicated.

In light of the literature and the present case, we recommend treating patients with matricidal CCAs with caution. Treatment of these aneurysms may be delicate with persistently high morbidity and mortality rates. In the case of ipsilateral FDD implantation failure caused by moderate- and severe-outflow stenosis, we discourage the transcirculation endovascular approach. While often helpful, the transcirculation approach seems to be inconvenient and hazardous in this particular diagnosis. We suggest that the next step should be parent ICA sacrifice with or without a bypass. Because of high morbidity and mortality, all patients with matricidal CCAs should be treated by a multidisciplinary and interactive collaborative team. The "CARE Checklist" has been completed by the authors for this case report, attached as online supplementary material (for all online suppl. material, see https://doi.org/10.1159/000533832).

Statement of Ethics

This retrospective review of patient data did not require ethical approval in accordance with local guidelines. Written informed consent was obtained from the patient for publication of the details of their medical case and any accompanying images.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Norbert Svoboda performed manuscript preparation, collected data, and participated in study conception. Jozef Malik performed detailed analysis of radiological data and helped with formation of the study. Frantisek Charvat provided guidance and surveillance in a view of an intervention radiologist. David Netuka provided guidance and surveillance in a view of a vascular surgeon and participated in study conception.

Data Availability Statement

All data analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

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