Covered stent placement for the treatment of mycotic extracranial carotid artery aneurysm: a case report and comprehensive review

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Extracranial carotid artery aneurysms (ECAAs) are rare, and mycotic aneurysms are even rarer. Here, we report a case of a giant extracranial carotid artery mycotic aneurysm treated successfully with a covered stent. A 78-year-old man with no pertinent medical history other than a history of acute cholangitis 2 months previously presented with a huge expansile, pulsatile, and non-tender mass in the right neck. Cerebral angiography revealed a right ECAA measuring 35.3 × 27.5 mm involving the bifurcation of the right common carotid artery. Endovascular reconstruction of the right carotid artery using a vascular-covered stent was performed. After treatment, the ECAA was occluded, and the patient had no new neurological symptoms. The patient underwent a concurrent 2-week course of antibiotic therapy, and the masses regressed entirely. Endovascular treatment with a covered stent, along with appropriate antibiotics, is a feasible and safe option for treating mycotic aneurysms involving the carotid bifurcation.

Keywords: Aneurysm, infected; Carotid artery, external; Stents

Introduction

The extracranial carotid artery aneurysm (ECAA) is extremely rare, accounting for 0.4% to 1% of all arterial aneurysms and approximately 4% of peripheral arterial aneurysms [1,2]. Among them, aneurysms caused by infectious etiology called “mycotic aneurysms” are even rarer. The fundamental principles of treating mycotic aneurysms involve a minimum of 6 to 8 weeks of antibiotic therapy and surgical removal or debridement of all infected tissue [3]. The use of medical therapy alone is linked to a 50% mortality rate, prompting most experts to advocate for surgical intervention alongside prolonged antimicrobial therapy [3,4]. Recent research indicates that surgical treatment for mycotic aneurysms is typically avoided due to higher mortality rates and the difficulties in accessing infected tissue [5]. On the contrary, endovascular therapy is gaining more attention due to its lower mortality rates, improved accessibility, and lower risk of hemorrhage from anticoagulation compared with direct surgical repair [5]. We aim to present another successful endovascular treatment (EVT) case of a mycotic aneurysm in the extracranial carotid artery. Our institutional review board approved this study, and the requirement for informed consent was waived (subject number: HC23ZISI0107).

Case Report

A 78-year-old male, who had no previous medical history, was found to have presented with a huge expansile, pulsatile, non-tender mass in the right neck (Fig. 1A, B). He was diagnosed with acute cholangitis based on an abdominal-pelvic enhanced computed tomography (CT) scan and received one week of antibiotic treatment. The patient experienced sore throat symptoms and neck swelling 2 weeks after discharge. Three weeks after discharge, he exhibited generalized weakness and gait instability, fell at home, and presented to the hospital again due to several contusions. He reported persistent dizziness and transient ischemic attack symptoms since discharge, which led to approximately 5 to 6 similar ep-
isodes of falling.

CT neck angiography revealed a giant aneurysm at the bifurcation of the right common carotid artery (CCA) (Fig. 1C, D). Magnetic resonance imaging (MRI) revealed delayed perfusion in the right hemisphere (Fig. 1E). Cerebral angiography revealed a right ECAA measuring 35.3 × 27.5 mm that involved a bifurcation of the right CCA (Fig. 2A, B). On the right CCA angiogram, blood flow to the right external carotid artery (ECA) was not identified, and the right ECA flow was confirmed through collateral flow from the right vertebral artery (Fig. 2C, D). During symptom manifestation, the patient tested positive for Staphylococcus aureus in a blood culture test. Considering its rapid growth, the patient was diagnosed with a mycotic aneurysm. Considering the complexity of surgical access to the infected surrounding tissue, EVT was performed for aneurysms.

Under local anesthesia, right femoral access was obtained using an 80 cm 8 Fr Shuttle sheath (Cook, Bloomington, IN, USA). Control angiography of the right CCA revealed the presence of a right ECAA (Fig. 3A). The right internal carotid artery (ICA) was selectively catheterized beyond the ECAA using a 125 cm 5 Fr Headhunter 1 angiocatheter and a stiff-type 0.035-inch Radifocus guidewire (Terumo), and an 8 Fr Shuttle sheath was placed in the right CCA (Fig. 3B). Subsequently, the guidewire was exchanged with a 0.035-inch 260 cm exchange guidewire (Terumo, Leuven, Belgium) for stent delivery. An 8.0 mm × 60 mm Covera Plus vascular-covered stent (Bard, Tempe, AZ, USA) was deployed to cover the entire segment affected by the aneurysm (Fig. 3C). A postoperative control angiogram revealed a complete cessation of blood flow into the aneurysm after deployment of the covered stent (Fig. 3D). The patient did not develop any new neurological complications after the procedure. After the procedure, a dual antiplatelet therapy with aspirin and clopidogrel was administered.

The patient received a concurrent course of antibiotic therapy. Considering the methicillin-resistant Staphylococcus aureus (MRSA) bacteremia confirmed by blood cultures, intravenous vancomycin was administered. After a week of vancomycin treatment, the blood cultures turned negative. Intravenous vancomycin was continued for an additional 2 weeks. Upon discharge, the patient was prescribed a one-week course of empirical levofloxacin 750 mg. After 2 weeks, most pulsatile and expansive masses had improved remarkably (Fig. 4A, B). In addition, there was an improvement in the right cerebral hemisphere’s time to peak delay on the postoperative MRI perfusion compared to the preoperative MRI perfusion (Fig. 4C, D). Also, the patient remained free from any discernible atypical neurological manifestations.

**Discussion**

This case report presents a mycotic pseudoaneurysm located at the bifurcation of the right extracranial CCA that was effectively managed using a covered stent. The successful management of this pseudoaneurysm offers evidence to support the viability of EVT as a therapeutic option among the array of treatments available for ECAA.

Mycotic aneurysms are infrequent causes of ECAA and present a clinical challenge in complex and demanding cases. Myotic aneurysms’ most common causative pathogens are *Staphylococcus* and *Streptococcus* species, with diseases such as syphilis, tuberculosis, and untreated infective endocarditis frequently mentioned as the primary underlying conditions [6,7].

The pathophysiology of mycotic aneurysms is the confluence of arterial injury and bacterial seeding, which gives rise to intimal infection [3]. Upon microorganism infiltration into the vessel wall, rapid degradation of the deeper layers ensues, ultimately leading to
Fig. 2. Anteroposterior (A) and lateral (B) projections of the preoperative right common carotid artery angiogram demonstrate the presence of a right extracranial carotid artery aneurysm, with the right external carotid artery (ECA) not being opacified. Anteroposterior (C) and lateral (D) projections of the preoperative right vertebral angiogram revealed collateral flow to the right ECA. Written informed consent was obtained for publication of this case report and accompanying images.

Fig. 3. Preoperative and postoperative angiographic images of the right common carotid artery. (A) A preoperative control angiogram of the right common carotid artery (CCA) revealed the presence of the right extracranial carotid artery aneurysm (ECAA). (B) The right internal carotid artery was selectively catheterized beyond the ECAA using a 125-cm, 5-Fr Headhunter 1 angiocatheter and a stiff-type 0.035-inch Radifocus guide wire, and an 8-Fr Shuttle sheath was placed in the right CCA. (C) An 8.0 mm × 60 mm Covera plus vascular-covered stent was deployed, covering the entire segment affected by the aneurysm. (D) A postoperative control angiogram revealed complete cessation of blood flow into the aneurysm after the deployment of the covered stent. Written informed consent was obtained for publication of this case report and accompanying images.

Fig. 4. (A) Preoperative and (B) 2-week postoperative gross findings of the right extracranial carotid artery aneurysm. A significant reduction in neck swelling is observed after applying the covered stent. (C) Preoperative and (D) postoperative perfusion magnetic resonance imaging findings demonstrate an improvement in right cerebral hemisphere time to peak delay following the application of the covered stent. Written informed consent was obtained for publication of this case report and accompanying images.
the genesis of an aneurysm [3]. This pathophysiological mechanism is precisely why the complete removal of infected tissue becomes crucial, and surgical repair becomes the principle of treatment for mycotic aneurysms beyond the scope of antibiotic therapy alone.

However, the conventional approach to surgical repair has recently been less favored due to a higher prevalence of cranial nerve dysfunction and limited accessibility to infected tissue [8,9]. According to Li et al.’s systematic review [9], there is a growing interest in endovascular stenting for ECAA treatment, particularly in cases where the neck presents challenges due to factors like infection or radiation. Compared to surgical procedures, endovascular stenting eliminates the necessity for general anesthesia and enables continuous intraprocedural neurological status monitoring [9]. In practice, endovascular approaches for ECAA are being successfully performed more frequently than in previous years. Baril et al. [10] introduced the possibility of attempting aneurysm treatment through endovascular procedures, particularly in cases where direct surgical repair is challenging due to previous surgical or radiation therapy or anatomical reasons involving the location of the infected field. Bulsara et al. [11] also presented a case of EVT utilizing a covered stent for a pseudoaneurysm of the right ICA that occurred following MRSA infection.

After identifying ECAA, several EVT options were considered. We initially assessed the feasibility of stent-assisted coil embolization and flow diverter stent placement. However, challenges arose due to the large size of the aneurysm, which made appropriately sized devices unavailable for these techniques. Additionally, the unique blood flow characteristics involving the carotid bifurcation raised doubts about the effectiveness of these methods. These concerns led us to opt for an alternative treatment strategy using a covered stent. Covered stent-grafts are generally used for the treatment of aneurysms and pseudoaneurysms in the aorta, iliac arteries, and femoral arteries; however, several successful cases have utilized covered stent-grafts for pseudoaneurysms in the extracranial carotid artery [12,13]. Gupta et al. [14] demonstrated successful aneurysm removal using a covered stent to treat mycotic intracavernous carotid artery aneurysms.

Several precautions must be taken when performing EVT with a covered stent for ECAA mycotic aneurysms. The first point to consider is that there is no established regimen for antiplatelet therapy after covered stent insertion. Lai et al. [15] suggested that irregular post-procedural antiplatelet therapy and cerebrovascular arteriosclerosis are key predictors of in-stent stenosis or occlusion in covered stents used to treat intracranial vascular disease. Furthermore, they advocated the need to maintain dual antiplatelet therapy for a minimum of 6 months or more. Zhu et al. [16] recommended short-term anticoagulant therapy with low molecular weight heparin after stent graft insertion, followed by at least 6 to 12 months of dual antiplatelet therapy. Following stent-assisted coil embolization, dual antiplatelet therapy is commonly maintained for 6 to 12 months. If the aneurysm does not require retreatment and the stent remains intact, transition to a single antiplatelet agent is considered. The second point of consideration is the necessity for follow-up of ECA occlusion. Immediate occlusion of the ECA was observed on angiography after stent insertion. Owing to the application of a graft stent, ECA occlusion is inevitable, and in most cases, the clinical symptoms of ECA occlusion are not prominent. According to Siracuse et al. [17], ECA stenosis occurring after ICA stent placement did not manifest clinically significant symptoms, and they argued that the possibility of ECA stenosis should not deter from including the ECA origin in ICA stent insertion. Casey et al. [18] emphasized that ECA stenosis can occur frequently following carotid endarterectomy and carotid artery stenting, underscoring the need for long-term evaluation. Despite identifying collateral flow via the vertebral artery into the ECA before stent insertion, regular assessments and follow-up studies are advised to monitor any possible neurological symptoms after ECA occlusion. Finally, from a practical standpoint, it is essential to prepare adequately to ensure medical reimbursement. Covered stent-grafts are generally used for the treatment of aneurysms and pseudoaneurysms in the aorta, iliac arteries, and femoral arteries. Therefore, when submitting insurance claims, it is crucial to provide thorough justification for the necessity of using covered stents in the treatment of ECAA. Fortunately, in this case, there were no issues related to insurance coverage.

Consequently, in cases where surgical treatment complications or limited accessibility are prominent, a covered stent with appropriate antibiotics may be a favorable treatment method for mycotic ECAA.

Conflicts of interest

No potential conflict of interest relevant to this article was reported.

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