CASE REPORT

Carotid stent infection: a rare but potentially fatal complication of carotid artery stenting

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SUMMARY

Infections involving endovascular devices are rare and, to our knowledge, only three cases of infection with an inserted carotid stent have ever been reported. A 68-year-old man underwent carotid artery stenting (CAS) of the left proximal internal carotid artery. Two days after CAS the patient developed a high fever and investigation showed that the inserted carotid stent was infected. The infection could not be controlled despite adequate antibiotic therapy. Eventually a rupture of the carotid artery occurred and the patient underwent emergency resection of the left carotid bifurcation in addition to stent removal and reconstruction with a saphenous vein interposition graft. The patient recovered fully without any neurological sequelae.

BACKGROUND

Infections involving endovascular devices are rare, particularly those associated with a carotid artery stent.^{1–2} We describe a patient who presented with acute systemic sepsis after carotid artery stenting (CAS). An investigation showed that the inserted carotid stent was infected. To our knowledge, carotid stent infection is very rare, with few cases having ever been reported. Because of the potential for a fatal outcome, we report our experience in this case study.

CASE PRESENTATION

A 68-year-old man with plaque in both internal carotid arteries (ICAs) diagnosed 8 years previously developed sudden-onset dysarthria. Upon admission, he was diagnosed with acute infarction of the right basal ganglia. MR angiography showed severe stenosis of the left proximal ICA (figure 1A). CAS to the left proximal ICA was successfully performed 7 days after stroke onset using a carotid WallStent (Boston Scientific, Fremont, California, USA), without any procedure-related complications (figure 1B,C).

Two days after CAS the patient developed a high fever. Phlebitis of the left forearm was identified as the focus. After a fever study, we initiated antibiotic therapy with amoxicillin and clavulanate (Augmentin; Ilsung Pharmaceuticals, Seoul, Korea). Two days later the fever remained and the patient had confusion, leading to a decision to perform a lumbar puncture. The opening pressure of the spinal tap was 140 mm H₂O, and the cerebrospinal fluid had a white blood cell count of 23/μL (95% polymorphonuclear neutrophils, 5% lymphocytes), a protein level of 85 mg/dL and a glucose level of 87 mg/dL (serum 130 mg/dL). Infective

endocarditis with septic meningoencephalitis was suspected; however, no evidence of this was observed on a transoesophageal echocardiogram. The next day the results of a blood culture performed on the first day of fever showed the presence of methicillin-resistant *Staphylococcus aureus*. We therefore changed the antibiotic to vancomycin (CJ Cheiljedang Pharma, Seoul, Korea).

Two days after starting vancomycin the patient complained of mild right-sided weakness with dysarthria. MRI showed newly developed multiple acute infarctions on the left hemisphere, alongside the border zone (figure 1D). At this time the patient complained of swelling in the left neck region. A CT of the neck and carotid Doppler ultrasonogram were performed 9 days after CAS (figure 2A,B). Inflammatory changes with abscess/pseudoaneurysm formation were observed on the lower portion of the stent. The patient was transferred to the division of infectious disease for treatment at 14 days after CAS. The condition of the patient stabilized rapidly; however, the swelling of the neck progressed, despite vancomycin therapy. The antibiotic regimen was therefore changed to linezolid (Zyvox; Pfizer, New York, New York, USA) at 24 days after CAS. Despite this, the follow-up neck CT taken on day 25 after CAS showed signs of an impending rupture of a pseudoaneurysm (figure 2C).

The patient was transferred to another hospital for stent removal. On the day of transfer a rupture of the carotid artery occurred and the patient underwent emergency resection of the left carotid bifurcation in addition to stent removal and reconstruction with a saphenous vein interposition graft. The patient recovered fully without any neurological sequelae.

DISCUSSION

Infections involving an inserted carotid stent are rare. In 2007 Hogg *et al*¹ reported that, between 1991 and 2007, only 35 cases of stent infection were reported and only one of these involved a carotid stent. In a review by Bosman *et al*² in 2014, only 2 of 77 cases with bare metal stent infection were found to have carotid stent infection. The principal difference between the case reported here and those reported previously is the time interval. The time interval from CAS to infection of previous cases was 20 months,³ 13 months⁴ and 24 months⁵ but, in our patient, the infection developed much more acutely. In retrospect, there were indications of a possibility of stent infection in this patient, such as ipsilateral border zone infarction, despite CAS. However, we did not become aware

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Figure 1 (A) Initial gadolinium-enhanced MR angiogram (MRA) obtained on the day of stroke onset. The focal and severe stenosis of the left proximal internal carotid artery (ICA) is shown (white arrow). (B) Extracranial lateral projection angiogram before carotid artery stenting (CAS). The length of the stenotic segment of the left proximal ICA is wider than that of the MRA. (C) Extracranial lateral projection angiogram after CAS. The carotid WallStent is inserted into the stenotic portion of the left proximal ICA. (D) Brain magnetic resonance diffusion-weighted images obtained 8 days after CAS. Newly developed multiple acute infarctions are observed in the internal border zone area of the left hemisphere.

of the possibility of stent infection until the patient complained of neck swelling, leading us to perform the neck CT.

The known risk factors for stent infection include improper sterile technique, prolonged procedure time, puncture site hematoma formation, the septic environment of the angiography room and deployment of multiple stents or multiple

interventions.¹ In our institution more than 300 cases of neurointerventional procedures (including diagnostic angiography) and about 50 CAS procedures are performed annually. This was the first case of stent infection in our institution. The procedure time for this patient was approximately 30 min and he did not receive any additional interventions. Furthermore, the patient

Figure 2 Neck CT (A) and carotid Doppler ultrasonogram (B) obtained 9 days after carotid artery stenting (CAS). Deviated trachea and inflammatory changes with abscess/pseudoaneurysm formation on the lower portion of the inserted stent are shown in (A). Abnormal carotid flows into the abscess/pseudoaneurysm are shown in (B). (C) Neck CT obtained 25 days after CAS. Note the extravasation of contrast, representing arterial disruption and the impending rupture of the pseudoaneurysm.

did not show any evidence of infection clinically or in laboratory results prior to the procedure. We believe an in-hospital methicillin-resistant *S aureus* infection, contracted after CAS, resulted in a secondary infection of the carotid stent.

The exact pathology of stent infection is not fully understood.^{1 2} In animal studies, stents act as a nidus for colonization or a vector for iatrogenic introduction.⁶ The stent may act as a bacterial medium, sequestering bacteria beneath the struts, allowing the infection to spread to the arterial wall. The resulting inflammation causes necrosis and destruction of the arterial wall, which can lead to pseudoaneurysm and subsequent rupture and promote platelet adherence and thrombus formation, resulting in septic emboli.¹ Thus, the natural history of stent infection is progressive arterial destruction, thrombosis, septic embolization, pseudoaneurysm formation, arterial rupture and hemorrhage.^{6 7} This entire process was observed in the case described here.

The treatment of infected stents remains controversial. Successful treatment with antibiotics has been described, but the outcome is fatal in up to 50% of cases.² Similar to infected vas-

cular prostheses, surgical removal is the preferred course of action.^{1 2} We considered surgical removal of the infected stent initially, but hesitated because of the high mortality rate (27.6%).² Furthermore, the patient initially stabilized and showed normal laboratory findings after antibiotic therapy.

Stent infection is a possible complication of CAS and can occur relatively acutely. To prevent infection, periprocedural sterility is important. If infection does occur, early recognition and adequate treatment can prevent a fatal outcome.

Contributors SS wrote the manuscript. OHC helped to write the manuscript. DSC was responsible for the English editing. NCC directed all the process. The final manuscript was approved by all authors.

Competing interests None.

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Learning points

- ▶ Stent infection is a possible complication of carotid artery stenting and can occur relatively acutely.
- ▶ To prevent infection, periprocedural sterility is important.
- ▶ If infection does occur, early recognition and adequate treatment can prevent a fatal outcome.

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