

Case Report

Endovascular reconstruction for a kinked internal carotid artery after carotid endarterectomy

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Received: 17 November 17 Accepted: 25 June 18 Published: 13 July 18

Abstract

Background: Although different surgical techniques have been reported for repairing kinked stenosis of the internal carotid artery (ICA) after carotid endarterectomy (CEA), there are no reports using endovascular reconstruction. We present the details of a case successfully treated by carotid artery stenting (CAS).

Case Description: A 73-year-old female was referred to our department with fugacious amaurosis and transient sensory disturbance in the left upper limb due to moderate stenosis of the right ICA that was treated by CEA 28 days after admission. However, postoperative angiography and carotid Doppler revealed a kinked ICA with a high-flow velocity that was not present intraoperatively. After 3 months, she had suffered transient ischemic attacks that were refractory to medical treatment, so we performed CAS to prevent future events. The kinked ICA was immediately resolved by stenting and there was no restenosis at a follow-up angiogram 19 months later.

Conclusions: This case shows that CAS could be a potential therapeutic option for the management of symptomatic kinking stenosis of the ICA after CEA.

Key Words: Carotid artery stenting, carotid endarterectomy, kinking

Access this article online

Website:www.surgicalneurologyint.com**DOI:**

10.4103/sni.sni_431_17

Quick Response Code:

INTRODUCTION

There are no clearly defined management options for kinking stenosis of the internal carotid artery (ICA) after carotid endarterectomy (CEA). Reports to date have indicated that patch angioplasty,^[10] posterior transverse plication,^[8] other shortening procedures,^[2,3,6,9] and fixing the artery in position with fibrin and gelatin^[4] may be appropriate in certain cases. In this report, we present a case of successful ICA course repair achieved by deploying a stent at the site of the kink. To our knowledge, this is the first report of carotid artery stenting (CAS) for the treatment of kinking stenosis after CEA.

CASE DESCRIPTION

A 73-year-old female was transferred to our hospital with a history of fugacious amaurosis and transient

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How to cite this article: Horio Y, Takemoto K, Sakamoto S, Inoue T. Endovascular reconstruction for a kinked internal carotid artery after carotid endarterectomy. *Surg Neurol Int* 2018;9:135.

<http://surgicalneurologyint.com/Endovascular-reconstruction-for-a-kinked-internal-carotid-artery-after-carotid-endarterectomy/>

sensory disturbance of the left upper limb, but was symptom free at admission. Magnetic resonance imaging showed an acute spotty cerebral infarction lateral to the caudate head, and magnetic resonance angiography revealed moderate stenosis in the right ICA (North American Symptomatic Carotid Endarterectomy Trial [NASCET], 58%). The right ICA was noted to be tortuous, following a curved course medially. Plaque was present and markedly calcified. Also, the origin of the right ophthalmic artery was stenotic and had delayed blood flow on assessment by digital subtraction angiography (DSA) [Figure 1].

Based on the presentation, we performed CEA 21 days after onset to reduce the risk of recurrence. During surgery, no kinking stenosis was observed and video angiography with indocyanine green showed no delay in ICA blood flow. Postoperatively, clopidogrel 75 mg daily was started. Routine DSA revealed severe kinking stenosis of the right ICA. Ophthalmic symptoms appeared 20 days postoperatively. Fundus copy revealed cotton-wool spots in the right eye. Therefore, supplemental aspirin was added at a dose of 100 mg daily. Despite dual therapy, however, her symptoms recurred frequently and were refractory to further medical treatment. Moreover, no improvement of the stenotic lesion was seen on DSA or carotid Doppler ultrasound (peak systolic velocity [PSV], 226 cm/s) after 3 months. Therefore, CAS was performed under filter protection.

During the CAS procedure, the kinking lesion was easily crossed with a micro guidewire and an open cell stent was deployed at the appropriate site. However, navigation of the stent delivery system beyond the kink was difficult. Postoperatively, both the ICA stenosis and the patient's symptoms improved. Fundus copy showed that there had been resolution of the cotton-wool spots in her right eye



Figure 1: Preoperative carotid angiography. Anterior–posterior (a) view on preoperative carotid angiography showing moderate stenosis of the right ICA. The origin of the right ophthalmic artery was stenotic (white arrow), and blood flow was delayed (b)

after CAS. No restenosis was seen by DSA performed 19 months after the procedure [Figure 2].

DISCUSSION

Yuan *et al.* reported that kinking stenosis detected by intraoperative ultrasonography during CEA was seen in approximately 27 of 285 patients (9.5%). They asserted that these cases were caused by differences in the arterial wall thicknesses of the proximal and distal ICA, where newly patent vessels with thin walls after CEA were unable to support the acute changes in flow rate and velocity.^[10] In addition, Paulsen reported that 10% of ICAs follow a medially curved course, and aging and atherosclerotic changes can increase vessel tortuosity.^[7] Either together or in isolation, these factors may contribute to the occurrence of kinking.

The accurate timing of kinking is unclear. We assume that most of the kinking may occur intraoperatively or immediately after CEA, when the rotated head is returned to its actual position. Intraoperative DSA may be useful for detecting kinking at that particular time.

It was also reported by Yuan *et al.* that a kinking stenosis with hemodynamically significant PSV (>120 cm/s) on intraoperative duplex ultrasonography should be repaired.^[10] Based on this indication, 11 of their 285 cases (3.9%) were repaired using a synthetic patch, and none of these experienced strokes because of kinking. They also reported that 16 patients with kinking stenosis and nonhemodynamically significant PSV (<120 cm/s), and who only underwent direct primary closure, remained asymptomatic throughout their 24-month follow-up period. The degree of vessel stenosis in these cases improved naturally by 4–8 months after surgery in two patients. We also experienced spontaneous improvement in such patients [Figure 3]. Here, we expected the



Figure 2: Postoperative angiography. Postoperative DSA (a) revealed kinking stenosis of the right ICA (white arrow). CAS was performed, and the stenotic lesion was improved (b). Restenosis did not occur as of 19 months after CAS (c)

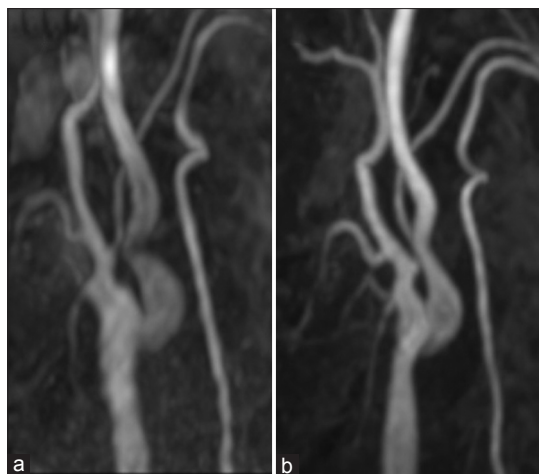


Figure 3: Representative imaging in a 60-year-old male with asymptomatic right ICA stenosis. CEA was performed, and the right ICA was kinked but asymptomatic after the procedure. The stenotic lesion subsequently improved without intervention, and the patient remained free of strokes. The images are taken after 2 months (a) and after 39 months (b)

kinking stenosis to naturally improve and make her symptom disappear. We were also concerned about the mechanical stress caused to the fragile ICA immediately after CEA. We first observed the patient using medical treatment for 3 months, therefore, although the optimal management of kinking stenosis after CEA remains unclear, conservative treatment remains a viable option for asymptomatic lesions because the kinking stenosis can improve spontaneously.

Regarding the surgical options for repair of kinking stenosis after CEA, various procedures have been reported. However, we selected CAS because redo surgery has been reported to cause temporary cranial nerve injury in 13% of patients with restenosis after CEA.^[5] Ahmadi *et al.* have also reported that CAS can be performed successfully for spontaneously kinked ICAs caused by arterial elongation.^[1] We believe our case is the first in which CAS was performed for kinking stenosis after CEA. We achieved successful course repair by stent deployment at the kink site, but marked tortuosity of the stenotic lesion meant that it was hard to deliver the device. We first tried the buddy wire technique. We expected the kink to straighten owing to the 0.014-inch outer diameter hard guidewire across the stenotic lesion. However, kinking was still observed. We thus stopped using that method and switched to simple filter protection. We achieved straightening of the stenotic after the stent delivery system was pushed slightly hard and the stent reached the stenotic lesion. This might be an effective option to use a stent designed to accept a

0.035-inch outer diameter guidewire. Another issue with the procedure is that it takes a long time to complete. Therefore, although CAS was possible and resulted in good outcomes, it was not a technically easy procedure. Unless patients are symptomatic, we recommend that conservative treatment retains priority over CAS.

CONCLUSION

Kinking stenosis of the ICA after CEA can improve naturally over time, so in asymptomatic patients, conservative treatment may be the best option. However, revascularization is recommended when patients are symptomatic, and given the risk of cranial nerve injury with other procedures, we believe that CAS represents a promising alternative to current treatment strategies. Further research is required to elucidate the safety of the procedure.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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