Bilateral Migration of Open-Cell Design Carotid Stents in the Early Post-Procedure Period: a Rare Complication

AMAR SWARNKAR¹, SHRI HARSHA KRISHNA¹, NICOLE ZIMMERMAN¹, JULIUS LATORRE², ERIC M DESHAIES³

¹ Department of Radiology, SUNY Upstate Medical University; Syracuse, NY USA

² Department of Neurology, ³ Department of Neurosurgery, Upstate Medical University; Syracuse, NY USA

Key words: carotid artery, stent, open-cell, migration

Summary

We describe migration of bilateral carotid stents in a 63-year-old man shortly after stenting. Carotid stent migration was found four days post-procedure on the right side and one day post-procedure on the left side on angiography and duplex ultrasound, respectively. This is the first reported case of bilateral carotid artery stenting complicated by bilateral proximal migration of open-cell design stents in the early post-procedure period.

Introduction

Carotid artery angioplasty and stenting is a treatment option for significant carotid artery stenosis¹. Common post-procedural complications reported in the literature include stroke, myocardial infarction and death^{2,3}. Long-term complications include in-stent re-stenosis or stent occlusion. Stent migration is a rare occurrence, and has only been reported with closed-cell design stents^{4,5}.

Case Report

A 63-year-old man presented with left extremity weakness and paresthesias to a nearby hospital. He had had bilateral carotid endarterectomy six months prior to presentation, com-

plicated by hematoma formation bilaterally, which required surgical evacuation. A non-enhanced CT scan of the head performed at the outside facility showed trace subarachnoid hemorrhage over the cerebral convexities. The patient was transferred to our institution and a diagnostic cerebral angiogram revealed bilateral severe carotid stenosis but no aneurysms or arteriovenous malformations. MRI revealed multiple acute small infarcts along the watershed territories suggesting perfusion failure. As a result, bilateral carotid angioplasty was done in stages.

A 90 cm long 6F NeuronMax carotid sheath (Penumbra Inc, Alameda, CA, USA) was placed in the right common carotid artery (CCA). The stenosis measured 5.2 cm in length with 90% maximal narrowing. The CCA proximal to stenosis measured 3.4 mm in diameter and the internal carotid artery (ICA) distally measured 2.3 mm in diameter (Figure 1A). Due to long segment stenosis, we planned to use two overlapping stents across the stenosis. After balloon angioplasty using a 3.5 mm × 30 mm TREK balloon (Abbott Vascular, Santa Clara, CA, USA), a 5 mm × 40 mm RX Acculink stent (Abbott Vascular, Santa Clara, CA, USA) was placed distally, followed by a 5 mm × 20 mm RX Acculink stent proximally. During deployment, the second stent moved proximally and there was a 3 mm unprotected segment between the two stents. An additional 6 mm × 20 mm Acculink stent was placed to bridge the

Figure 1 A) Pre-stenting diagnostic angiogram demonstrates long segment stenosis of the right carotid bifurcation region with maximal stenosis up to 90%. B) Angiogram after placement of three overlapping stents across the right carotid stenosis. Black arrows point to the region of overlap of the third stent bridging the first and second stents. C) Angiogram on day four post-stenting of the right carotid. Black arrows point to the unprotected segment resulting from stent migration.

gap to prevent possible kinking, stenosis, or dissection. The post-procedure angiogram showed satisfactory restoration of the lumen (Figure 1B).

On day four, the patient returned for left carotid stenting. A 90 cm long 6F NeuronMax carotid sheath (Penumbra Inc, Alameda, CA, USA) was placed in the left CCA. Diagnostic angiography showed a 7 cm long segment of stenosis with up to 80% narrowing with slightly irregular contour. The CCA proximal to the stenotic segment and the ICA distal to it measured 4 mm and 3.8 mm in diameter, respectively (Figure 2A). A 5 mm Emboshield device (Abbott Vascular, Santa Clara, CA, USA) was deployed in the distal left ICA. Balloon angioplasty was performed using a 4 mm × 30 mm Viatrac 14 Plus balloon (Abbott Vascular, Santa Clara, CA, USA). A 5 mm × 40 mm Acculink stent was deployed distally. A 6 mm × 40 mm Acculink stent was then deployed and overlapped the distal stent by 7 mm (Figure 2B).

During left ICA stenting, we incidentally noted migration of the recently placed stents in the right carotid artery. Angiography of the right carotid artery showed caudal migration of

the proximal stent and cranial migration of the distal stent, with 9 mm separation between the ends of the stents. Spasm and irregularity of the unprotected segment were seen (Figure 1C). A 6 mm × 40 mm Acculink stent was deployed to cover the area of separation.

On day five, the patient underwent duplex ultrasonography of the carotid arteries bilaterally. The scan showed migration of both stents in the left carotid artery, measuring to a separation of 12 mm (Figure 3). The patient did not have any clinically significant narrowing of the carotids. At this stage, no further intervention was done. Three months post-procedure, the patient was asymptomatic and back to his baseline on dual antiplatelets.

Discussion

Recurrent symptomatic stenosis after carotid endarterectomy is one of the indications for carotid artery stenting. Early and delayed complications have been described after carotid stenting, including stroke, myocardial infarction, death, stent re-stenosis and occlusion. Stent mi-

Figure 2 A) Pre-stenting diagnostic angiogram demonstrating long segment stenosis of left carotid bifurcation region with nearly 80% stenosis. B) Angiogram after placement of two overlapping stents across the left carotid stenosis. Black arrows point to the region of stent overlap.

Figure 3 Carotid ultrasound on day one post-stenting of the left carotid. White arrows point to the proximal and distal ends of the two stents, which have separated as a result of stent migration.

gration has rarely been described. Two previously published cases include a report of proximal migration of a carotid artery stent identified at eight-month follow-up and a case of distal migration of a stent placed in the CCA identified at 15-month follow-up^{4,5}.

The precise cause of stent migration is not known although several hypotheses have been postulated, including the “watermelon seeding” effect described by Badruddin et al.⁴. They described stent migration after deployment of a 2 cm long closed-cell design stent across a short segment of ICA stenosis with angulation close to the stenotic site. A large gradient in vessel diameter between the proximal and distal segments may encourage the watermelon-seeding effect. Deployment of short stents in regions of vessel kinking and tortuosity may also predispose to migration. In our case, the stenotic segments were not significantly kinked or angulated. We believe that the fibrosis and loss of elasticity at the surgical site related to postoperative

hematoma formation may have played a role. Currently most centers use self-expandable nitinol stents for carotid artery stenting. Open-cell stents have greater flexibility and a lower tendency to kink⁶. The design permits independent and variable expansion of individual segments of the stent yielding an advantage in vessels where there is a large gradient in luminal diameter. This differential expansion may prevent stent migration. The RX Acculink stent is an open-cell design nitinol stent and is therefore less likely to migrate. Both cases of carotid stent migration reported previously occurred with closed-cell design stents^{4,5}.

In both of the cases reported previously, stent migration was identified on imaging performed several months after placement. We demonstrated migration in the first few days after placement. After placement of an endovascular stent, ingrowth of endothelium tends to occur, with incorporation of the stent into the vessel wall, which is expected to prevent stent migration. We postulate that if a stent migrates, it does so earlier rather than later. Additionally, over-sizing the stent diameter or using a tapered design such as the 6-8mm Acculink stent, may reduce the risk of stent migration.

Conclusion

Carotid stent migration is an uncommon complication, but there may be an increased tendency for this to occur in specific clinical scenarios. In such cases, early follow-up imaging with CT, ultrasound or even plain radiographs may enable detection.

Disclosure

Author disclosure: EMD is a physician consultant for ev3/Covidien, MicroVention, and Integra.

References

- 1 Brott TG, Halperin JL, Abbara S, et al. 2011 2011 2011 ASA/ACCF/AHA/AANN/AANS/ACR/ASNR/CNS/SAIP/SCAI/SIR/SNIS/SVM/SVS guideline on the management of patients with extracranial carotid and vertebral artery disease: executive summary: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American Stroke Association, American Association of Neuroscience Nurses, American Association of Neurological Surgeons, American College of Radiology, American Society of Neuroradiology, Congress of Neurological Surgeons, Society of Atherosclerosis Imaging and Prevention, Society for Cardiovascular Angiography and Interventions, Society of Interventional Radiology, Society of NeuroInterventional Surgery, Society for Vascular Medicine, and Society for Vascular Surgery. *J Am Coll Cardiol*. 2011; 57 (8): 1002-1044. doi: 10.1016/j.jacc.2010.11.005.
- 2 Habersberger J, Brott TG, Roubin GS. Carotid artery stenting: a clinical update. *Curr Opin Cardiol*. 2012; 27 (6): 565-571. doi: 10.1097/HCO.0b013e3283587506.
- 3 Lal BK, Beach KW, Roubin GS, et al. Restenosis after carotid artery stenting and endarterectomy: a secondary analysis of CREST, a randomised controlled trial. *Lancet Neurol*. 2012; 11 (9): 755-763. doi: 10.1016/S1474-4422(12)70159-X.
- 4 Badruddin A, Lazzaro MA, Taqi MA, et al. Downward migration of carotid stent on 8 months follow-up imaging: possible stent "watermelon-seeding" effect. *J Neuroimaging*. 2011; 21 (4): 395-398. doi: 10.1111/j.1552-6569.2011.00586.x.
- 5 Castriota F, Martins EC, Dall'Olmo CA, et al. Stent migration as a late complication following carotid angioplasty and stenting. *Eurointervention*. 2008; 4 (3): 397-399; discussion 400-404. doi: 10.4244/EIJV4I3A69.
- 6 Wholey MH, Wholey M, Mathias K, et al. Global experience in cervical carotid artery stent placement. *Catheter Cardiovasc Interv*. 2000; 50 (2): 160-167.

Amar Swarnkar, MD
Department of Radiology
SUNY Upstate Medical University
750 East Adams Street
Syracuse, NY 13210 USA
Tel.: 1 315 464 7439
Fax: 1 315 464 7494
E-mail: swarnkaa@upstate.edu