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Case Report

Delayed Carotid Wallstent Shortening Resulting in Restenosis Following Successful Carotid Artery Angioplasty and Stenting

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Carotid angioplasty and stenting (CAS) for carotid stenosis has been increasingly used as an alternative treatment in patients not eligible for surgery. Even though CAS can be performed relatively simply in many cases, various complications can occur. We report four cases of CAS using the Carotid Wallstent, which were complicated by delayed shortening of the stent, resulting in restenosis after successful CAS.

KEY WORDS : Carotid angioplasty and stenting · Stent shortening · Restenosis.

INTRODUCTION

Carotid angioplasty and stenting (CAS) is a minimally invasive technique that is gaining wide acceptance in carotid revascularization for high-grade carotid artery stenosis. CAS for carotid stenosis augments cerebral blood flow and stabilizes atherosclerotic plaques, thereby preventing hemodynamic and/or embolic ischemic stroke[2]. Even though the CAS is technically simple and is considered a low risk procedure, various complications such as transient hypotension, bradycardia, distal embolization, hyperperfusion syndrome, intracranial hemorrhage and carotid dissection have been reported[4,5]. However, delayed shortening of the Carotid Wallstent resulting in restenosis has never been reported in the literature. The authors report four cases of delayed Carotid Wallstent shortening resulting in restenosis and discuss the possible mechanisms of this complication.

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CASE REPORT

Case 1

A 72-year-old male patient presented with recurrent transient ischemic attacks in the left internal carotid artery (ICA) territory. Digital subtraction angiography (DSA) showed severe left proximal ICA stenosis [North American Symptomatic Carotid Endarterectomy Trial (NASCET) criteria; 92%] associated with a tortuous cervical ICA (Fig. 1A). A CAS procedure was performed under local anesthesia with embolic protection devices. Predilatation was performed using a 4 mm diameter balloon (Ultrasoft-SV, Boston Scientific, Natick, MA, USA). Stent deployment was then performed using a 9×40 mm self-expandable Carotid Wallstent (Boston Scientific). Postdilatation was performed due to residual stenosis using a 6 mm diameter balloon. Angiography immediately after CAS showed successful stent implantation without residual stenosis even though straightening of the cervical ICA was evident (Fig 1B). A follow-up angiography at 5 months showed stent shortening toward the proximal end and stenosis at the distal portion of the stent (Fig. 1C). Repeated CAS was planned but could not be performed because the patient died due to a contralateral acute middle cerebral artery (MCA) occlusion.

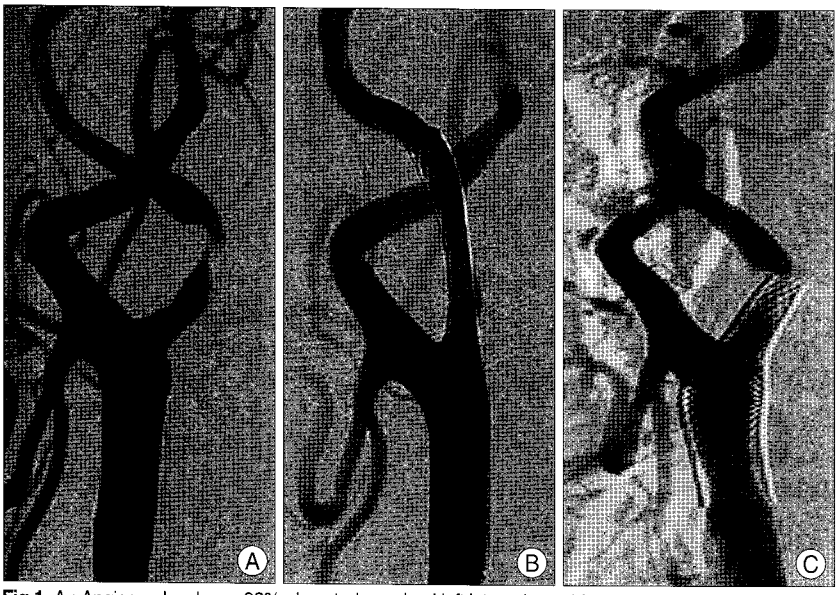

Fig 1. A : Angiography shows 92% ulcerated, proximal left internal carotid artery stenosis associated with a tortuous cervical ICA. B : Angiography after stenting shows no residual stenosis with straightening of the cervical ICA. C : Five months later, follow-up angiography demonstrats stenosis at the distal portion of the stent due to stent shortening.

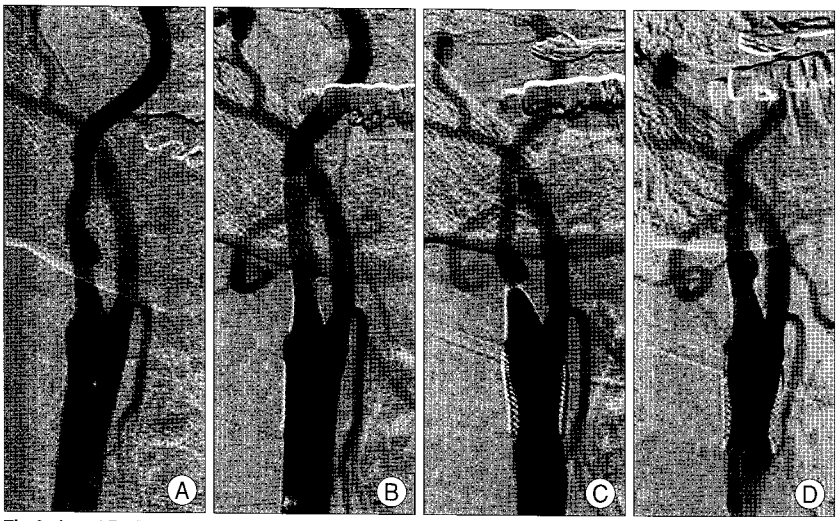

Fig 2. A and B : Right carotid angiogram before and after stenting. C : Two months after carotid stenting, angiogram demonstrates stent shortening and stenosis at the distal portion of the stent. D : After retreatment with a Precise Stent.

Case 2

A 61-year-old female presented with symptomatic, severe stenosis of the left proximal ICA. CAS was performed using a 7 × 40 mm Carotid Wallstent. Immediate post-stent angiography showed successful deployment of the stent covering 15 mm of normal ICA beyond the stenotic portion. A follow-up DSA obtained 8 months later revealed proximal shortening of the stent and stenosis of the distal portion of the stent. Additional follow-up DSA obtained 4 years later showed that the stenosis had progressed; however, we were unable to retreat the patient, because another follow up was not obtained.

Case 3

A 53-year-old male was admitted with recurrent cerebral infarctions in the left MCA territory. DSA showed severe stenosis of the right proximal ICA. A 7×40 mm Carotid Wallstent implantation was performed. A follow-up DSA obtained 2 years later revealed shortening of the Wallstent toward the proximal end and stenosis of the distal portion of the stent. An additional CAS was done using a self-expandable 7 × 40 mm Smart Control Stent (Cordis, Warren, NJ, USA). ICA flow through the stent was competent without restenosis at 7 month follow-up DSA after restenting.

Case 4

A 67-year-old male with symptomatic, moderate, right proximal ICA stenosis (NASCET criteria 56%) associated with contralateral carotid occlusion underwent CAS using a 10×40 mm Carotid Wallstent even though the common carotid artery diameter was 10.5 mm (Fig. 2A and B). Post-dilatation could not be done because he was intolerant of numbness in his lower extremity resulting from severely disturbed blood flow due to underlying severe atherosclerotic disease in both iliac arteries. A satisfactory angiographic outcome was achieved immediately; however, stent shortening resulting in restenosis after one month (Fig. 2C). The patient underwent retreatment with a Precise Stent (Cordis) (Fig. 2D). He is doing well at 20 months follow-up.

DISCUSSION

Although carotid endarterectomy is the established gold standard for carotid revascularization, CAS is continually being developed as a safer and more effective method of stroke prevention[3]. Even though the CAS can be performed simply in many cases, various complications can occur. Reported complications of CAS include major and minor strokes due to thromboembolism or intracerebral hemorrhage, transient hypotension, bradycardia, hyperperfusion

syndrome and carotid artery dissection[4,5].

We describe four cases of delayed stent shortening resulting in restenosis after successful CAS. This complication may have occurred due to inexperienced surgeon's technique or stent type. Currently available carotid stents are divided into two categories based on the cell design (i.e., open-cell design and closed-cell design). Each of them offers certain key advantages. Closed-cell stents are excellent in terms of plaque coverage and lesion crossability. They, however, have the disadvantages of shortening or lengthening of the stent during or after deployment compared to open-cell stents. In spite of their merits and disadvantages, there are no data to support the superiority of a specific carotid stent cell design with respect to outcome after CAS[6].

In our cases, Carotid Wallstents were used for these four patients. The Carotid Wallstent was used because no open cell type stent was available in our hospital at that time and in retrospect it may have not been the appropriate choice. The Carotid Wallstent is a closed cell type with self-expanding design. Its advantages are the smooth mesh construction made of elgiroy (cobalt-chrome alloy), the dilation power, and the ability to reconstrain the stent in the exterior tube before deployment. Stent shortening, however, during or after stenting can occur.[1]

In addition, in our cases, the stents were well-placed but delayed stent shortenings were observed. This complication has not been reported yet. The authors' opinions about the reason for delayed stent shortenings were as follows. Firstly, this complication could be explained by the elastic recoil of the tortuous carotid artery, which was straightened after CAS. Elastic recoil force might repeatedly push the stent downward, resulting in shortening of the stent. Secondly, stent shortening seemed to be induced by the marked diameter mismatch between the CCA and ICA. In case 4, the CCA diameter was approximately 10.5 mm whereas the ICA diameter was 5 mm. This diameter mismatch resulted in a rather conical shaped Wallstent implantation. After implantation, post-stent balloon dilatation was not performed, thus a tight apposition of the stent and vessel wall could not be achieved immediately. A slow and further expansion of the Wallstent at the CCA level might have caused stent shortening, which pulled the distal end of the stent downward. To prevent this complication, it might be reasonable to place the center of the stent at or above the stenotic portion and try to get tight apposition of the stent when closed cell design stents are used.

Interestingly, restenosis occurred at the exact site of the migrating stent tip in all four cases. We hypothesize that constant irritation from the migrating stent tip caused intimal injury and reactive hyperplasia resulting in the progressive stenosis at the distal stent margin; however, we are not yet certain. In addition, the whole stent did not migrate more into the CCA. The upper part of the stent was displaced along the artery by the stress produced by the pulsating of the artery. When the whole stent is put under enough procedure, the displacement seems to stop. However, this is only speculation.

CONCLUSION

Delayed Carotid Wallstent shortening and restenosis can occur even after successful CAS. Therefore, regular short term follow-up evaluation is important to detect unexpected complications such as stent shortening.

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