Carotid artery stenting by non-femoral arterial approach in patients with difficult anatomy

R. V. Narayana[1], Rajesh Pati[2], Sibasankar Dalai[3]

[1,2]Departments of Neurology and [3]Interventional Neuroradiology, Seven Hills Hospital, Visakhapatnam, Andhra Pradesh, India

ABSTRACT

Background: Carotid endarterectomy (CEA) and carotid artery stenting (CAS) are safe, effective, and standard methods to treat significant carotid artery stenosis. CAS is generally performed through femoral arterial access. We had six patients with significant carotid artery stenosis, who had difficult anatomy prohibiting a trans-femoral CAS. Those patients were given an option for CEA. However, they refused for surgical intervention. **Aim:** We investigated the feasibility of performing CAS from a non-femoral arterial approach in patients with difficult anatomies like severe aortic/aorto-iliac disease, tortuous aortic arch, and tortuous carotid artery origin. **Materials and Methods:** Six patients with difficult anatomy presented to us with either transient ischemic attack or stroke with high-grade carotid artery stenosis. Out of the six patients, three had aorto-iliac disease, one had high-grade coarctation of aorta, two had tortuous aortic arch and or tortuous carotid artery origin. All these patients were treated with CAS though non-femoral arterial route. **Results:** CAS could be done successfully in all these six patients; four of them were done through trans-brachial arterial route and two were done through a direct carotid artery puncture. There were no new neurological deficits seen in any of the patient post-procedure. **Conclusion:** CAS can be done safely through non-femoral arterial approach in patients with difficult anatomy.

Key words: Carotid artery stenting, common femoral artery, direct carotid puncture, endovascular, trans-brachial

INTRODUCTION

Carotid artery stenting (CAS) is an accepted technique for the treatment of patients considered high risk for endarterectomy.[1] A majority of carotid interventions are successfully performed using percutaneous common femoral artery (CFA) cannulation. Despite the technologic advances in catheters and guide wires, sometimes a trans-femoral approach is not possible due to severe atherosclerotic changes, tortuosity of the aortic arch, and/or brachio-cephalic trunks.[2] Hence, a non-femoral arterial approach like trans-brachial and direct carotid artery puncture has been used for CAS.[3]

MATERIALS AND METHODS

We have six patients of CAS preformed through a non-femoral arterial approach. This was done as it was not possible to perform CAS through a CFA approach. These cases were treated with a trans-brachial arterial approach in four cases and direct carotid puncture (DCP) in two cases.

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Trans-brachial Arterial Approach

Four cases of CAS were done through a trans-brachial approach. These patients presented with (1) coarctation of aorta, (2) post-aorto bi-femoral graft in one patient each, and (3) aorto-iliac disease in two patients.

A 54-year-old man presented with transient ischemic attack (TIA) in right internal carotid artery (ICA) territory with severe, uncontrolled hypertension on two antihypertensives. CT scan and carotid artery Doppler studies were done. Computed tomography (CT) scan was normal, and carotid arterial Doppler showed approximately 90% stenosis of the right ICA origin. The patient was posted for digital subtraction angiogram (DSA) of the carotid and cerebral vessels via a CFA route. However, the diagnostic catheter could not be progressed beyond the thoracic aorta. Hence, the patient was further investigated by CT angiogram of the entire aorta and carotid vessels. CT angiogram showed severe coarctation of aorta and high grade stenosis of right ICA origin. Hence we planned a trans-brachial arterial CAS with distal embolic protection.

Address for correspondence: Dr. Sibasankar Dalai,
OP No: 12, First Floor, Seven Hills Hospital, Waltair Main Road, Visakhapatnam, Andhra Pradesh, India. E-mail: sibasankar@gmail.com

The right brachial artery was punctured using a 16G Gelco double wall puncture needle. A 7F short sheath was placed in the brachial artery. The right common carotid artery was cannulated with a 4F Sim 2 catheter. The right common carotid artery angiogram demonstrated critical stenosis of the ICA origin [Figure 1a]. A 0.035 terumo guide wire was navigated into the external carotid artery and parked in the internal maxillary artery. After that the Terumo wire was exchanged with a 0.035 Teflon wire. A 7F renal double curve guiding catheter was navigated till the distal common carotid artery. A NAV6 (Abbott Endovascular, USA) distal embolic protection device was navigated into the right ICA and deployed at the petrous portion of the ICA. A 6 mm × 8 mm × 40 mm, self expandable, Acculink (Abbott Endovascular, USA) stent was navigated across the right ICA lesion and deployed. The post-stent angiogram demonstrated 50% residual stenosis of the right ICA origin. Hence, a post-stent balloon angioplasty was done with a 5 mm × 20 mm balloon. The final angiogram demonstrated good flow in the carotid with no significant residual stenosis [Figure 1b]. The entire procedure was uneventful. The patient was discharged on day 3 of procedure. He was advised to come for a follow up after 4 weeks. Cardio thoracic surgeon opinion was sought for coarctation of aorta.

Our second patient was a 62 year male, a known case of aorto-iliac disease and had undergone aorto bi-femoral graft in the past. He presented with TIA in the right ICA territory and carotid artery Doppler demonstrated 80% stenosis of the right ICA origin. A trans-brachial CAS was done for him successfully.

The third and fourth cases were 44 year old male smoker and 68 year old male, both were known cases of severe aorto-iliac disease presented to us with TIA and stroke in the right ICA territory, respectively. Carotid arterial Doppler demonstrated approximately 70% and 85% stenosis of the right ICA, respectively. Both the patients underwent transbrachial CAS successfully. The procedures were uneventful.

Direct Carotid Puncture

Two cases of CAS were done through DCP because of extreme tortuosity of the arch of aorta, carotid artery origin, and proximal course of CCA.

A 73-year-old man presented with progressive memory loss, repeated episodes of TIA in the left ICA territory in the last 6 months. MRI study of the brain and carotid artery Doppler were done. MRI brain showed multiple lacunar infarcts and carotid arterial Doppler showed critical stenosis of the left ICA origin. DSA through a trans-femoral arterial route was done, which showed extreme tortuosity of the aortic arch with a tight curve in the proximal CCA course.

The left CCA origin could be cannulated with lot of difficulties and the left CCA angiogram demonstrated critical stenosis of the left ICA origin. However, the catheter could not be progressed beyond the origin in an attempt to CAS. Trans-brachial CAS also could not be done due to the difficult anatomy. CEA was offered to the patient, but the patient refused surgery. Then, it was decided to do a DCP.

Under general anesthesia, the left common carotid artery was punctured opposite to C6 vertebra using a 16G, single wall puncture needle. A 0.035 guide wire was navigated for approximately 6 inches into the CCA. A 7F short sheath was placed into the CCA with the distal end of the sheath proximal to the bifurcation and an angiogram was done through the sheath, which demonstrated critical stenosis of the ICA origin [Figure 2a]. A NAV6 distal embolic protection was navigated into the ICA under roadmap guidance and a 6 mm × 8 mm × 40 mm stent was navigated and placed across the lesion. The post-stent angiogram demonstrated good caliber of the ICA [Figure 2b]. The sheath was removed and

Figure 1: (a) Anterio-posterior and lateral view of right transbrachial common carotid artery angiogram demonstrating critical stenosis of right internal carotid artery origin. (b) Lateral view of right common carotid artery angiogram after transbrachial carotid artery stenting

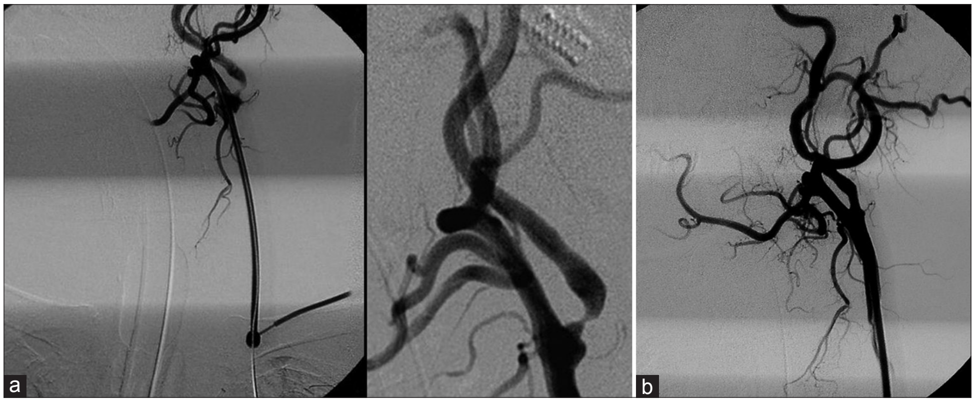

Figure 2: (a) Anterio-posterior view of left common carotid artery angiogram from a direct carotid puncture showing critical stenosis of the internal carotid artery origin. (b) Anterio-posterior view of left common carotid artery angiogram after stenting from a direct carotid puncture

manually compressed till the homeostasis was achieved. The patient was closely observed for hematoma of the puncture site for next 6 hours. The procedure was uneventful. The patient was discharged after 2 days of the procedure.

The second patient in the CAS through DCP group was a 78 year old male, known diabetic and hypertensive presented with multiple episodes of TIA. MRI of brain showed multiple lacunars infarcts. MRA of the neck vessel demonstrated approximately 80% stenosis of the left ICA origin with an ulcerated plaque. A DSA of the arch and carotid vessels demonstrated extreme tortuosity of the aortic arch and carotid arteries. A trans-femoral arterial/trans-brachial arterial CAS could not be done. CEA was offered to the patient but the patient refused to undergo surgery. Hence, a DCP was done and a 7 mm × 10 mm × 40 mm Acculink, self-expandable stent was placed across the lesion with a distal embolic protection device (NAV6, Abbott Vascular). The post-stent angiogram showed no significant residual stenosis. The procedure was uneventful.

RESULTS AND DISCUSSION

The modern technique to access the vascular system through a peripheral vessel was introduced by Seldinger using a two-piece (needle and stylet) 18-G needle.[4] The right CFA is the most commonly used artery for performing majority of the peripheral interventions including CAS as this permits easy catheter and table manipulation with the operator standing on the right side of the patient. However, the presence of aorto-iliac disease or tortuosity negates the possibility of advancing a sheath from the femoral to the carotid artery. Hence, CAS via non-femoral arterial access is considered as an option by experienced carotid stent operators in situations where carotid revascularization is deemed essential and alternate options are absent. The brachial/radial artery may be successfully used as an alternative route even in the more complex carotid intervention with distal protection.[5-7]

DCP has been used for several years as a route to access the cerebral vasculature bypassing the tortuous anatomy of the aortic arch and the brachiocephalic trunks.[8,9] DCP for CAS has been described in the past. However, it should be performed in extremely selected cases and with great caution only by an experienced operator. CEA is the treatment of choice in these patients. But, we had to perform CAS through a DCP, despite it being a risky procedure, as our patients refused to undergo surgery.

The major complications seen with DCP are dissection and hematoma. An atherosclerotic plaque in CCA may pose difficulty in placing a sheath and sometimes this may lead to distal embolism. As these patients are on double antiplatelets prior to stenting, puncture site complications may be higher in these cases.

To avoid some of the puncture-related complications, a DCP may be done using ultrasound guidance. We elected to do the carotid puncture without ultrasound guidance because of our good previous experience with carotid puncture for other neurointerventional procedures.

Hemostasis after sheath removal can be challenging. Hematoma of the neck that could compromise the airway is among the most feared complications. Hemostasis is achieved generally by a through manual compression. Hemostatic devices also have been used in the past for closure of a DCP.[9]

CAS through a non-femoral arterial route is not commonly required. However, a difficult situation as we encountered in the above cases warrants for a different approach. In a selected group of patients, a CAS through a DCP approach might be beneficial.[9,10] These patients must be offered CEA before proceeding with a DCP for CAS as DCP is a highly risky procedure. For patients undergoing CAS, a Doppler study of bilateral iliac arteries may be performed prior to a DSA to avoid possible problems of safe access during intervention.

Endovascular interventions continue to improve with improved catheter, guide wire, stent, and imaging technologies. However, the ultimate success or failure of an endovascular intervention may rest heavily on the operator's experience to plan and execute a safe and rational strategy.

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