VDM Vascular Disease Management

CASE REPORT

PEER REVIEWED

Reversing Course: A Retrograde Approach to Stenting the Common Carotid With Simultaneous Internal Carotid Artery Stenosis

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Abstract

Carotid artery stenting (CAS) is a minimally invasive approach to treating carotid artery stenosis. A retrograde approach to CAS is a unique technique that can be used where a conventional antegrade approach poses technical challenges and risk of complications. This approach offers procedural ease and improved safety with a lower stroke risk compared with the traditional transfemoral approach. Distal clamping is employed for neuroprotection, diverging from the traditional embolic protective devices. We present 2 cases of retrograde CAS in patients with complex vascular anatomy, highlighting the technique's effectiveness and safety. A literature review underscores the method's benefits and risks.

Case Presentation

An 82-year-old man with a medical history of coronary artery disease (CAD) status post coronary artery bypass grafting and percutaneous intervention (PCI), peripheral arterial disease (PAD), hypertension, sick sinus syndrome with a permanent pacemaker, and paroxysmal atrial fibrillation presented with more than 6 months of lightheadedness and loss of balance. A computed tomography (CT) angiogram revealed 70% to 75% stenosis at the proximal segment of the left internal carotid artery (ICA) at bifurcation and the ostial common carotid artery (CCA), 99% subclavian artery stenosis, and a heavily calcified type 3 aortic arch (**Figure 1**). Given the ostial location, degree of calcification, and severe angulation related to a type 3 arch, a retrograde approach was favored over the traditional transfemoral route due to concerns about safe catheter and wire maneuverability. Treatment was planned with a hybrid approach, where a vascular surgeon and interventional cardiologist worked in tandem. In a multistage procedure, the patient first underwent stenting of a left sub-totally occluded subclavian artery via a transfemoral approach. Three weeks later, he returned for a hybrid procedure. Under general anesthesia, the vascular surgeon first performed the carotid cutdown. Neuroprotection was achieved using distal clamping of the ICA and external carotid artery. Following standard heparinization, a short 6Fr sheath was placed in a retrograde manner over a 0.35" Supra Core wire (Abbott) (**Figure 2**). Afterwards, the patient underwent a typical carotid endarterectomy (CEA) by CT surgery.

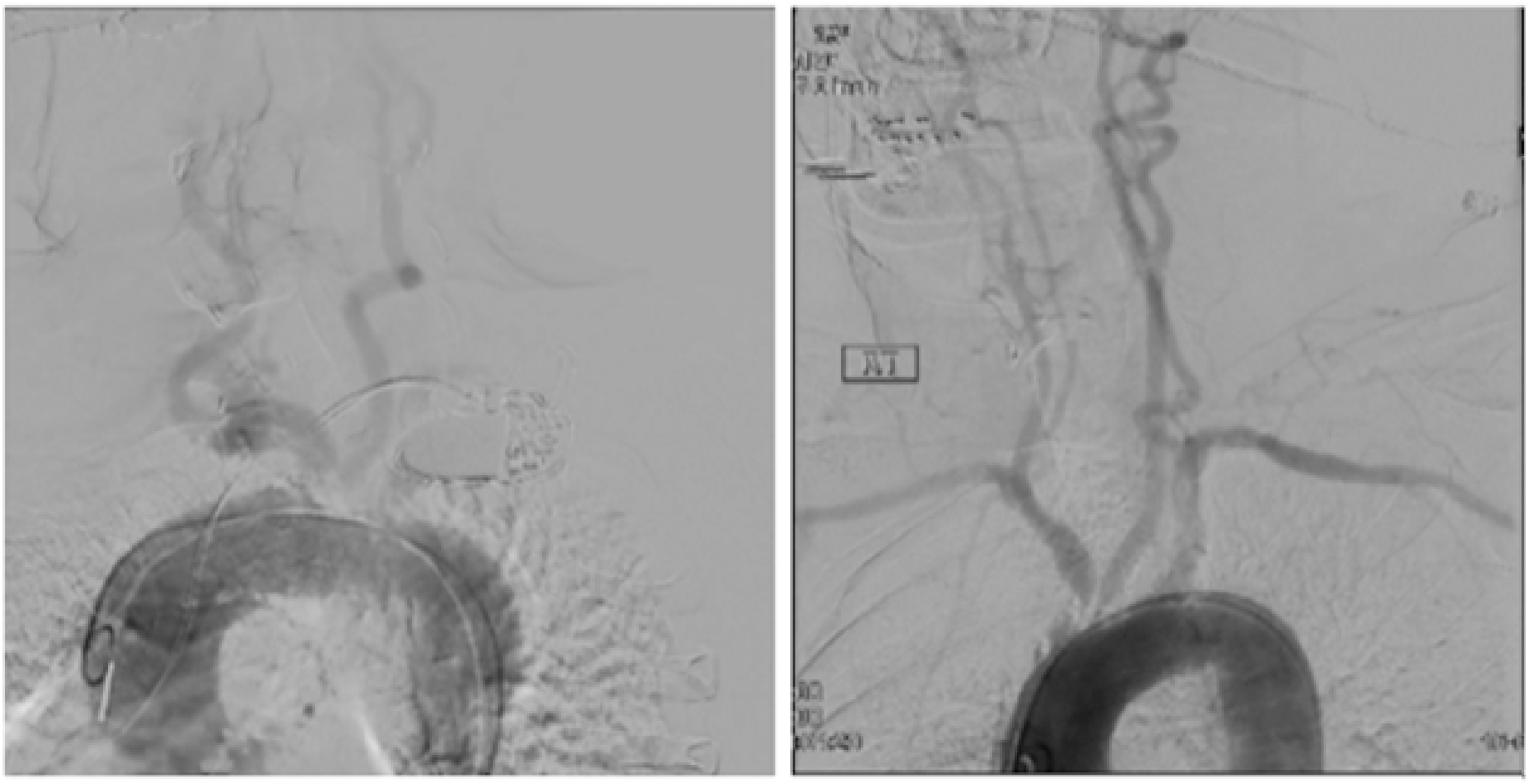

Figure 1. Pre-carotid stenting images. Left image is patient 1; right image is patient 2.

The second patient was a 72-year-old-woman with medical history of CAD status post PCI, PAD, and chronic obstructive pulmonary disease who presented with 6 months of dizziness, presyncope, and right arm numbness. A CT angiogram revealed 75% to 80% ostial left CCA stenosis, left ICA stenosis, and critical stenosis of the brachiocephalic artery, as well as a type 2 aortic arch with severe calcification at the origin of the great vessels (**Figure 1)**. Similar to the first patient, a hybrid approach with retrograde stenting of the left CCA was recommended due to the extent of calcification, challenging vascular anatomy, and concurrent ICA stenosis. After a combined effort from interventional cardiology and CT surgery, the patient had carotid cutdown and neuroprotection, identical to the first patient, with successful placement of an 8- x 19-mm Omni Link stent (Abbott) into the ostial left CCA followed by a successful endarterectomy (**Figure 2**). A month after the procedure, she underwent a second procedure to intervene on the brachiocephalic artery stenosis with successful placement of a 9- x 19-mm Omni-link stent and right ICA CEA.

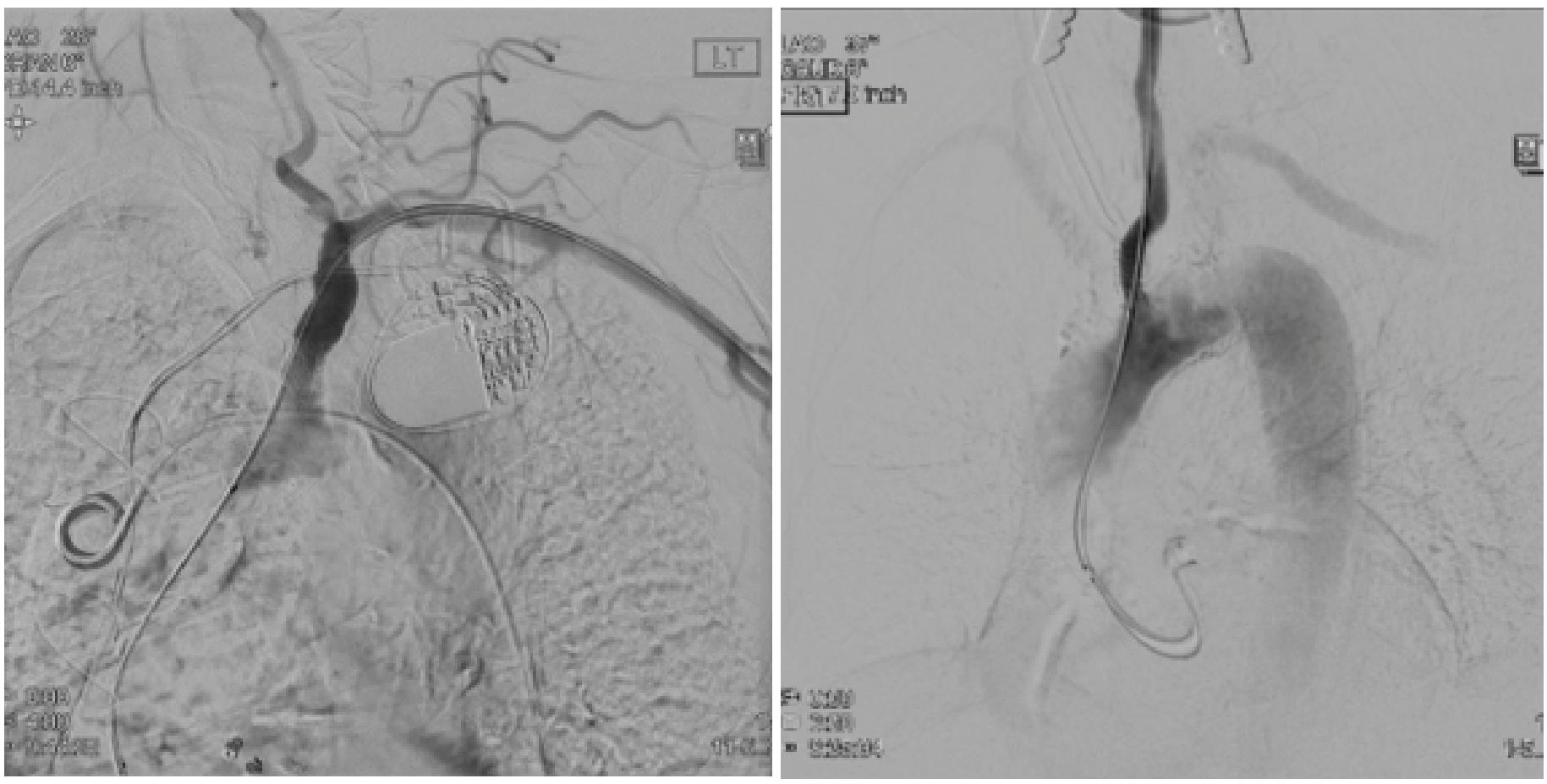

Figure 2. Post-carotid stenting images. Left image is patient 1; right image is patient 2.

Discussion

Carotid angioplasty with stenting is a well-established method to address carotid artery stenosis. Historically, the most common approach to carotid artery stenting (CAS) is transfemoral and uses distal ballooning for neuroprotection.[1] However, there are a variety of reasons that limit the applications and success rate of the transfemoral approach such as adverse anatomy, anomalies of the aortic arch, degree of atheromatous blockage, coiling of the CCA, and a neuroprotective technique.[1,3] Our patients both had

concomitant CCA and ICA stenosis. Data regarding ostial carotid stenting are limited. One concern with a traditional antegrade approach to stenting patients with both internal and ostial common carotid stenosis includes difficulty with navigation of tandem lesions with guidewires.[3] In these "technically difficult" situations, a retrograde approach to CAS can be used.[3,4]

Anatomy

A significant advantage of the retrograde approach for CAS is its ability to navigate complex anatomical structures, particularly beneficial in cases where the transfemoral approach is limited by challenging aortic anatomy.[1] The decision between these approaches necessitates a detailed evaluation of both the aortic arch and the proximal CCA.[1] Aortic arches with minimal calcification, less than 30-degree angularity, and minimal stenosis, classified as type 1, are conducive to the transfemoral approach. In contrast, type 2 and 3 aortic arches, as well as bovine arch variations, present considerable anatomical challenges to navigation of guidewires that may impede the successful use of the transfemoral route, thereby making the retrograde approach a more viable option in such scenarios.[5] The technical failure rate of transfemoral CAS, attributable to anatomical difficulties, ranges between 2% and 20%. Aortic arch variants particularly complicate guidewire placement, raising the risk of vessel damage or embolization.[1]

Neuroprotection

In CAS, embolic protection devices are traditionally used to mitigate the risk of cerebral embolization. However, these devices, particularly in a transfemoral approach, present certain limitations. A retrograde approach offers an alternative neuroprotective strategy by using distal vessel clamping. This method has been found to be a safe and effective alternative to traditional techniques such as distal balloon occlusion or filter devices.[4] Distal balloon occlusive devices, while effective, are associated with a significant adverse event rate, exceeding 10% in some studies. This is attributed to the challenges in maneuvering these devices past stenotic lesions without causing distal embolization. Moreover, the physical constraints of navigating the balloon past tandem lesions can sometimes render their placement unfeasible.[5] In contrast to the transfemoral approach, the distal clamping of the retrograde technique facilitates neuroprotection more efficiently. This method bypasses the need to navigate past stenotic lesions, reducing the risk of embolization associated with balloon or filter device placement. Furthermore, monitoring with intraoperative transcranial doppler and magnetic resonance imaging suggests a lower incidence of cerebral embolization with this approach compared with distal balloon neuroprotection. However, comprehensive statistics comparing stroke rates between these two methods are still evolving.[1] Overall, the retrograde approach with distal clamping represents a significant advancement in neuroprotection during CAS, offering a safer alternative in cases where traditional embolic protection devices may pose increased risks or technical challenges.

Risks

A retrograde approach for CAS, while beneficial in certain cases, is more invasive than a transfemoral approach due to the necessity of an open carotid artery cutdown.[1] This increased invasiveness can lead to specific risks such as neck hematoma, pseudoaneurysm, and tracheal compression.[4] Additionally, anatomic barriers such as oversize thyroid and a low carotid bifurcation[5] can make the retrograde approach impossible. Reversal of blood flow that comes with distal clamping can be problematic for those with contralateral carotid occlusion.[5] Before employing a distal clamping technique in retrograde carotid stenting, it is crucial to perform imaging studies such as CT angiograms to evaluate the contralateral blood flow and confirm the patient's suitability for this approach. This pre-procedural imaging ensures that collateral circulation is sufficient and unobstructed.

Conclusion

Selecting between a retrograde carotid approach and a transfemoral approach for CAS should involve a comprehensive evaluation, considering factors such as vascular anatomy, aortic arch anomalies, and the patient's medical history and overall health. Evidence suggests that a retrograde approach can be advantageous in terms of procedural speed, cost efficiency, and reduced contrast use compared with a transfemoral approach. Moreover, some studies indicate a potentially lower stroke incidence with a retrograde approach, although this requires further validation. In our patient cases, the decision to opt for a retrograde approach was guided by the degree of common carotid stenosis with concurrent internal artery stenosis, underscoring the importance of individualized patient assessment in determining the most appropriate and safe stenting technique. ■

Affiliations and Disclosures

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