



Original Case Report

Hybrid Retrograde Stenting for Symptomatic Innominate Artery Stenosis

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Abstract:- Innominate (brachiocephalic) artery stenosis is a rare but important cause of cerebrovascular events, accounting for <2% of extracranial cerebrovascular disease. Clinical presentations include transient ischemic attacks (TIAs), cerebrovascular accidents (CVA), and upper extremity ischemia. Diagnosis is frequently delayed due to symptomatic overlap with carotid and intracranial pathology. Endovascular stenting is increasingly favored over open bypass, although reported experience remains limited compared with open revascularization. In addition, the optimal site access and embolic protection strategy remain topics of debate. The presented case involves a 64-year-old woman who developed recurrent transient left hemibody weakness. Carotid artery evaluation including Computed Tomographic Angiography (CTA) and duplex ultrasound, revealed no significant stenosis within the carotid vessels. Subsequent review of CTA of the head and neck demonstrated severe calcific plaque throughout the brachiocephalic artery with filling defects suggestive of adherent thrombus. The patient was started on apixaban by cardiology as an outpatient. Despite therapy, her symptoms progressed, prompting emergency department referral for TIA evaluation. The patient underwent a hybrid retrograde innominate artery stenting via surgical right common carotid artery (RCCA) access. This case highlights the importance of considering proximal great vessel disease in patients with unexplained cerebrovascular symptoms and the diagnostic and therapeutic challenges posed by innominate artery disease.

Keywords : cerebrovascular, Endovascular , brachiocephalic.

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Introduction:

Symptomatic atherosclerotic innominate disease accounts for roughly 2–4% of all causes of extracranial cerebrovascular insufficiency [1]. Although less prevalent and frequently underestimated in comparison to carotid and vertebral artery diseases, subclavian artery pathology constitutes an established etiology of symptomatic extracranial cerebrovascular insufficiency. This insufficiency may manifest as transient ischemic attacks (TIAs), cerebrovascular accidents (CVAs), vertebrobasilar symptoms, or upper extremity ischemia [2]. These complications may arise with trauma, thrombosis, or occlusion of the innominate artery. Stenosis of this artery is relatively rare, and frequently clinically insignificant due to numerous collateral vessels in the brachiocephalic trunk [3]. While uncommon, atherosclerosis represents the predominant etiology of significant cases. Other causes include large-vessel vasculitides, giant cell arteritis, radiation-induced injury, and fibromuscular dysplasia. [4]. The main clinical implications of this disease include compromise of the right carotid & vertebrobasilar circulation, potentiation of embolic stroke (most commonly right MCA), and upper-extremity ischemia. Although innominate lesions represent a minor proportion of supra-aortic trunk interventions in major treatment series and meta-analyses, their management is critical due to the substantial associated risk of stroke and mortality if left untreated [5-7].

Innominate artery stenosis can also cause a form of subclavian steal physiology. Subclavian steal is a rare condition with associated extracranial vessel lesions. Surgical treatment of this has high stroke mortality and morbidity. This pathology originates from retrograde vertebral flow due to proximal subclavian or innominate stenosis/occlusion. When the lesion is in the innominate, flow can reverse in the right vertebral artery and right carotid axis (“innominate steal phenomenon/syndrome”). Subsequent color duplex will show reversed/bidirectional right vertebral flow, midsystolic deceleration or complete reversal in right CCA/ICA, and elevated left CCA/right CCA velocity ratio. Thus, indications for revascularization include stroke or transient ischemic attacks due to atherosclerosis. Subclavian steal itself is often asymptomatic. When attributed to innominate lesions, it is a clear indication for revascularization. Clinically the steal phenomenon can present as arm claudication, heaviness, fatigue, paresthesias (often right arm), vertebrobasilar symptoms (lightheadedness, vertigo, visual phenomena, near-syncope), or marked inter-arm BP differential and reduced ipsilateral pulse. It can also present with possible transient monocular or hemispheric visual loss and low internal carotid velocities when carotid flow is additionally reversed (“carotid steal”) [5-9].

The historical gold standard of innominate artery stenosis is open revascularization. More recent techniques involve extra-anatomic bypass (carotid-carotid or axillo-axillary) that can avoid the morbidity of a median sternotomy. With the advances in endovascular techniques, there have been more reports of stenting of these lesions with differing sites of access and considerations for embolic protection.

This report details the successful use of a hybrid retrograde approach for endovascular innominate stenting to provide symptomatic relief as well as procedural embolic protection.

Case Presentation :

A 64-year-old woman presented to her cardiologist’s office with a complaint of weekly episodes of recurrent transient left hemibody weakness over the prior 10 months, with four episodes in the week before admission. Her medical history was notable for a right internal capsule infarct (two years prior; no residual deficits), coronary artery disease, hypertension, diabetes, and hyperlipidemia. Associated symptoms included

progressive falls, left knee buckling, and intermittent left arm heaviness without associated sensory deficits, dysarthria, or visual changes. In the prior month, she had a CTA Head and Neck ordered by cardiology due to concern for aortic atherosclerosis. This study revealed severe irregularity, primarily calcific plaque, throughout the brachiocephalic artery with a filling defect extending off the uppermost aspect of the stent, which could represent adherent thrombus. The patient was started on apixaban following these results. Despite initiation of anticoagulation, she had progressive symptoms and presented to the emergency department.

Upon presentation, the patient's vital signs were within normal range except for blood pressure. Serial blood pressure measurements demonstrated a significant discrepancy between arms. Physical and neurological examination findings included slight drift in both lower extremities without sensory deficit, without other abnormalities.

Diagnostic workup started with a non-contrast CT head that did not show any acute pathology. A subsequent CTA of the head and neck revealed severe atherosclerotic changes, <50% stenosis of the right carotid artery, and possible distal embolic changes without clear evidence of occlusive disease. The initial radiological impression, which focused on a potential right middle cerebral artery embolism, notably excluded any mention of a brachiocephalic thrombus in the radiology report itself (*Figure 1*). After vascular surgery consultation and review, the patient was admitted for expedited workup and coordination for management between neurology and vascular surgery. She was transitioned to a high intensity heparin drip upon inpatient admission to prevent clot propagation.

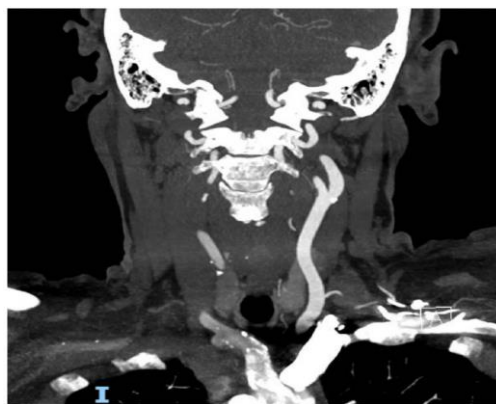


Figure 1. CTA of the head and neck demonstrating severe innominate stenosis.

Further evaluation with duplex ultrasound of the carotids demonstrated mild-to-moderate calcific plaque in the right proximal internal carotid artery, with both internal carotid arteries exhibiting <50% stenosis. Of greater significance, the study revealed retrograde flow in the right vertebral artery, a finding consistent with subclavian steal syndrome and suggestive of proximal innominate artery stenosis. Upper extremity arterial duplex studies confirmed evidence of high-degree innominate artery stenosis. Magnetic resonance imaging (MRI) of the brain and cervical spine did not show any acute pathologies or new large territory infarct.

Following multidisciplinary discussion, the decision was made to take the patient to the operating room for a hybrid retrograde innominate artery reconstruction via right CCA access. After systemic heparinization, a vascular clamp was applied to the distal right common carotid artery to provide embolic protection for the cerebral circulation. Retrograde access was obtained via micropuncture, and the arteriotomy was upsized to a 7-French, 25-cm Brite tip sheath. Angiography confirmed high-grade stenosis nearing occlusion at the origin of the innominate artery (*Figure 2a*), characterized by severe calcific plaque extending to the aortic arch. Using an angled Glidewire Advantage, the high-grade occlusion was successfully traversed. A 9 x 39 mm Atrium covered stent was deployed across the innominate origin (*Figure 2b*). To ensure optimal wall apposition

and inflow, the proximal portion of the stent was flared at the aortic arch using a 10 x 4 mm Mustang balloon. Completion angiography and intraoperative continuous-wave doppler confirmed a widely patent vessel with brisk distal flow and restoration of a strong RCCA and radial pulse (*Figure 2c*). Completion angiography confirmed adequate stent expansion. The carotid arteriotomy was repaired in standard fashion.

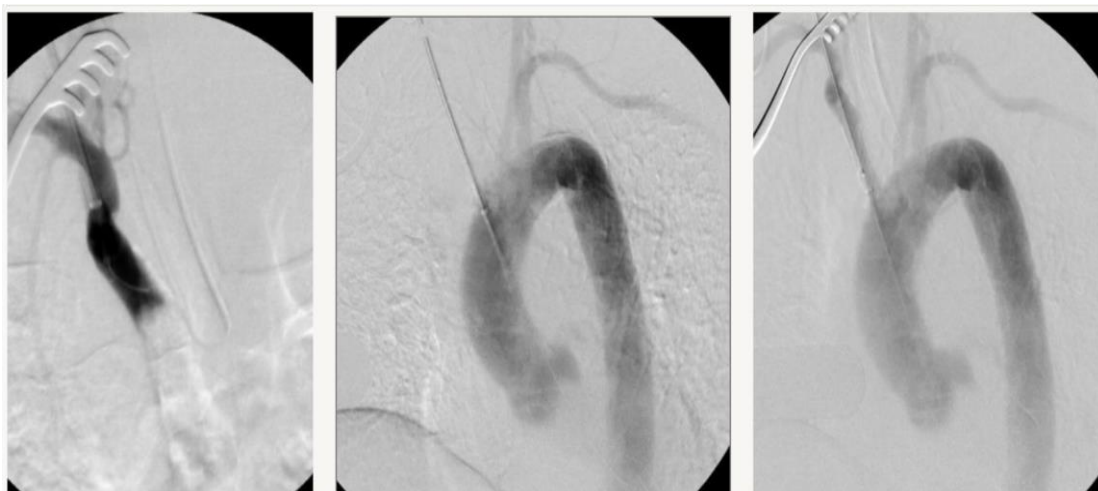


Figure 2 (A, B) Right CCA access for aortic arch angiogram demonstrating severe stenosis. (C) Completion angiogram following retrograde innominate stent placement.

The patient was admitted to the intensive care unit (ICU) overnight and discharged on postoperative day two on apixaban, aspirin, and plavix. Ten days post-operation, the patient experienced transient right 4th-5th digit ulceration, which was clinically suspicious for distal microembolization. Comprehensive workup, including upper-extremity arterial duplex and chest CT angiography, was unremarkable, and the symptoms resolved spontaneously over a period of 3 weeks with conservative care.

Discussion:

Symptomatic innominate artery stenosis remains an uncommon but clinically significant cause of recurrent cerebrovascular insufficiency. Because presenting symptoms often mimic carotid or intracranial pathology, diagnosis is frequently delayed or misattributed, particularly when standard carotid imaging does not demonstrate hemodynamically significant disease. This case reinforces the importance of maintaining a high index of suspicion for proximal supra-aortic trunk pathology in patients with recurrent or “cryptogenic” TIAs, especially in the presence of inter-arm blood pressure discrepancy or duplex findings consistent with steal physiology [6-8].

Historically, open transthoracic reconstruction of the innominate artery carried substantial perioperative morbidity and mortality. Although durable, these operations require invasive exposure and are associated with significant physiologic stress. More standard developments of extra-anatomic bypass options similarly introduce operative complexity and stroke risk [5-8,10].

In contrast, our approach combined surgical carotid exposure with retrograde endovascular stenting, allowing direct control of the right common carotid artery and distal clamping for embolic protection. This strategy provided superior catheter stability across a heavily calcified lesion at the aortic origin while minimizing aortic arch manipulation. By avoiding a transfemoral approach in this hostile arch anatomy, the risk of intracranial embolization was minimized.

While distal embolization remains a recognized complication of innominate intervention, this case demonstrates that hybrid retrograde stenting can achieve durable symptom resolution with low morbidity and rapid recovery. Importantly, it offers a less invasive yet technically controlled alternative to open reconstruction in anatomically complex disease.

Given the rarity of symptomatic innominate artery stenosis, cumulative experience is limited. Carefully described cases such as this contribute to the evolving body of evidence supporting endovascular-first or hybrid strategies as safe and effective options for appropriately selected patients.

Conclusion:

This case represents the need for providers to consider proximal great vessel disease in patients with recurrent or refractory TIAs despite noncritical carotid findings, particularly when duplex imaging demonstrates steal physiology or significant inter-arm blood pressure discrepancy.

Hybrid retrograde innominate stenting via surgical carotid access offers a cerebral-protective, less invasive alternative to open reconstruction. By combining direct carotid control with endovascular therapy, this approach enables effective revascularization while avoiding the morbidity associated with traditional open repair. As techniques continue to advance, hybrid strategies may become a preferred first-line option for appropriately selected patients with symptomatic innominate artery disease.

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