THE EUROPEAN SOCIETY OF MEDICINE
Medical Research Archives, Volume 14 Issue 4

CASE REPORT

Blood Pressure Discrepancy: A Diagnostic Clue to Innominate Artery Occlusion in Acute ischemic Stroke-A Case Report

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OPEN ACCESS

PUBLISHED
30 April 2026

CITATION
Salar, H., et al., 2026. Blood Pressure Discrepancy: A Diagnostic Clue to Innominate Artery Occlusion in Acute ischemic Stroke-A Case Report. Medical Research Archives, [online] 14(4).

ISSN
2375-1924

ABSTRACT

Background: Innominate artery occlusion is an uncommon but important cause of cerebral ischemia. A simple bedside clue—inter-arm blood pressure discrepancy—can direct clinicians toward this proximal large-artery pathology.

Case: A 42-year-old man presented with sudden left-sided weakness and right sided gaze preference (NIHSS 9) for more than 12 hours. Initial non-contrast CT showed acute right frontotemporal infarction. CT angiography (CTA) demonstrated non-opacification of the right MCA (M1) and attenuated right ICA; duplex ultrasound revealed reversed vertebral flow. A marked inter-arm blood pressure difference had been noted during examination. Repeat CTA of the head, neck, including aortogram revealed a short-segment occlusion of the innominate artery with distal reconstitution. The patient was treated conservatively with antithrombotic medication and early rehabilitation, with gradual clinical improvement.

Conclusion: Inter-arm blood pressure asymmetry should prompt targeted vascular imaging for proximal lesions including innominate artery disease. Conservative therapy may be reasonable in stable patients when endovascular options are deferred, with rehabilitation playing a key role in recovery.

Keywords: Innominate artery occlusion; blood pressure discrepancy; ischemic stroke; subclavian steal; CTA; neurovascular imaging.

Introduction

The innominate artery (IA) or brachiocephalic artery (BCA), is the first branch of the aortic arch. It divides into the right subclavian artery (SA) and common carotid artery (CCA) and supplies the right arm, head, and neck. Atherosclerotic disease is the most common cause of lesions in the IA; however, severe stenoses are relatively rare.[1,2] Innominate artery stenosis on vascular imaging accounts for only 2.5% to 4% of atherosclerotic lesions of the extracranial cerebral arteries. This includes symptomatic and asymptomatic cases. The exact incidence of symptomatic innominate artery disease is not known[2,3]. The presence of a hemodynamically significant stenosis in the IA typically results in compensatory changes to flow in the ipsilateral vertebral artery (VA) and CCA. It can lead to cerebral hypoperfusion, subclavian steal phenomenon , and disabling anterior and posterior circulation strokes[4-7].

Innominate artery occlusions lead to diversion of blood flow, leading to the siphoning of blood from the contralateral vertebral artery into the subclavian artery and decreased blood flow in the right common carotid artery. Compromised cerebral circulation as a result of compensatory blood flow diversion results in ischemic episodes, particularly when exercise stress is afflicted on the right arm[7,8].

Subclavian and Innominate artery stenosis shared some similarities, since in both entities, large-vessel high-degree stenosis is proximal to the vertebral arteries. This leads to the clinical picture of diminished arterial pulses in the ipsilateral arm, high arm blood pressure differential (usually greater than 20 mm Hg)[8]. Differences in blood pressure between arms may have a number of causes such as subclavian artery stenosis, aortic aneurism, aortic coarctation, vasculitis, fibromuscular hyperplasia, connective tissue disorders, and thoracic outlet compression[7]. The tetrad of right arm, eye, and hemispheric and posterior circulation ischemia points to innominate artery lesion Strokes in the anterior circulation and features of subclavian steal phenomenon including significant inter- arm blood pressure differences is a characteristic the involvement of innominate artery[7,9].

Interventional treatment with either percutaneous angioplasty or surgery is recommended by most authorities to prevent recurrence of stroke and disability[10,11].

Case Presentation

HISTORY AND EXAMINATION

A 42-year-old Bangladeshi gentleman, with no known vascular risk factors was brought to the emergency with history of abrupt-onset left hemiparesis and right sided gaze preference of 12 hours duration. He was working at a construction site when he developed the weakness. No history of any headache or seizures. He denied prior TIA or stroke. He denied history of smoking. On arrival, he was conscious and alert, but had dysarthria, left facial weakness, right gaze preference, partial left hemianopia and left-sided weakness with power of 3/5 in the upper limbs and lower limbs. There was sensory inattention on the left side. NIHSS was 10. A clinically significant inter-arm blood pressure discrepancy was recorded in triage. Blood pressure recording in the right arm was 80/50 mm Hg while on the left side it was 122/84 mm Hg. radial pulse was diminished on the right side.

NEUROIMAGING AND DIAGNOSTIC WORK-UP

Routine blood investigations including blood counts, renal and liver function tests, lipid profile and Glycosylated Haemoglobin were normal.

Non-contrast CT brain revealed right frontotemporal cortical–subcortical hypodensity consistent with acute infarction (figure 1A and 1B).

Initial CTA (limited by motion) showed non-opacification of the right MCA (M1, ~8 mm from origin) and right ACA (A1), with attenuated flow in the right ICA from the cervical segment to the clinoid (figure 2A and 2B).

Transthoracic echocardiography showed preserved ejection fraction (65%) with no structural source of

embolus; autoimmune studies including Antinuclear Antibody, anti dsDNA and ANCA were negative. Workup for thrombophilia including antiphospholipid antibodies, protein C, protein S, antithrombin III, factor V Leiden mutation, homocysteine levels were negative.

Electrocardiogram did not show any evidence of atrial fibrillation. Holter testing was negative for arrhythmias.

Carotid duplex ultrasound demonstrated bilateral atherosclerotic changes with intima-media thickening and reversed vertebral artery flow on the right; weak flow velocities were also noted on the right carotid artery.

CT angiogram of the head and neck demonstrated a ~1.5 cm non-filling segment of the innominate artery from its origin with distal reconstitution to the right subclavian and right common carotid arteries; the right ICA remained attenuated to the clinoid without complete occlusion. (Figure 3A). CTA of the aorta confirmed innominate artery occlusion without dissection (3B).

MRI brain was done to look for possible infarctions in the posterior circulation. Which showed infarctions in the right Middle Cerebral Artery territory and watershed infarction in the right Middle Cerebral Artery and Posterior Cerebral Artery territories (Figure 5A, 5B).

Figure 1 A and 1B: CT brain (plain) at admission

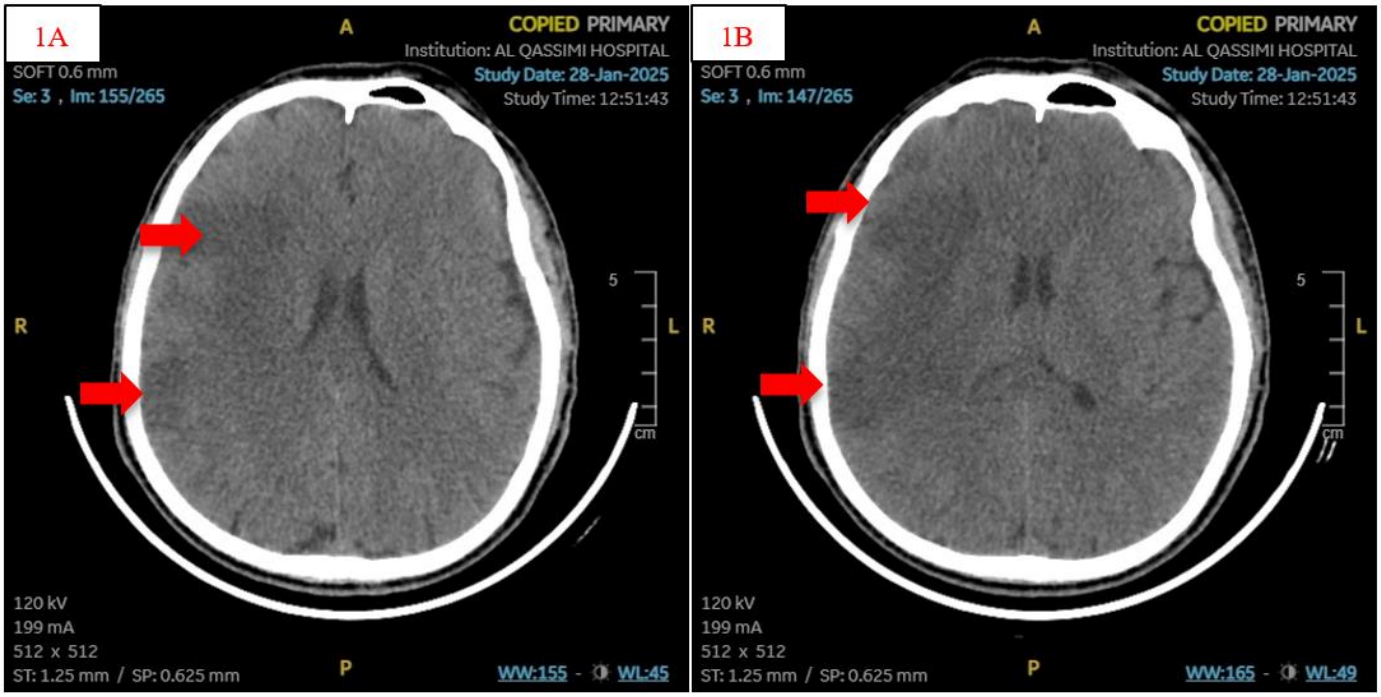

Figure 1 A and 1B: Plain Computerized Tomography brain showing acute infarctions in the right frontotemporal regions

Figure 2 A and 2B: Axial and coronal Computerized Tomography angiogram of head

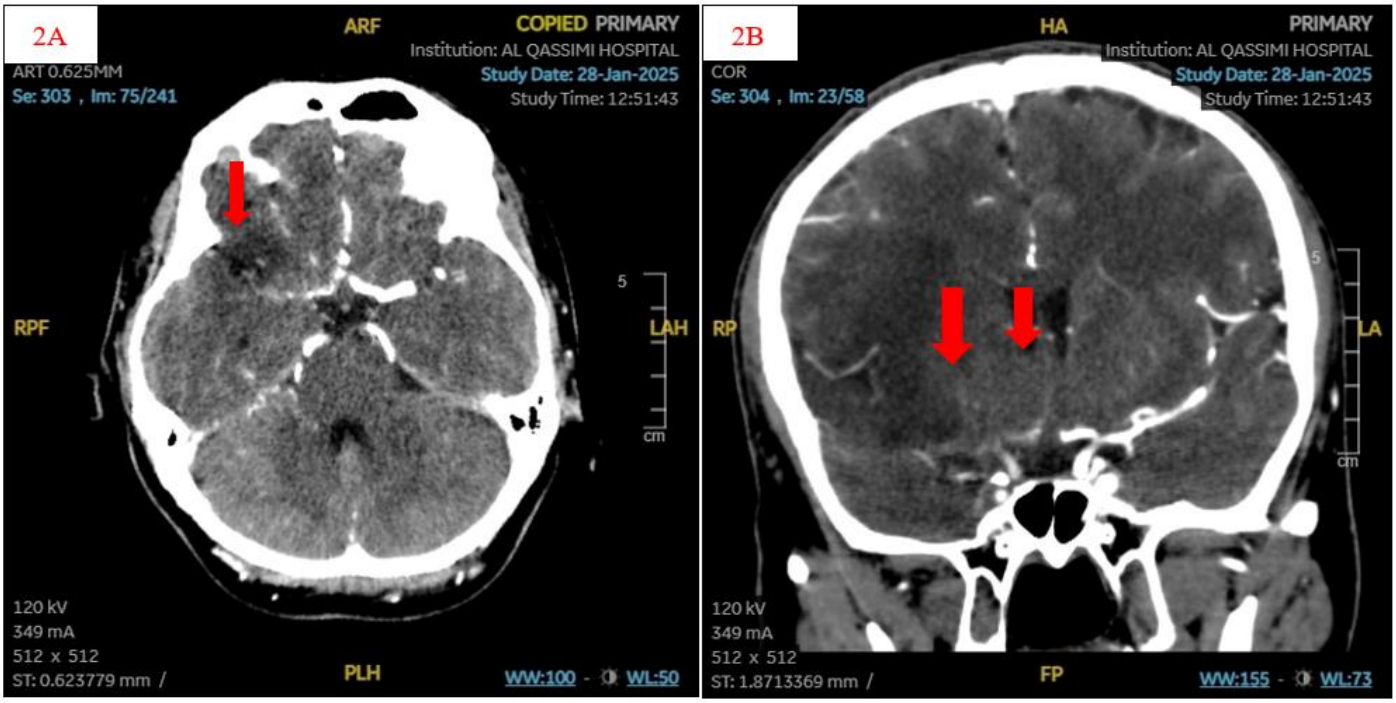

Figure 2 A and 2B: Axial and coronal Computerized Tomography angiogram of head showing right M1 segment of Middle Cerebral Artery and right Anterior Cerebral Artery occlusion

Figure 3A: Computerized Tomography angiogram of neck

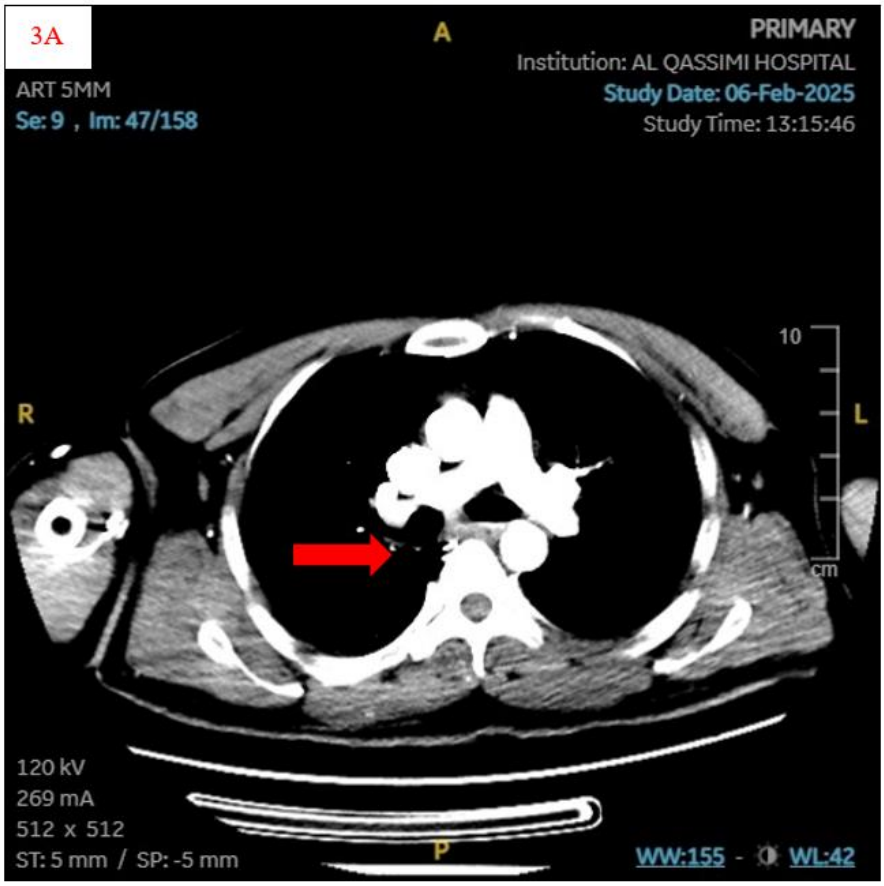

Figure 3A: Computerized Tomography angiogram of neck showing non-opacification of right ICA

Figure 3B: Computerized Tomography aortogram

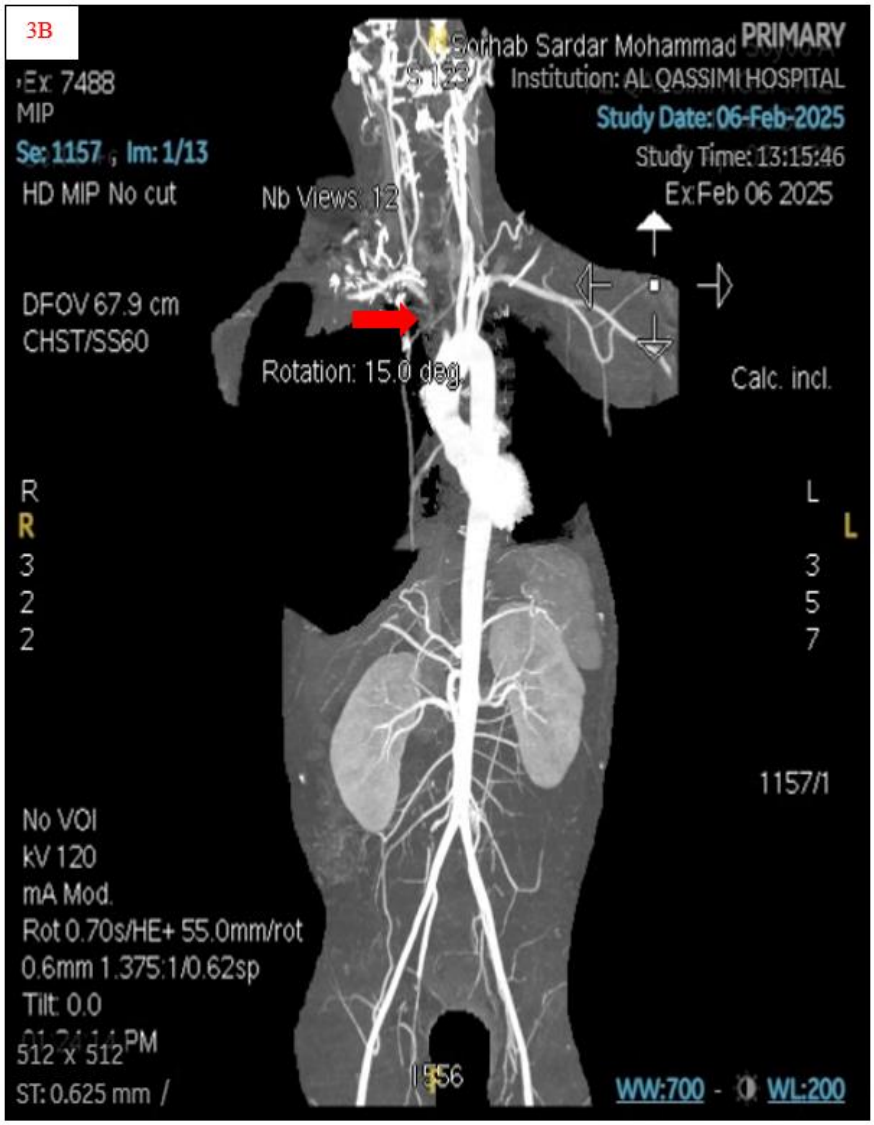

Figure 3B: Computerized Tomography aortogram showing innominate artery occlusion

Figure 4 A MRI DWI images and Figure 4 B MRI FLAIR images

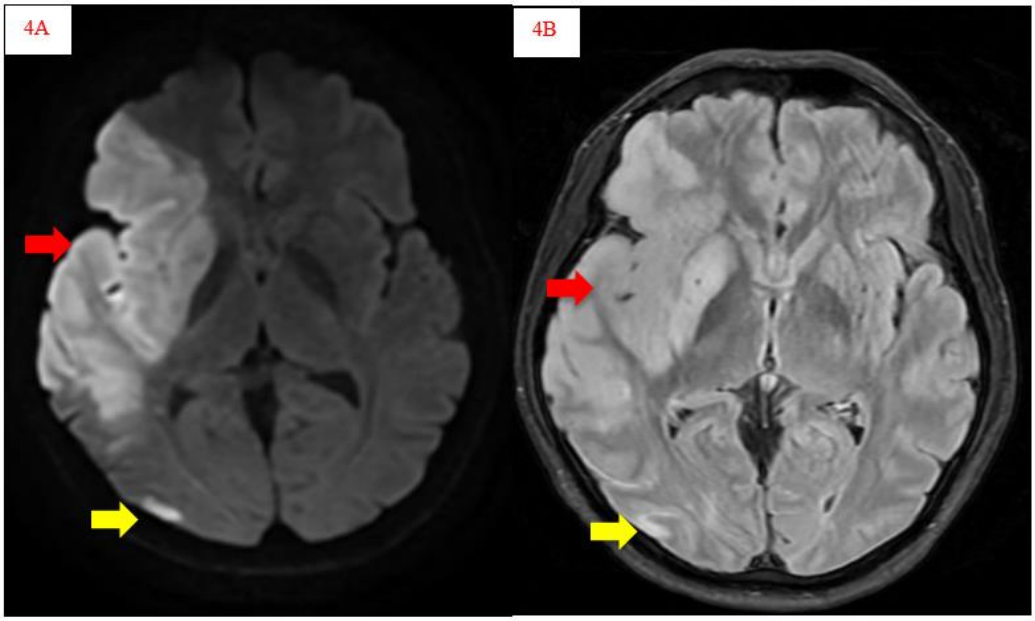

Figure 4 A MRI DWI images and Figure 4 B MRI FLAIR images shows infarctions in the right MCA territory (red arrow) and watershed infarction in the right MCA -PCA territory (yellow arrow)

DIAGNOSIS AND MANAGEMENT

Since he presented out of window for thrombolysis and established infarctions on imaging, he was not a candidate for intravenous thrombolysis or mechanical thrombectomy. He was initiated on a conservative treatment strategy with mandatory bed rest in flat bed, Intravenous fluids to maintain the blood pressure on the higher side, high-dose atorvastatin, and dual antiplatelet therapy with aspirin and clopidogrel. Physiotherapy was initiated with restricted active movements of the right arm. His symptoms remained stable over the few days, and he was mobilized out of bed. Motor function improved gradually during the inpatient course. His case was discussed with multidisciplinary team including interventional neuroradiologist, vascular surgeons, neurologist and rehabilitation services. The option of endovascular intervention to prevent further complications, was discussed with the patient however he was not willing for the same In view of stable neurological symptoms without any further episodes of dizziness or arm claudication and patient preference, he was decided to be continued on conservative management.

At discharge he was able to walk with assistance and was advised to come back in case of recurrence of neurological events including dizziness, new onset deficits or arm claudication. At three-month follow-up, he remained stable without any new deficits.

Discussion

Innominate artery occlusion is a rare cause of acute ischemic stroke. In a study analyzing 30,000 ultrasound examinations, the prevalence of innominate artery occlusions was lower than 0.1%,[6] while angiography studies shows a higher percentage of around 2.5% of lesions involving the extracranial circulation.[9] The most common cause is atherosclerosis, while a smaller percentage of lesions were attributed to Takayasu's Arteritis, giant- cell arteritis, radiotherapy-induced actinic fibrosis, and fibromuscular dysplasia[10]. Our patient appeared to have an atherosclerotic occlusion, in view of atherosclerotic changes with intima media thickening of doppler study and distal recanalization. Blood test and vascular imaging were negative for vasculitis or dissection.

Inter- arm differences in blood pressure according is an important diagnostic clue for subclavian/ innominate artery occlusions[8,9]. Some studies suggest that inter-arm difference in blood pressure has to be greater than 20 mmHg in order to be reproducible and greater than 25 mmHg to attain a sufficiently high positive predictive value for proximal vascular stenosis/occlusion.[9] Our patient had an inter arm blood pressure difference of 42 mmHg between sides. His initial CT angiogram for head and neck had shown MCA occlusion and attenuated flow in the ICA. The neck vessel doppler study showed bilateral atherosclerotic changes with intima-media thickening and reversed vertebral artery flow on the right; weak flow velocities were also noted on the right carotid artery. The Doppler findings in addition to the significant interarm BP difference prompted us to do CT aortogram for proximal vascular imaging looking for innominate artery lesions. CT aortogram confirmed IA occlusion.

This case underscores the diagnostic value of inter-arm blood pressure discrepancy in the acute stroke setting. Innominate artery disease can create complex hemodynamics, including vertebrobasilar flow reversal and apparent distal large-vessel occlusions or hypoperfusion patterns on imaging. The most common neurological finding in the innominate artery stenosis or occlusion is flow reversal in the right vertebral artery (subclavian steal phenomenon). However, it is not always a "single" subclavian steal, as it happens in subclavian artery stenosis or occlusion, but it might cause changes to flow in the right carotid system[5,11,12]. This makes innominate artery stenosis / occlusions a serious entity and mandates careful evaluation and management. Our patient also had characteristic doppler findings with reversal of flow in right vertebral artery with diminished flow in the right carotid artery. A possibility of significant obstructive lesion of the innominate artery should be considered in cases in which there is diffuse reduction of flow in the right carotid artery.

Bedside detection of a >20 mm Hg arm pressure difference should prompt targeted great-vessel imaging (duplex and CTA) to identify proximal lesions, since early intervention in symptomatic patients help preventing further strokes and disability due to steal phenomenon[13].

Patients who remain symptomatic on conservative management, or recurrent neurological events recommend endovascular stenting. It has favorable outcomes in appropriately selected patients[14,15]. Conservative antithrombotic therapy with vigilant follow-up may be suitable when neurological status is stable or intervention is not immediately feasible[4]. Our patient had short-segment occlusion with fairly good refilling of the internal carotid and vertebral artery. He already had established infarctions in the right MCA and MCA-PCA territory watershed infarctions. He clinically improved on conservative management, possibly due to good collaterals.

Conclusion

Innominate artery lesions though rare is a serious etiology of stroke, resulting in anterior and posterior circulation strokes or symptoms due to vascular steal phenomenon. Significant inter-arm difference in blood pressures should alert the physician of affection of subclavian or innominate artery. In patients with right-sided cerebrovascular ischemia with duplex evidence of vertebral flow reversal, innominate artery occlusion appears more likely. Conservative antithrombotic therapy and early rehabilitation might be effective when intervention is deferred.

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