Innominate Steal Phenomenon: Color and Spectral Doppler Sonographic Findings

To the Editor: Occlusion of the innominate artery (brachiocephalic artery) is less commonly seen than subclavian and common carotid artery (CCA) obstruction, and it leads to several hemodynamic alterations of the extracranial circulation.[1] Major or total occlusion of the innominate artery may cause retrograde blood flow in the right vertebral and carotid arteries. This condition has been discussed rarely in the literature and has been called the "innominate steal phenomenon" (ISP).[2,3]

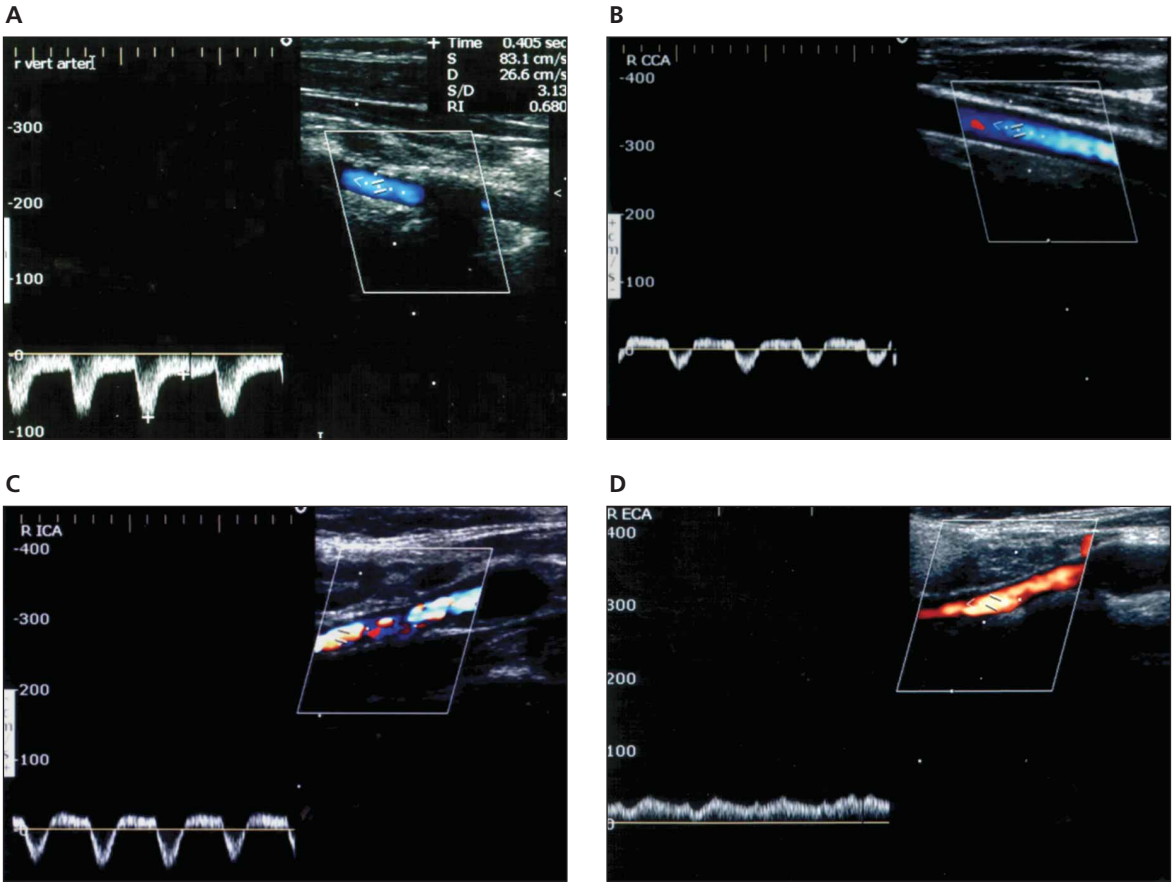
We aimed to determine the color and spectral Doppler findings of the ISP and to correlate the findings with computed tomographic angiography.

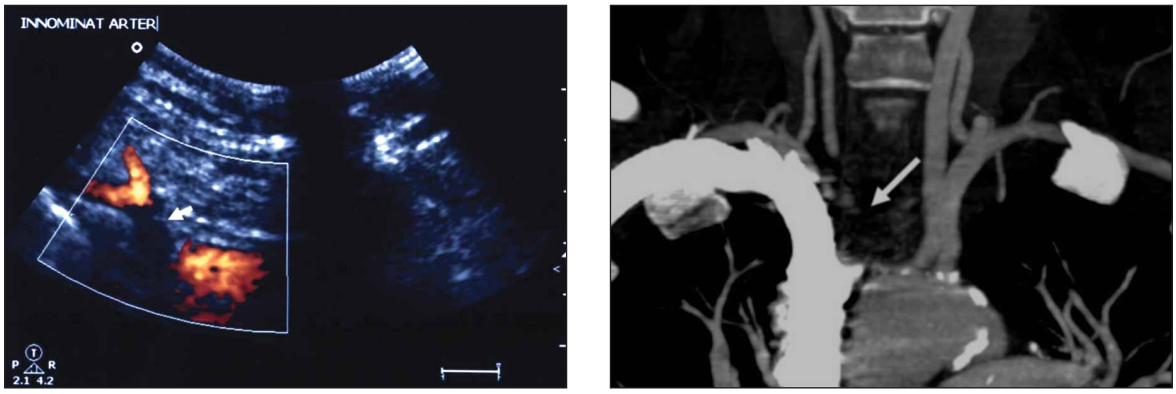
Case Description

A 58-year-old woman came to our department with vertigo, syncope, right arm pain during exercise, blurring of vision, and intermittent claudication. On physical examination, the systolic pressure was 140 mm Hg in her left arm and 100 mm Hg in her right arm.

On sonography, reversal of flow was shown in the right vertebral artery (VA), CCA, and internal carotid artery (ICA), and low-amplitude antegrade flow was observed in the right external carotid artery (ECA; Figure 1). Computed tomographic angiography and Doppler sonography of the innominate artery clearly depicted total occlusion beyond its origin (Figure 2).

Figure 1. Spectral and color Doppler images of the right carotid and vertebral arterial system. **A–C**, Reversal of the flow direction in the right VA, CCA, and ICA. **D**, Low-resistance antegrade flow pattern in the ECA. R indicates right; and r vert arter, right VA





A B

Figure 2. Color Doppler image (**A**) and coronal reformatted multidetector computed tomographic angiogram (**B**) showing complete occlusion of the innominate (brachiocephalic) artery (INNOMINAT ARTER) just distal to its origin (arrows).

Discussion

In the presence of major stenosis or occlusion, the extensive cerebrovascular collateral and anostomotic network allow continuation of cerebral perfusion. When the stenosis is located in the innominate artery, blood flow in the right CCA may also be reduced or even reversed to provide a collateral source of blood to the right arm.[4]

In the literature, there are many angiographic studies of innominate artery occlusion, but reports describing Doppler sonographic findings are rare. In 1 small case series, Doppler sonography was highly sensitive and specific for the diagnosis of a subclavian steal, and there was an excellent correlation between sonographic waveform alterations observed in the VA and the degree of subclavian or innominate stenosis on angiography.[5] The degree to which the carotid circulation was affected was more varied. Doppler findings ranged from subtle midsystolic deceleration to complete reversal of flow. Brunhölzl and von Reutern[6] described a phenomenological classification of innominate artery disease according to the severity of hemodynamic changes. Type 1 shows systolic deceleration or alternating flow in the right VA and only minor changes in the carotid arteries; type 2 is characterized by reversed flow in the ipsilateral VA and systolic deceleration in the carotid arteries; and type 3 is characterized by alternating flow or even a complete steal in the carotid arteries in addition to the VA steal.

In conclusion, the ISP is a rare clinical entity that may cause serious cerebrovascular symptoms. On color and spectral Doppler sonography, a distinctive pattern of hemodynamic alterations occurs in the right VA, CCA, and ICA. In addition, Doppler sonography can provide information about the degree of innominate artery stenosis.

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