The Use of Transthoracic Echocardiography in Diagnosing Brachiocephalic-Subclavian Artery Stenosis

David Anwar, DO, and Renée P. Bullock-Palmer, MD, FACC, FASE, FASNC, FSCCT, *Browns Mills, New Jersey*

INTRODUCTION

Subclavian artery stenosis is commonly caused by atherosclerotic disease. Clinical manifestations include ipsilateral arm claudication, arm numbness, vertebrobasilar symptoms, and cardiac ischemia secondary to coronary steal (in patients with left internal mammary artery bypass graft).[1] Diagnosis has been traditionally made using duplex ultrasound and confirmed using computed tomography or magnetic resonance imaging (MRI). However, echocardiography can be useful in detecting ostial and proximal brachiocephalic, left subclavian, and left carotid disease, although this utility has been underappreciated. We present the case of a female patient with a history of right arm numbness and dizziness with recent unremarkable carotid arterial Doppler findings who was diagnosed with right brachiocephalic arterial stenosis incidentally found on transthoracic echocardiography.

CASE PRESENTATION

The patient was a 65-year-old woman with a medical history of diabetes mellitus, hypertension, hyperlipidemia, mild aortic valve stenosis with mean and peak gradients of 12 and 20 mm Hg, respectively, and also a history of significant peripheral vascular disease with a history of right carotid endarterectomy in June 2012, transaortic endarterectomy-endarterectomy of the right and left renal arteries in the mesenteric artery region, and left venous–to–femoral arterial bypass in 2007. She presented to the cardiology clinic for a follow-up appointment regarding management of her hypertension and valvular heart disease and modification of her cardiovascular risk factors. It was noted that the patient's systolic blood pressure measured in the left forearm was higher than that on the right side by a difference of 40 mm Hg. The patient at that time denied any right upper extremity claudication, dizziness, or lightheadedness. Vascular surgery consultation was obtained and conservative management was recommended due to the fact that the patient was asymptomatic and it was felt that no further testing was necessary.

From the Department of Cardiology, Deborah Heart and Lung Center, Browns Mills, New Jersey.

Keywords: Brachiocephalic-Subclavian artery stenosis, Subclavian artery stenosis, Echocardiography, Arm claudication

Conflicts of interest: The authors reported no actual or potential conflicts of interest relative to this document.

2468-6441
https://doi.org/10.1016/j.case.2017.10.008

Six months later, the patient was seen by the cardiologist with symptoms of right arm pain and lightheadedness. Because of the patient's reported lightheadedness, transthoracic echocardiography was performed to assess for any progression of her aortic valve stenosis.

Transthoracic echocardiography revealed normal left ventricular ejection fraction, mildly thickened left ventricular walls, grade 2 diastolic dysfunction, and mild aortic valve stenosis with mean and peak gradients of 12 and 20 mm Hg, respectively. The view of the aortic arch as seen at the suprasternal notch view on echocardiography is shown in Figures 1 and 2, and a schematic diagram is also shown in Figure 3; the first branch of the aortic arch on the left is the brachiocephalic artery, followed by the second branch, which is the left common carotid artery, followed by the third branch on the right, which is the left subclavian artery. In our patient, there was turbulent flow and severe ostial plaque and narrowing at the first branch off the aorta (brachiocephalic) when imaged from the suprasternal view (Figures 1 and 2, Videos 1 and 2).

An unexpected high gradient was also found along the beam of the continuous-wave transducer placed at the suprasternal notch. A Pedoff transducer was used to record a peak velocity of 4.6 m/sec and a peak gradient of 85 mm Hg, suggesting the presence of severe stenosis along the brachiocephalic trunk (Figures 4 and 5).

Vascular reconsultation was obtained because of these findings, and computed tomography was performed for confirmation. Computed tomographic (CT) angiography showed severe calcified plaque within the origin of the brachiocephalic artery as well as additional stenosis within the subclavian artery (Figures 6–10).

Previously, the patient underwent carotid duplex ultrasound that demonstrated retrograde flow in the right vertebral artery suggestive of possible subclavian artery stenosis. On the basis of these findings and the patient's symptoms, the decision was made to proceed with diagnostic angiography and percutaneous revascularization to treat her brachiocephalic and subclavian artery occlusive disease.

Invasive angiography was performed and showed no flow refluxing beyond the brachiocephalic artery into the thoracic aorta (Figure 11). Severe calcification was noted in this same position. This was indicative of 100% occlusion of the brachiocephalic artery. Pressure measurement was taken, and a >50 mm Hg gradient was obtained across the ostium of the brachiocephalic artery. Balloon angioplasty across the brachiocephalic artery was then performed, and an 8 × 30 mm balloon-expandable stent was deployed. The sheath was then pulled back into the subclavian artery beyond its origin, and angiography demonstrated additional 60% stenosis in the subclavian artery distal to the vertebral takeoff. The pressure gradient measured across this distal subclavian artery demonstrated a 25 mm Hg gradient. This lesion was then treated with a 6 × 40 mm self-expanding stent. Postprocedural angiography demonstrated an excellent result, with no evidence of any residual stenosis. Repeat echocardiography showed resolution of the increased gradient across the ostium

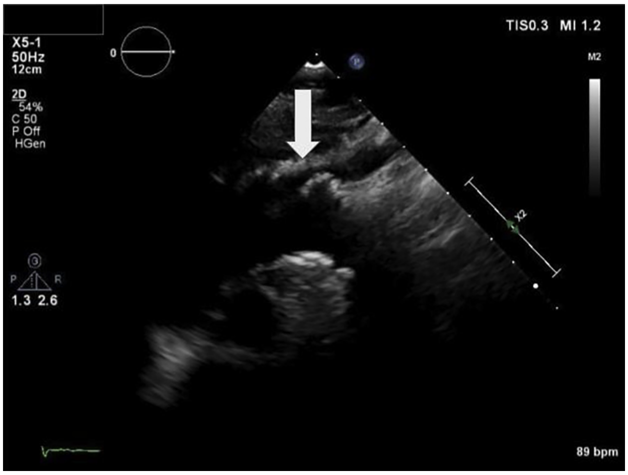

Figure 1 Two-dimensional transthoracic echocardiography suprasternal view displaying narrowing of the brachiocephalic trunk (*arrow*).

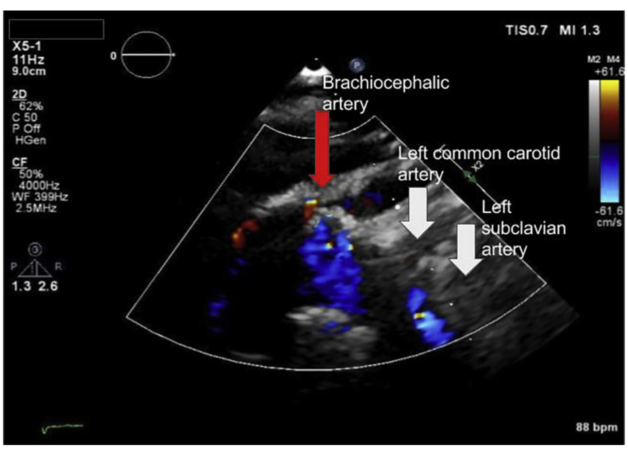

Figure 2 Color flow Doppler of the two-dimensional transthoracic echocardiography suprasternal view showing narrowing of the ostium of the brachiocephalic trunk with turbulent flow, suggestive of high flow velocity across the brachiocephalic trunk, which is the first branch of the aortic arch (*red arrow*). The other branches, from left to right, are the left common carotid artery, which is the second branch, followed by the left subclavian artery, which is the third branch (*white arrows*).

of the brachiocephalic artery in the suprasternal position (Figures 12–14, Videos 3–5).

The patient was seen in the cardiology clinic 4 months after the percutaneous intervention and was doing well, with complete resolution of her right arm pain and dizziness.

DISCUSSION

The prevalence of brachiocephalic or subclavian artery stenosis is about 0.8%–1.9% in the general population and up to 8.5% in patients with coronary artery disease.[2] Atherosclerotic disease of the supra-aortic trunk vessels, including the innominate artery, subclavian artery, and the common carotid artery, tends to present either as a low-flow state distal to the lesion or as embolic events.[3] A typical

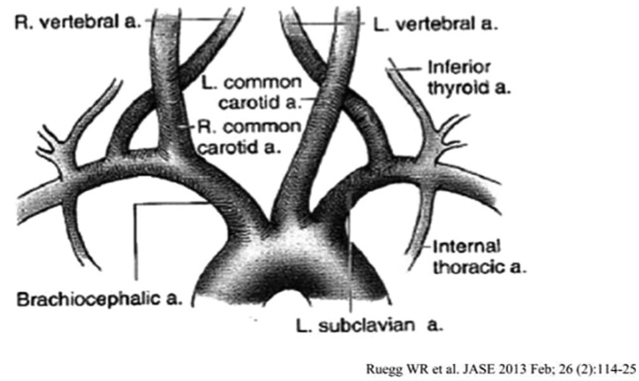

Figure 3 Schematic diagram showing the aortic arch anatomy. The usual anatomy of the aortic arch vessels begins with the brachiocephalic trunk as the first branch shown on the left in the diagram, followed by the left common carotid artery, and then the left subclavian artery on the right.

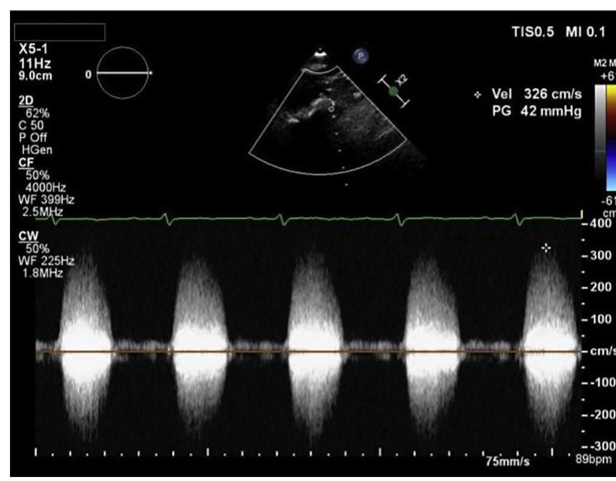

Figure 4 Continuous wave Doppler demonstrating a high gradient (> 40 mm Hg) across the brachiocephalic trunk in the suprasternal view on transthoracic echocardiography.

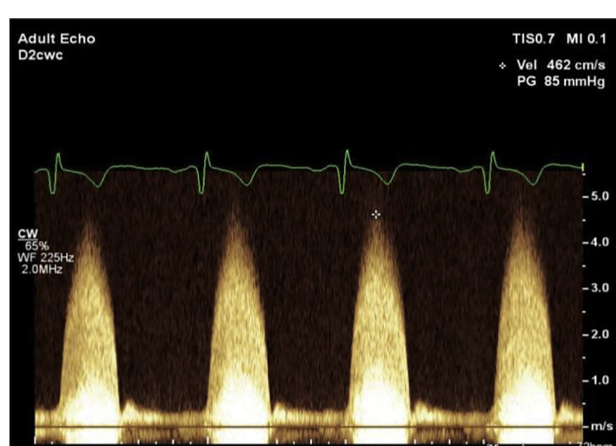

Figure 5 Continuous wave Doppler using a Pedoff transducer placed in the suprasternal view on transthoracic echocardiography demonstrated a very high velocity (4.6 m/sec) and gradient (85 mm Hg) along the beam of the transducer, which is suggestive of severe stenosis.