Images in Cardiovascular Medicine

Multimodality Imaging of Coronary-Subclavian-Vertebral Steal Syndrome

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A 59-year-old man was admitted with unresolved chest pain after coronary artery bypass graft surgery that had been performed 3 years earlier; aorta-obtuse marginalis, and aorta-posterior descending artery with the use of a saphenous vein graft and left anterior descending artery-left internal mammary artery (LIMA). He reported recurrent angina pectoris and cerebral symptoms, including dizziness and drop attacks, especially when moving his left arm. When he stopped moving his left upper extremity, these symptoms were spontaneously resolved within minutes.

On physical examination, pulse rate was regular at 72 beats/min, and there was a significant blood pressure difference between the right and the left arm (135/85 mm Hg and 95/65 mm Hg, respectively). On auscultation, there was a marked bruit at the left supraclavicular region. The results of transthoracic echocardiography were within normal limits. We performed coronary computed tomography angiography to display the cause of ischemic symptoms. Coronary computed tomography angiography revealed that the left subclavian artery was totally occluded 2 cm from its origin (Figure 1A), but all grafts and the left vertebral artery were patent (Figure 1B). It was also shown that the distal part of the occluded left subclavian artery was filling with contrast media, which made us think about retrograde flow from the left vertebral artery and/or the LIMA. Therefore, cardiac MRI was also performed to evaluate flow directions at the LIMA and left vertebral artery. Phase-contrast velocity mapping of the right internal mammary artery and the LIMA graft in the transaxial plane (Figure 2A) showed antegrade caudally directed flow in the right internal mammary artery, but predominantly retrograde flow in the cranial direction in the LIMA (Figure 2B). With the use of the same technique, it was also showed the right and left vertebral arteries in the transaxial plane (Figure 3A) and antegrade cranially...

Figure 1. A, Three-dimensional reconstruction from CCTA revealing that the left subclavian artery is totally occluded 2 cm from its origin (arrowhead). B, Three-dimensional reconstruction from CCTA revealing the LIMA graft, the left vertebral artery, and their courses in comparison with the occluded segment of the subclavian artery (asterisk). CCTA indicates coronary computed tomography angiography; LIMA, left internal mammary artery.
directed flow in the right vertebral artery, but predominantly retrograde caudally directed flow in the left vertebral artery (Figure 3B). Proximal left subclavian arterial occlusion and retrograde flow in the LIMA graft and the left vertebral artery were convincing evidence of coronary-subclavian-vertebral steal syndrome. After coronary computed tomography angiography and MRI, he underwent coronary angiography. The left subclavian artery was totally occluded (online-only Data Supplement Movie I). The LIMA graft was patent, but blood flow was retrograde from coronary circulation through the LIMA into the distal part of the subclavian artery (online-only Data Supplement Movie II).

A saphenous vein graft was placed between the left carotid and the left subclavian artery just below the LIMA after 1 month. An anterograde flow in the LIMA graft and the left vertebral artery could be achieved, resulting in complete relief from angina pectoris and vertebrobasilar symptoms.

The left vertebral artery and the LIMA originate from the left subclavian artery and the presence of the subclavian artery stenosis may cause insufficient, even retrograde blood flow in these vessels, resulting in myocardial ischemia and vertebrobasilar symptoms.1 This “steal” effect of the subclavian artery over coronary and cerebral circulation is defined as coronary-subclavian-vertebral...
steal syndrome. This case illustrates the versatility of coronary computed tomography angiography, coronary angiography, and especially phase-contrast velocity mapping from cardiac MRI techniques for demonstrating this well-recognized complication after coronary artery bypass graft. Cardiac MRI can be considered as a valuable substitute for invasive and x-ray-based technique, such as diagnostic conventional angiography, to reveal the flow direction in great vessels. Anatomic, functional, and flow information can be obtained from these techniques, and they can guide medical management of such patients.

Disclosures
None.

References
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_Circulation_. 2012;125:e241-e243
doi: 10.1161/CIRCULATIONAHA.111.065805

_Circulation_ is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

The online version of this article, along with updated information and services, is located on the World Wide Web at:
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