Bronchocoronary Collateral Circulation
Clinical Utility of Cardiac Computed Tomography

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A 47-year-old male patient with 3-vessel coronary artery disease underwent quadruple coronary artery bypass graft surgery (right internal mammary artery–right coronary artery [RIMA–RCA], left internal mammary artery–left anterior descending artery [LIMA–LAD], and radial artery–second posterolateral branch with jump anastomosis to the first posterolateral branch). Surgery was complicated by difficulties sustaining cardioplegia and backflow of blood through the coronary arteries despite cross-clamping of the aorta. Eleven months after surgery, the patient presented with recurrent signs of ischemia on an electrocardiogram during exercise.

Invasive coronary angiography was subsequently performed, which demonstrated a normal LIMA graft to the distal LAD (chronic total occlusion of the proximal and mid LAD). However, the RIMA graft showed a string sign (severe stenosis), and the RCA showed an 80% ostial stenosis. The circumflex (CX) and the radial artery bypass graft could not be demonstrated angiographically. Subsequent balloon angioplasty and stenting of the ostial RCA stenosis were successfully performed (complete reconstitution of flow and lumen).

Despite revascularization, the patient continued to demonstrate signs of myocardial ischemia during exercise electrocardiography, and adenosine stress/rest perfusion magnetic resonance imaging was performed. Magnetic resonance imaging showed ischemic myocardium in the basal and midventricular anteroseptal and anterior left ventricular wall. The myocardium subtended by the CX and grafted posterolateral branches showed no signs of ischemia and no late gadolinium enhancement.

Thereafter, the patient was referred for cardiac computed tomography (CT) to assess for the morphology of the CX, as well as the origin and patency of the radial artery bypass graft. Dual-source CT coronary angiography confirmed the patency of the LIMA–LAD bypass and the occluded proximal LAD and demonstrated a patent stent in the ostial RCA (Figure 1). The RIMA–RCA bypass graft was occluded, most probably as a result of concurrent flow after foregoing stenting of the ostial RCA. The CX showed a proximal occlusion by a calcified plaque. The radial artery bypass graft demonstrated a proximal high-grade stenosis, being patent until the jump anastomosis onto the first posterolateral branch and being occluded in its distal segment (Figure 1).

However, CT demonstrated collateral perfusion of the distal CX through the sinus node artery fed by an enlarged and tortuous bronchial artery originating from the descending aorta.

Figure 1. Volume-rendered cardiac CT demonstrating (A) the patent LIMA–LAD bypass graft (white arrowhead), the occluded RIMA–RCA bypass graft (arrows), and the high-grade stenosis of the proximal radial artery bypass graft (black arrowhead). B, The stenosed radial artery bypass graft was patent until the jump anastomosis to the first posterolateral branch with occlusion of its distal segment (white arrow). An enlarged sinus node artery (black arrows) was noted, connecting to the proximally occluded CX (black arrowhead). C, CT reconstruction after removal of the cardiac chambers, cardiac veins, and distal descending aorta, showing an enlarged bronchial artery (arrows) from its origin in the descending aorta eventually reaching the CX (arrowhead).
aorta (Figure 1). The anastomosis between the bronchial and the sinus node artery was located in the area of the posterior pericardial reflection above the roof of the left atrium. Subsequent catheter coronary angiography with stenting of the radial artery bypass graft was performed, and bronchocoronary collateral perfusion was confirmed (Figure 2).

Anastomoses between extracardiac vessels and coronary arteries were first described by Albrecht von Haller in 1747. Later, it would be shown that they exist in all subjects with or without cardiac or pulmonary disease and even in infants. Despite this, however, anastomoses represent a rare imaging finding, with an incidence of only 0.5% at catheter angiography and 0.6% at cardiac CT.

Extracardial coronary blood supply leads through the pericardial reflection sites. Dorsally, the pericardium is supplied by the bronchial arteries that may have anastomoses with atrial branches of the coronary arteries. Generally, these anastomoses remain hemodynamically insignificant and clinically silent. In patients with severe coronary artery disease, bronchocoronary anastomoses may contribute to the preservation of systolic left ventricular function. Conversely, the anastomoses may also lead to coronary steal in patients with pulmonary disease such as bronchiectasis.

Knowledge about the presence, origin, and extent of bronchocoronary collateral circulation is important for surgery because these collaterals may complicate cardioplegia through backflow of blood in the coronary arteries during cardioplegia despite cross-clamping of the aorta, a problem that also occurred in our patient. Perfusion magnetic resonance imaging in the patient reported here showed ischemia only in myocardial segments subtended by the occluded proximal and mid LAD, not in the left ventricular wall supplied by the CX and posterolateral branches. Considering the proximally occluded CX, the severely stenosed radial artery bypass graft, and the occlusion of this graft in its distal segment, the lack of ischemia or scar indicates sufficient collateral blood flow to the myocardium from the bronchocoronary collateral.

The utility of cardiac CT, being a cross-sectional imaging modality, lies in its ability to depict both coronary and extracardiac vessels simultaneously.

Disclosures
None.

References
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