Single coronary artery from the right aortic sinus of Valsalva with anomalous prepulmonic course of the left coronary artery

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Cardiac computed tomography allows for improved, noninvasive and accurate visualization of coronary artery anomalies. The case of a single coronary artery with origin from a single ostium in the right sinus of Valsalva with an anomalous course of the left coronary artery anterior to the pulmonary trunk is presented. The unusual distal reconstitution of a normal anatomical course at the junction of the mid and distal left anterior descending artery with occlusion of the proximal circumflex artery has not, to the authors' knowledge, been previously described.

Key Words: Anomalous prepulmonic left coronary artery; Cardiac CT; Catheterization; Coronary artery disease; Coronary circulation; Single coronary artery

Single coronary artery is a rare congenital anomaly with a quoted incidence of 0.024% to 0.06% (1), and may be associated with sudden cardiac death after exercise and angina. We present the case of a single coronary artery originating from a single ostium in the right sinus of Valsalva with an anomalous course of the left coronary artery (LCA) anterior to the pulmonary trunk, and unusual distal anastomosis at the junction of the mid and distal left anterior descending artery (LAD) with occlusion of the proximal circumflex (Cx) artery.

CASE PRESENTATION

A 56-year-old male geologist presented from another institution, complaining of exertional chest pain for several months. He was initially admitted with a presumptive diagnosis of unstable angina. Cardiac risk factors included previously smoking for 25 years, hypercholesterolemia and a positive family history of premature coronary artery disease (his mother died of myocardial infarction at 42 years of age). The initial troponin test was negative, and an electrocardiogram (ECG) did not show any ischemic changes. However, he had a recurrent episode of chest pain at rest in the hospital and subsequently underwent cardiac catheterization, percutaneous coronary intervention and stenting.

A coronary angiogram showed an anomalous left main branch originating from the right coronary artery (RCA). The RCA had an ulcerated 90% lesion in the midsegment, which was the presumed cause of the

Une seule artère coronaire du sinus de Valsalva droit et un parcours prépulmonaire anormal de l'artère coronaire gauche

La tomographie assistée par ordinateur cardiaque permet de mieux visualiser les anomalies des artères coronaires, avec plus de précision et de manière non effractive. Est présenté le cas d'une seule artère coronaire provenant d'un seul orifice du sinus de Valsalva droit accompagné d'un parcours anormal de l'artère coronaire gauche antérieure au tronc pulmonaire. En autant que le sache l'auteur, la reconstitution distale inhabituelle d'un parcours anatomique normal à la jonction de la branche antérieure médiane et distale de l'artère coronaire gauche avec occlusion de l'artère circonflexe proximale n'a jamais été décrite auparavant.

patient's angina (Figure 1). The patient subsequently underwent cardiac computed tomography (CT) coronary angiography to further evaluate the anomalous anatomy and distal supply in the LCA territory.

Images were acquired at 10% increments throughout the cardiac cycle on a Siemens Somatom Sensation (Siemens, Germany) 64-slice dual-source cardiac multidetector CT (MDCT) following contrast administration, with limited cardiac views in best diastolic phase and multiphase.

The RCA demonstrated a normal origin (Figures 2 and 3A). The left main coronary artery and left coronary ostium were not present (Figure 3D), and there was anomalous origin of the LAD by a large artery arising off the RCA, passing anterior to the pulmonary outflow tract in the distribution of the conus branch (Figures 3B and 4A). This fed into the junction of the mid and distal LAD coronary artery, and the anomalous vessel was calcified in its middle one-third, with 0% to 50% stenosis. At its junction with the normal course of the LAD, there was another 0% to 50% stenosis. The distal LAD was small but disease free. The second diagonal branch was large and disease free (Figure 3C). Retrograde flow occurred up from the mid LAD (Figure 4B), with 50% to 70% stenosis. A tiny first diagonal branch was identified. The proximal LAD was not demonstrated beyond the junction with the expected position of the left main coronary artery.

The proximal Cx was not visualized. A tiny first obtuse marginal artery was seen, filled by collaterals that were not resolved by the

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Figure 1) Right anterior oblique view of a conventional coronary angiogram following injection into the single right coronary ostium (curved arrow). Focal stenosis in the mid right coronary artery (arrowhead) and an aberrant left coronary artery originating from the proximal right coronary artery (arrow) are illustrated

Figure 2) Three-dimensional reconstruction cardiac computed tomography image of the coronary arterial tree in a similar projection with cranial angulation showing a single coronary ostium in the right sinus of Valsalva (arrow), prepulmonic course of the left coronary artery (curved arrow) and straightening of the right coronary artery lumen at the site of endovascular stenting (arrowhead)

scanner. The mid Cx filled retrogradely from the mid LAD and the distal Cx was occluded. A large posterolateral branch and distal obtuse marginal artery arose off the distal RCA. Large septal collaterals were not identified.

The mid RCA had a stent within it (Figure 2), which displaced a focal calcified plaque. The distal RCA had multiple foci of calcification with 0% to 50% stenosis. A large, disease-free posterior descending artery and posterolateral branches were seen.

Figure 3) Transaxial cross-section views. **A** Single origin of the coronary artery from the right coronary cusp (asterisk). **B** Prepulmonic course of the aberrant left coronary artery (arrow) with occlusion of the circumflex artery. **C** Retrograde filling of the proximal left anterior descending artery and the second diagonal branch (arrowhead). **D** Absence of a normal left main coronary artery (curved arrow)

Figure 4) Three-dimensional reconstruction of the heart. Right anterior oblique (**A**) and anterior (**B**) views showing a prepulmonic course of the anomalous left coronary artery (arrow), a right coronary artery with an endovascular stent at the site of previous stenosis (arrowhead) and retrograde filling of the left anterior descending artery (curved arrow)

Cine analysis demonstrated symmetric contraction of the left ventricle, with no areas of wall thinning. No perfusion defects were seen.

Automated ventricular volumes included an end-systolic volume of 50 mL, end-diastolic volume of 173 mL, stroke volume of 123 mL and ejection fraction of 51%. The myocardial mass was 155 g.

DISCUSSION

Single coronary artery is a rare congenital anomaly with a quoted incidence of 0.024% to 0.06% (1). A single, isolated origin of the coronary vessels may be associated with sudden cardiac death, particularly in cases with an interarterial course, although the risk has not been adequately quantified in specific studies. Its association with cardiac ischemia and congestive cardiac failure is likely due to the fact that a proximal stenosis of a single coronary artery may prove devastating if adequate collaterals do not exist. Origin of the LAD from the RCA is a relatively common abnormality. It occurs in approximately

5% of patients with tetralogy of Fallot, in which the LAD crosses the right ventricular outflow tract in front of the pulmonary artery and may complicate surgical repair of tetralogy of Fallot. In many of these cases, the Cx is also small.

Several classification systems for coronary artery abnormalities exist. Lipton et al (2) classified coronary variations based on origin and anatomical course relating to the ascending aorta and pulmonary trunk. Type L represents an RCA originating from the left main stem and type R indicates that the coronary artery originates from the RCA. These types are then classified as I to III. Class I follows the anatomical course of either an RCA or LCA. Class II indicates one coronary artery arising from the proximal part of the normally located opposite coronary artery. In class III, the LAD and Cx arise separately from the proximal part of a normal RCA. Classes II and III are then designated as anterior (type A) or posterior (type P) according to their route in relation to the pulmonary artery, or interarterial (type B) if it courses between the ascending aorta and pulmonary trunk. Type B morphology has been associated with a high risk of clinical consequences when associated with an intramural course (2). More recently, Angelini et al (3) proposed a slightly different classification according to the anatomical course within the interventricular sulcus and atrio-

ventricular groove, as well as the location of penetrating side branches.

Until recently, delineation of the anatomical course relied on the 'dot and eye' method and/or pulmonary artery catheter placement. The development of retrospectively ECG-gated MDCT and dual-tube cardiac CT technology has allowed for noninvasive, accurate visualization of coronary artery anomalies, which may be difficult to delineate fluoroscopically at angiography in a two-dimensional plane.

The present case illustrates a Lipton type RIIA anomaly. Its particular significance lies in its distal course, where it reconstitutes a 'normal' distribution at the junction of the mid and distal LAD with retrograde filling of the proximal LAD and mid Cx arteries, as opposed to reconstituting at the bifurcation into the LAD and Cx as illustrated by Angelini (4).

Single coronary ostium with the LCA taking its origin from the proximal RCA has been reported using retrospectively gated MDCT, but the distal branching pattern was not described (5). To our knowledge, the current report is the first to present a case of unusual distal anastomosis at the junction of the mid and distal LAD with nonfilling of the Cx documented on prospectively ECG-gated cardiac MDCT.

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