

Vioussens' ring coronary collateral circulation: a natural bypass history

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Abstract. "Vioussens' ring" or "arterial circle of Vioussens" is a crucial hetero-coronary pathway, bridging proximal right coronary artery (RCA) and left anterior descending artery (LAD) when a hemodynamically stenosis is established in the either of the vessel. In detail such coronary collateral circulation is usually supplied by branches of the conus artery. We present a case of a 62-year-old man who was admitted to our emergency department complaining of chest pain. Coronary angiography showed LAD occlusion at the mid tract with delayed and slight opacification of its distal segment sustained by Vioussens' ring. Coronary computed tomography angiography (CCTA) was subsequently performed which confirmed the presence of such natural bypass and evaluated its relationship with adjacent structures. Imaging, particularly CCTA offers a valid tool in assessing the hetero-coronary collateral vessel. Due to its high spatial resolution it may provide many information about the coronary anatomy by delineating their origin, course and termination. (www.actabiomedica.it)

Key words: Vioussens' ring, natural bypass, coronary computed tomography angiography, CCTA, CCT, cardiac CT, collateral coronary circulation

Introduction

A lot of different collateral pathways may be noted in patients having coronary obstruction, but usually collateral circulation is clearly identifiable only when the degree of arterial narrowing exceeded 90% (1). Moreover, these collateral vessels may play a key role in the pathophysiology of coronary artery disease and significantly influence prognosis and symptoms (2, 3). "Vioussens' ring" is an important vascular anastomotic bridge providing, as a natural bypass, flow between proximal right coronary artery (RCA) and left anterior descending artery (LAD) when one of these vessels has a critical stenosis (4-6). This collateral circulation is usually supplied by branches originated from

the conus artery, which most often derives from the proximal RCA, but sometimes it derives directly from aorta (anterior or right aortic sinus) and in this case it is named the "third coronary artery" (TCA) (7, 8). The conus artery supplies the right ventricular outflow tract (RVOT) and frequently contributes to the apical and septal perfusion.

Case report

A 62-year-old man, smoker, with a history of hypercholesterolemia, hypertension and essential thrombocytopenia (72×10^3 platelets; normal value ranges: $150-450 \times 10^3$) was admitted to the emergency

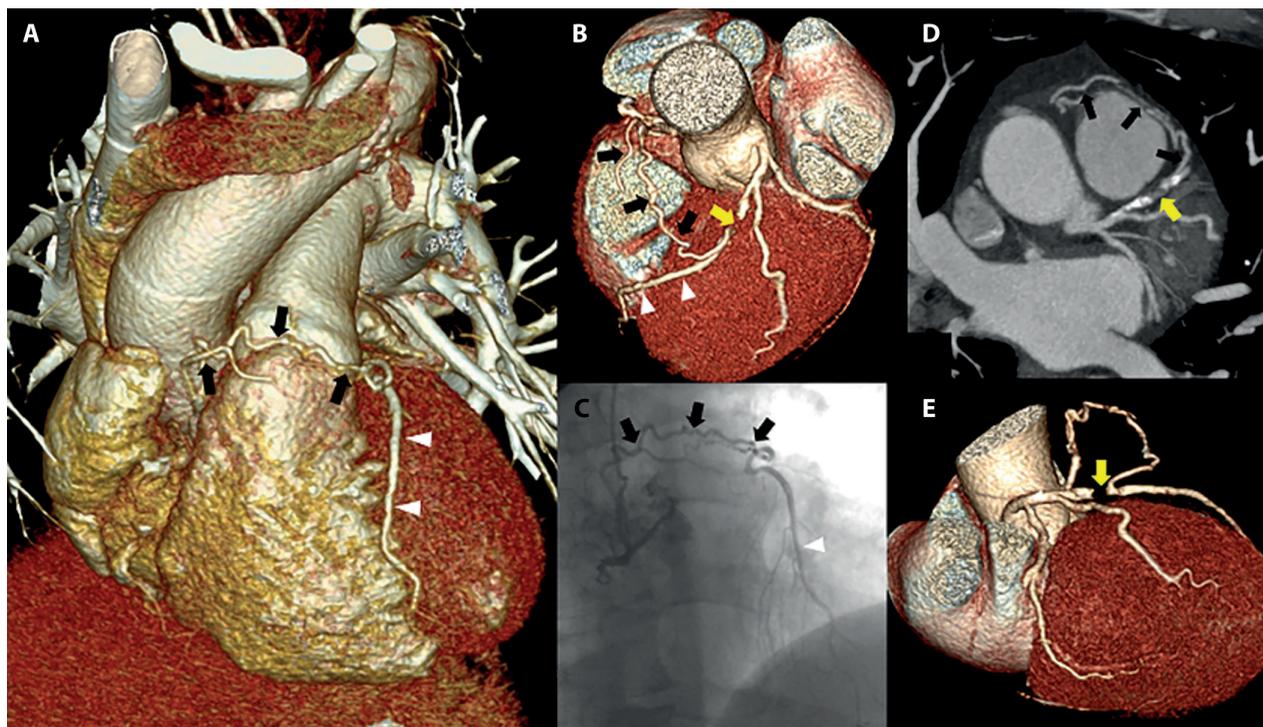


Figure 1. 3D-VRT CCTA (a,b,e), maximum intensity projection (MIP) (d) and selective RCA coronary angiography (c) images clearly show LAD (white arrowheads) occlusion at the mid tract (yellow arrows) immediately distal to the origin of a large first diagonal and the presence and course of eterocoronaric collateral vessels from the conus artery (black arrows), which arises immediately after the origin of the RCA occluded at the proximal tract.

department of our hospital due to typical chest pain. An electrocardiogram (ECG) revealed inferior Q-wave and transthoracic echocardiography identified inferior hypokinesia with a slightly reduced left ventricular ejection fraction (LVEF=53%). At admission, cardiac Troponin I was 3.3 ng/mL (normal value ranges: 0.00-0.10 ng/mL), creatine kinase isoenzyme Mb was 63.8 ng/mL (normal value ranges: 0.00-3.6 ng/mL) and myoglobin was 205 ng/mL (normal value ranges: 16-96 ng/mL). Coronary angiography revealed LAD occlusion at the mid tract, immediately distal to the origin of a large first diagonal, but with a delayed and slight opacification of the distal segment sustained by eterocoronaric collateral pathway from the conus artery arising immediately after the origin of the RCA, occluded at the proximal segment (Figure.1c).

A coronary computed tomography angiography (CCTA) and cardiac magnetic resonance (CMR) were performed to better demonstrate coronary anatomy, especially the eterocoronaric collateral vessel, to assess

aortic root and ascending aorta caliber and calcifications and to evaluate myocardial viability and left ventricle systolic function. The ECG-gated spiral CCTA was performed with a 128-slice single-source CT scanner. To improve image quality an additional reconstruction of the optimal diastolic phase was performed with the following parameters: effective slice thickness of 0.6 mm; reconstruction increment 0.4 mm; a convolution kernel with iterative reconstruction (I30; IRIS, Siemens, Germany) (9-10). The CCTA confirmed angiography findings, better demonstrating the course of the “Vieussens’ ring” running from the conus artery to the middle tract of the LAD (immediately downstream to the occlusion), passing anteriorly and superiorly to the right ventricle outflow tract (Figure 1a-e). To better evaluate biventricular function, the relationship between collateral circulation and myocardium viability and to find any unknown collateral findings, patient was referred for CMR (11). CMR demonstrated subendocardial late gadolinium enhancement

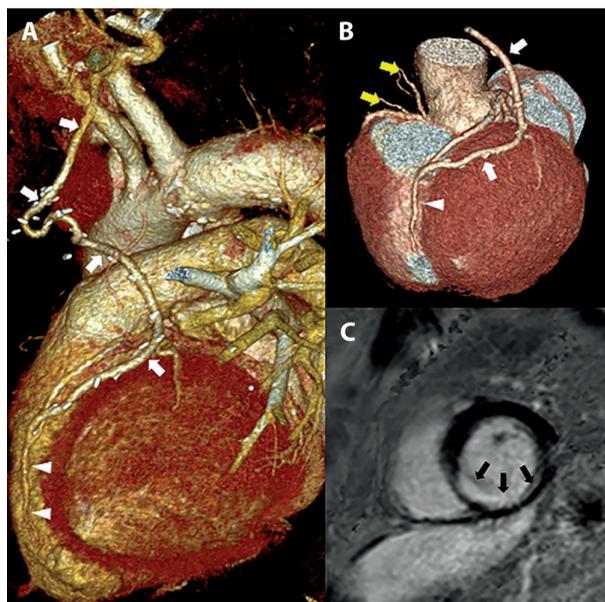


Figure 2. 3D-VRT CCTA images (a,b) showing graft (white arrows) patency and course (LIMA>LAD), with good LAD (white arrowheads) opacization distally to the anastomosis. Furthermore, as expected, the “Vieussens’ ring” caliber results significantly reduced (yellow arrows). CMR demonstrated sub-endocardial (about 50% of the myocardial thickness) late gadolinium enhancement (LGE) of the basal and mid-inferior and inferoseptal left ventricular walls, with no edema compatible with post infarction scar (c).

(LGE) of the basal and mid-inferior and inferoseptal left ventricular walls with a 50% degree of transmural-ity (Figure.2c). Notably, CMR documented absence of LGE in the LAD territory. Based on these findings and patient’s symptoms myocardial revascularization was conducted using left internal mammary artery (LIMA) graft to the distal LAD. CCTA performed thirty days after surgery documented graft patency (LIMA>LAD) with good LAD opacization distally to the anastomosis (Figure 2a,b). Furthermore, as expected, the “Vieussens ring” caliber resulted significantly reduced probably due to the flow competition/redistribution. Patient was discharged asymptomatic and two-years follow-up was uneventful.

Discussion

Presence and size of omo- or eterocoronaric collateral vessels may significantly affect coronary artery

disease symptoms, prognosis and treatment strategy; in particular for LAD occlusion the Vieussens’ ring can be frequently shown (20%) but it is not always identified. Some authors have suggested to study all patient with stable and chronic proximal/mid LAD occlusion with selective injection of the conus branch to improve planning of possible revascularization (2, 12). It is also fundamental for the surgeon to know the origin and course of conus artery in order to avoid iatrogenic damage during surgery. During coronary artery bypass graft surgery (CABG) handling of the right infundibulum, where conus artery and its collateral branches run, is often necessary. Furthermore, the Vieussens’ ring could be used as an alternative via to treat LAD occlusion using a retrograde route when the LAD stenosis cannot be successfully crossed using a classic antegrade approach (12). We highlight the importance of CCTA in the non-invasive evaluation of the coronary collateral circulation, its size and especially its relationship with the main anatomical mediastinal structures which are essential information in surgical planning.

Conflict of interest: Each author declares that she or he has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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