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Imaging of coronary artery fistulas by multidetector CT angiography using third generation dual source CT scanner

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ABSTRACT

Coronary artery fistulas are rare cardiac conditions which constitute a subgroup of anomalies of the coronary arteries. Though majority are asymptomatic, they may be associated with high prevalence of late symptoms and complications. Accurate identification of the fistulas, their hemodynamic significance and associated conditions generally influence management strategies. Dual source computed tomographic evaluation is valuable in delineating its precise morphology with identification and characterization of associated anomalies, thereby assisting in mapping the ideal treatment option.

1. Introduction

Coronary artery fistula (CAF) represents an abnormality in the termination of a coronary artery. It is defined as a direct pre-capillary connection between a branch of a coronary artery and the lumen of a cardiac chamber, coronary sinus or superior vena cava, or a pulmonary artery or pulmonary vein close to the heart [1]. It is a rare anomaly, prevalence has been reported as 0.002% in the general population and accounts for approximately 0.2% – 0.4% of congenital cardiac anomalies [2]. Majority of CAFs reported in literature are congenital and appear to represent persistence of embryonic intra-trabecular spaces and sinusoids. The rare acquired fistulas are usually iatrogenic as a complication of coronary angioplasty, coronary artery bypass surgery, or after cardiac transplantation and myocardial biopsy [3]. Rarely, they may be secondary to trauma, Takayasu arteritis or chest irradiation [4–6]. No race or sex predilection for CAF has been observed.

Though mostly asymptomatic and incidentally detected, coronary artery fistulas may be associated with chest pain, arrhythmias, endocarditis, thrombosis, myocardial infarction, stroke or very rarely sudden death. They usually drain into low pressure areas and their origin and proximal course is optimally delineated on conventional coronary angiography; however their distal evaluation may be suboptimal [7]. Large fistulas may also be seen on echocardiography; however it provides limited information and is operator dependent [8]. Multi-detector computed tomography (MDCT) is very useful in delineating the exact anatomy of the fistula; correctly identifying its origin, course, and termination, besides providing information about associated anomalies [8]. With the advent of third generation dual source computed tomography (DSCT) scanners and use of advanced dose reduction strategies, images can be obtained in a very short time having excellent spatial and temporal resolution with minimal radiation burden.

2. Clinical presentation/pathophysiology

Mostly, they are incidentally detected and are asymptomatic in adult patients unlike that seen in paediatric population. Majority of symptomatic CAFs originate from the right coronary artery than left coronary artery. Symptomatic patients often present with exertional dyspnoea and fatigue. The severity of symptoms is largely determined by the degree of shunt which in turn is dependent on the calibre of the fistula as well as the site of origin and distal drainage. Patients may present with myocardial steal phenomenon, features of which include arrhythmias, angina and myocardial infarction. Long-standing lesions may present with various complications including thrombo-embolic events, congestive heart failure, endocarditis, aneurysmal dilatation and rarely rupture [9–13].

3. Imaging modalities

Transthoracic echocardiography generally remains the initial investigation of choice for majority of cardiac conditions. In CAFs, dilated coronary artery may be seen and the distal drainage may be ascertained by using colour flow mapping. However, its utility may be limited in

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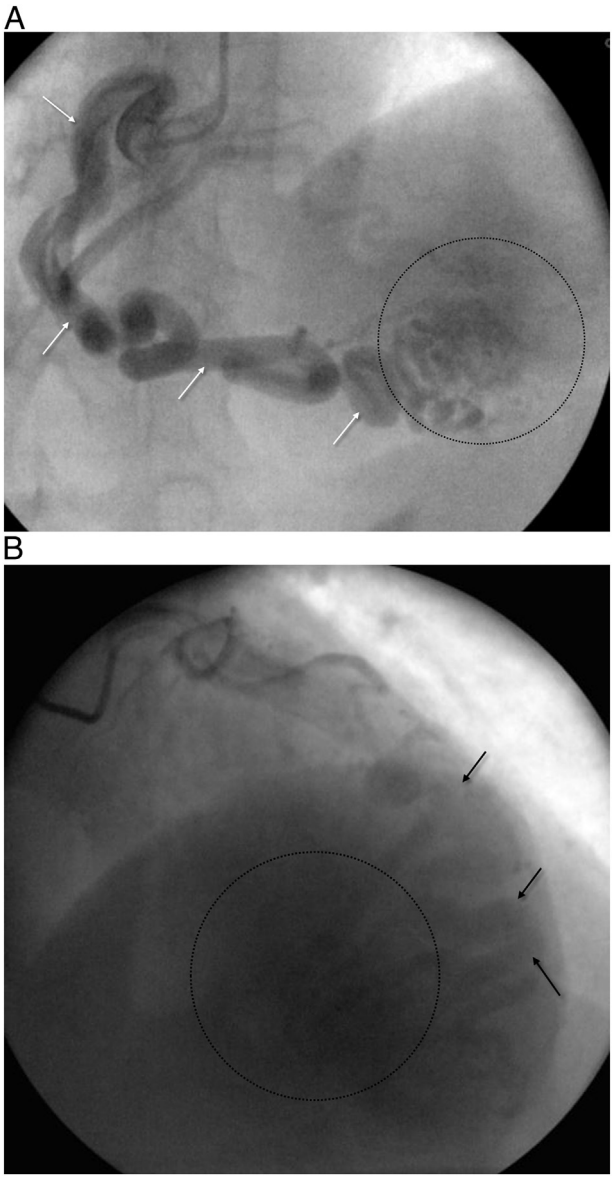

Fig. 1. (A) Right coronary angiogram reveals dilated and tortuous right coronary artery (indicated by white arrows) with distal fistulous communication with the right ventricle; the distal drainage site and pattern is however not very clearly delineated (dotted circle) (B) Similarly, a left coronary angiogram, in a case of left anterior descending artery to right ventricle fistula, depicts the dilated and tortuous left anterior descending artery (indicated by black arrows) with poor delineation of distal drainage point (dotted circle).

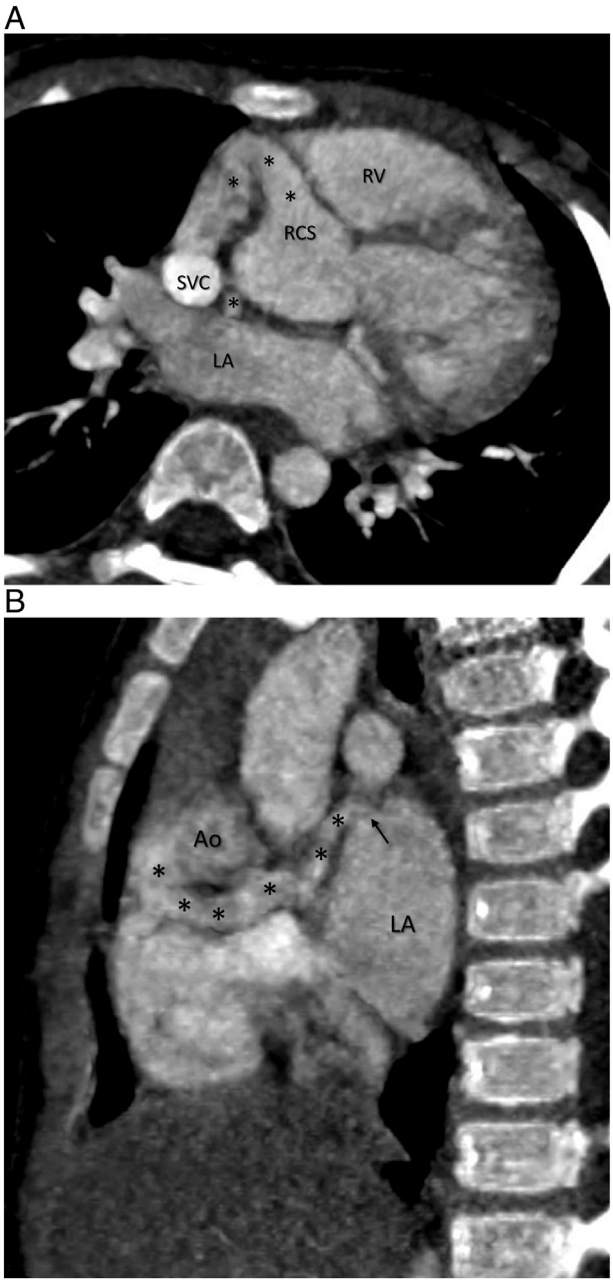

Fig. 2. Maximum intensity projections in the axial (A) and sagittal (B) reconstructions reveal a dilated right coronary artery (indicated by *) draining into the left atrium (LA). Point of drainage indicated by a black arrow in Fig. 2B. (RCS: right coronary sinus; RV: right ventricle; SVC: superior vena cava; Ao: Aorta).

cases of small shunts and fistulas to pulmonary arteries, where the coronaries may be of normal size. Use of microbubbles to augment the colour Doppler signals helps in delimiting the site and extent of CAFs [8].

Catheter angiography is invasive in nature. Although it delineates the origin and proximal course of CAFs well, demonstration of distal drainage may be suboptimal (Fig. 1). This is attributed to the contrast dilution that occurs at the distal drainage sites, usually low pressure chambers of the heart [7]. Previously, cardiac catheterization was usually performed pre-operatively to confirm the anatomy and in planning the surgical treatment. However, with advancements in non-invasive imaging modalities, nowadays it is only used as an adjunct to endovascular management in these lesions.

Magnetic resonance (MR) imaging has also been used in the pre-operative evaluation of CAFs. Newer MRI sequences allow improvement in image quality along with better anatomical demarcation. Cine MR sequences exquisitely demonstrate the flow dynamics, especially the turbulence observed at fistulous communication site, while the black-blood sequences permit excellent visualization of the vessel lumen and its wall [14]. MRI has evolved into an imaging substitute to assess anatomic, flow-related and functional aspects of the lesion with no ionizing radiation burden [15–17]. However, MRI has its own inherent disadvantages including long acquisition times with frequent need for sedation, issues related to cost and availability in emerging countries and limited temporal and spatial resolution.

MDCT is considered to be a good alternative to echocardiography and catheter angiography for evaluation of these anomalies [18–20]. With the increasing use of MDCT, an increase in prevalence rate of