

Percutaneous Coronary Intervention in Single Coronary Artery anomaly presenting with Acute Coronary Syndrome

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ABSTRACT

Single coronary artery is a rare but potentially devastating anomaly. Most cases are asymptomatic and found incidentally in patients that undergo coronary angiography. Such patients are more prone to acute coronary syndrome if an atherosclerotic plaque develops at the origin of the coronary ostia. We report an interesting case of single coronary artery arising from the right coronary cusp with anomalous origin of the left anterior descending and left circumflex coronary arteries that was found incidentally while evaluating a patient with acute coronary syndrome.

Keywords

Single coronary artery, Acute coronary syndrome, Accelerated atherosclerosis, Revascularization.

Background

A single coronary artery is a rare anomaly where the entire myocardium is supplied by a solitary coronary artery that arises from a single ostium [1]. In the majority of cases, patients are asymptomatic, with the anomaly being diagnosed when the patient presents with features of acute cardiovascular syndrome. Although angiography remains the gold standard for diagnosis, cardiovascular resonance imaging helps in better delineation of its aberrant course and subsequent 3-D modelling if needed. Here we describe a patient with a single coronary artery who presented with signs and symptoms of acute cardiovascular syndrome.

Case Report

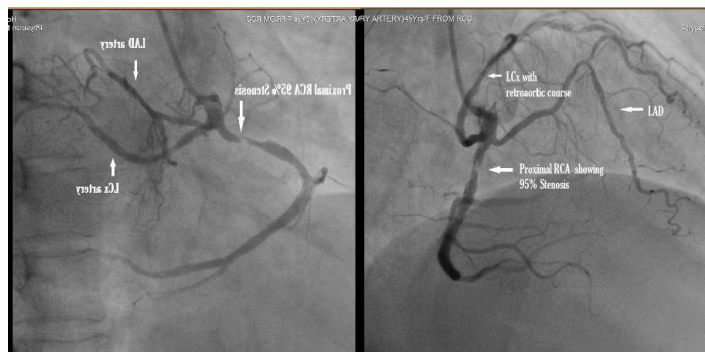
A 45-year-old female presented to the emergency department with complaints of worsening exertional chest pain and dyspnoea since the past two days. She denied any dizziness or palpitations. Oxygen saturation was 96%. Physical examination

was unremarkable. Past medical history was insignificant. Electrocardiogram showed ST depression in leads V1-V6, I, II and aVL. Trans-thoracic echocardiogram showed no left ventricular regional wall motion abnormality, normal valves and ventricular function. Serum troponin and CK-MB levels were elevated and the patient was diagnosed with non-ST segment elevation myocardial infarction (NSTEMI). The patient was started on low molecular weight heparin and dual antiplatelet therapy and was scheduled for coronary angiography. The coronary angiogram revealed no left main coronary artery arising from the left coronary cusp (Figure 1). Right cusp shoot revealed a single coronary artery arising with anomalous coronary ostia directed anteriorly. Left anterior descending artery (LAD), left circumflex artery (LCX) and right coronary artery (RCA) were found to be arising from the common ostia origin (Figures 2,3). Dot & eye method was used for identifying the course of LAD and LCX, which showed septal and retro- aortic courses respectively (classification by Lipton was based on CT angio). The RCA in its proximal part showed 95% stenosis with an ulcero-thrombotic plaque. Rest of the coronary arteries showed insignificant disease. Percutaneous coronary angiography (PTCA) to RCA was planned. There was no difficulty in engaging the ostia during catheterization with 3.5 Judkins right

coronary catheter. The bare metal wire (BMW) 0.014 guidewire was used for negotiating the lesion and balloon pre-dilatation was performed with 2.75 mm x 12 mm balloon. A 3.5 mm x 18 mm drug eluting stent was placed at 14 atm, post-dilated with 3.5 mm x 15 mm balloon. Excellent result with TIMI III flow was achieved (Figures 4,5). There were no complications and the patient did well. She was kept under observation for two days after which she was discharged.



Figure 1: Shows absent left main coronary artery (LMCA) from left cusp



Figures 2,3: Show RCA, LAD. LCx arising from the common trunk (right cusp) with 95% ulcerothrombotic lesion at the proximal RCA



Figure 4,5: Shows post PTCA to proximal RCA – TIMI-III flow

Discussion

Single coronary artery (SCA) is a rare congenital anatomical anomaly with an incidence ranging from 0.024-1% as per various

reports [1]. Many congenital structural cardiac anomalies can be associated with SCA like, for example, pulmonary artery atresia, tetralogy of fallot, patent truncus arteriosus, transposition of great vessels, interventricular septal defects, patent ductus arteriosus, bicuspid aortic valve and patent foramen ovale. SCA can also be an isolated defect [1,2].

There are multiple classifications for single coronary arteries, but the most widely used one would be Liptons Modified Classification. This classification takes into account the origin of the ostium, anatomical course of the vessel and the course of the transverse trunk. The classification is as follows:

Table 1 [1,3]:

Ostium	
L Left sinus	R Right sinus

Architectural Division		
I	II	III
Single main artery leads the course of a normal RCA or LCA.	Singular coronary vessel originates from the proximal portion of the typically placed other coronary.	Left anterior descending and Left circumflex originate independently from common trunk arising from the right sinus.

Route of the transverse trunk				
A	B	P	S	C
In front of pulmonary trunk	In the middle of the aorta and pulmonary trunk	Behind the aorta	Septal : partly passes through the septum between ventricles	Combined : combination of multiple courses

Most of the patients with single coronary arteries will be asymptomatic and not present on routine physical examination. If symptomatic, they will present with a multitude of symptoms which are suggestive of obstructive coronary disease like chest pain, shortness of breath at rest or with exercise, syncope, palpitations, ventricular tachycardia, myocardial infarction and most disastrously with sudden cardiac death(SCD) [1,4]. The cause of sudden death varies from 57% for anomalous left coronary artery to 25% for anomalous right coronary artery [10]. An inter-arterial course of an anomalous left or right coronary artery has the highest risk for SCD [11]. One of the lesser known long term complications of an anomalous coronary artery is the increased risk for accelerated atherosclerosis of the artery. This may be due to the long travelling distance, an abnormal origin or compression mediated damage to the endothelium [12].

The hemodynamic significance of this conditions depends largely on the course of the artery which determines its intraluminal shape. The pathophysiology could be related to an acute angle of origin from the ostium leading to non-atherosclerotic flow compromise [4]. It could also be related to secondary compression of the aberrant artery due to exercise related dilation of the great outflow tracts [5].

The gold standard for diagnosing coronary artery anomalies is coronary angiography [6]. However, correct delineation of its anatomic course is not always possible with coronary angiography. Multi-slice computed tomography can be used to delineate the course accurately, but it risks the patient to radiation exposure. Another method to bypass the side effects of harmful radiation exposure is cardiovascular magnetic resonance imaging which is useful to determine the course of the aberrant artery and also determine the functional significance of the single coronary artery. The only downside to this investigation is that acquisition and imaging times are prolonged. Both of these methods allow for 3D image reconstruction [7].

Treatment of SCA depends largely on presentation of the patient. No management strategies exist for SCA without associated atherosclerotic cardiovascular disease. In patients without atherosclerotic cardiovascular disease conservative treatment with medications yields good outcomes. If patients have significant atherosclerosis, percutaneous coronary interventions can be tried or coronary bypass grafts [8]. Performing interventions in cases of SCA is technically difficult and challenging due to the abnormal anatomy of the artery. An experienced operator and selection of the correct instruments is vital as any complications can be catastrophic [9]. Even for experienced interventional cardiologists cannulation of the aberrant artery can be time consuming and precarious. Hence it is important for the operator to have a detailed knowledge about the variations in the origin of the coronary artery in order to select the appropriate catheter for therapeutic and diagnostic interventions. A successful percutaneous coronary intervention for an anomalous coronary artery depends on adequate catheter backup support and excellent guiding catheter seating which may require modifications to the guiding catheter [13].

Following are a few helpful tenets for endovascular treatment of coronary artery anomalies:

Table 2 [14]:

Singular coronary vessel	Moderately stiff guide wire: Balance middle weight heavy weight With balloon support
Left circumflex from right coronary artery	Standard Judkins right, modified Judkins right and Champ 1-2 guide catheters
	Extra-support guide-wire
	Balloon support
Left circumflex from right sinus	Left Amplatz, Judkins right and right Amplatz guiding catheters
Emergence from the thoracic aorta	Cobra, hook and multi-purpose guiding catheter
Emergence from the contralateral sinus	Left Judkins or Champ guiding catheter for right coronary artery Right or left Amplatz guiding catheter for left coronary artery Moderately stiff guide-wire: BMW heavy weight, Whisper MS or ES Intravascular ultrasound guidance Drug-eluting stents in intramural segments of the anomalous vessel.

Hence, though SCA presents with a unique set of variables that has its challenges, one can successfully manage such patients with the appropriate repertoire of knowledge and timely interventions.

Conclusion

We report a case of atherosclerotic disease in single coronary artery which presented as non-ST segment elevation acute coronary syndrome (aVR ST elevation and global ST depression significant of left main coronary artery equivalent and global subendocardial ischemia). Percutaneous coronary intervention was performed proximal to right coronary artery (RCA) lesion with routine hardware and special angiographic views were taken to profile the lesion in proximal RCA. Cardiologists should be aware of this rare condition, which causes a potential risk of sudden cardiac death.

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