

# Myocardial ischemia in cocaine-user with anomalous origin of the left circumflex coronary artery

N. ALESSANDRI, A. DI MATTEO, M. PETRASSI, F. TUFANO, L. LANZI, L. FUSCO, A. D'AMBROSI

Department of Heart and Great Vessels "A. Reale", polo pontino, University of Rome "Sapienza", Rome (Italy)

**Abstract.** – The prevalence of anomalous coronary artery is approximately 0.6-1.7% in patients who undergo coronary angiography. These anomalies may cause angina, acute myocardial infarction, syncope and sudden death. Cocaine abuse is now a major health hazard: more than 5 million of Americans are current users. Cocaine abuse can result in coronary artery vasoconstriction and the association between cocaine abuse, myocardial ischemia and infarction in the absence of coronary artery disease has been reported. We report the case of a patient with a story of nasally inhaled cocaine abuse presented with exertional chest pain and a perfusion defect of the anterior and inferior-lateral walls of the left ventricle during myocardial perfusion SPECT. The anomalous origin of the left circumflex coronary artery from the right sinus of Valsalva was detected during coronary angiography and confirmed by the multislice computed tomography (MSCT). Although the coronary angiography is the gold standard of cardiac imaging technique for the diagnosis of coronary artery disease the identification of anomalous coronary arteries is frequently difficult with conventional coronary angiography because of the lack of 3-dimensional (3D) information related to the course of the coronary arteries to the great vessels. The MSCT provides a high spatial resolution, which allows a successful identification of the congenital coronary artery anomalies. This case report provides further a supportive evidence for the role of MSCT in the detection of the coronary artery anomalies.

## Key Words:

Coronary artery anomalies, Myocardial ischemia, Cocaine abuse, MSCT.

## Introduction

Anomalous origin of the coronary arteries is a rare congenital coronary anomaly with a preva-

lence ranging from 0.6-0.7% to 1.5-1.7% of autopsy cases and coronary angiograms<sup>1-4</sup>. It has been associated with acute myocardial infarction and sudden death during or after exercise in youngs<sup>5-7</sup>. The sudden death, syncope and angina can be due to a smaller coronary ostium or because the anomalous coronary artery runs through aorta and pulmonary trunk, causing an extravascular coronary compression that results in myocardial ischemia during exercise. However, most coronary anomalies are clinically asymptomatic.

The anomalous origin of the circumflex coronary artery is a relatively rare anatomical variation. Page et al.<sup>8</sup> have investigated 3000 patients detecting it in the 0.67% of the cases.

The association between the congenital coronary anomalies and the cocaine abuse has not yet been reported. Cocaine abuse is now a major health hazard; more than 22 million Americans have tried cocaine at least once, and 5 million are current users<sup>9</sup>. Recent reports have documented that cocaine abuse can result in myocardial ischemia and infarction in the absence of coronary artery disease<sup>9,10</sup> and cocaine induced coronary artery vasoconstriction has been reported in patients following the intranasal administration of cocaine<sup>11</sup>.

The coronary angiography is the gold standard of cardiac imaging technique for the diagnosis of coronary artery disease. However, the identification of anomalous coronary arteries is frequently difficult with conventional coronary angiography because of the lack of 3-dimensional (3D) information related to the course of the coronary arteries to the great vessels<sup>12</sup>.

Magnetic resonance imaging can be used as alternative but the limited spatial resolution reduces its usefulness in the study of anomalous coro-

nary arteries<sup>13</sup>. Multislice computed tomography (MSCT) provides a high spatial resolution, which allows a successful detection and estimation of the atherosclerotic coronary stenoses and the identification of the congenital coronary artery anomalies<sup>13</sup>. Although a few case reports have been published<sup>13-15</sup>, a systematic review in a large patient population has not yet been reported. In the present report, we describe a patient who had undergone coronary angiography for suspected myocardial ischemia in whom anomalous origin of the circumflex coronary artery from the right sinus of Valsalva was detected.

### Case Presentation

A 39-year-old male patient with a story of nasally inhaled cocaine abuse in the last 5 years, arterial hypertension, diabetes mellitus and dyslipidemia presented with exertional chest pain and dyspnoea that have lasted for six months. Eight months before, pathological negative T waves in V4-V5-V6 leads during a routine electrocardiogram at rest were detected. Thus, the patient had undergone to a resting myocardial perfusion SPECT (Single Photon Emission Computed Tomography) with <sup>99m</sup>Tc-Tetrophosmin-740 MBq that exhibited a perfusion defect of the anterior and inferior-lateral walls of the left ventricle (Figure 1).

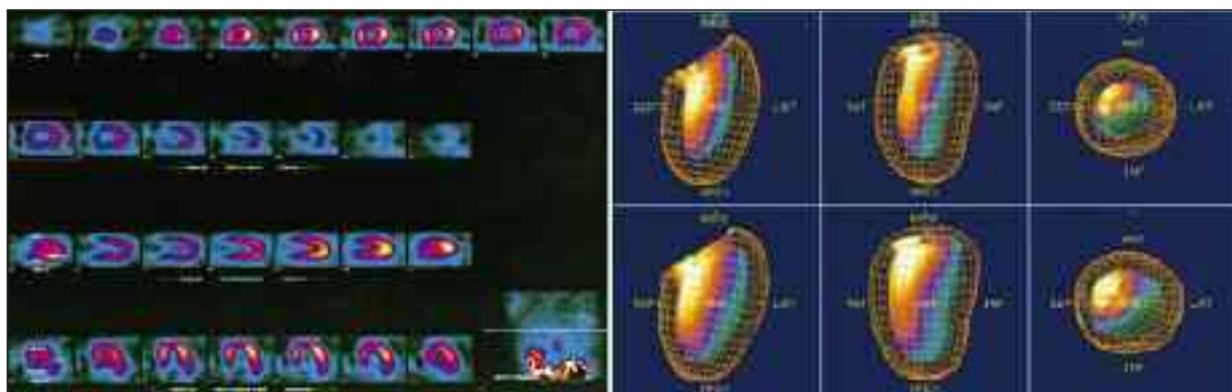
For these reasons, the patient was admitted to our Department. His physical examination was normal. Laboratory tests showed increased levels of fatty acids (631 mg/dl) and fasting plasma glucose (131 mg/dl). Glycosylated hemoglobin was 7.5%. The electrocardiogram at rest showed a si-

nus rhythm with pathological negative T waves in V4-V5-V6 leads (Figure 2).

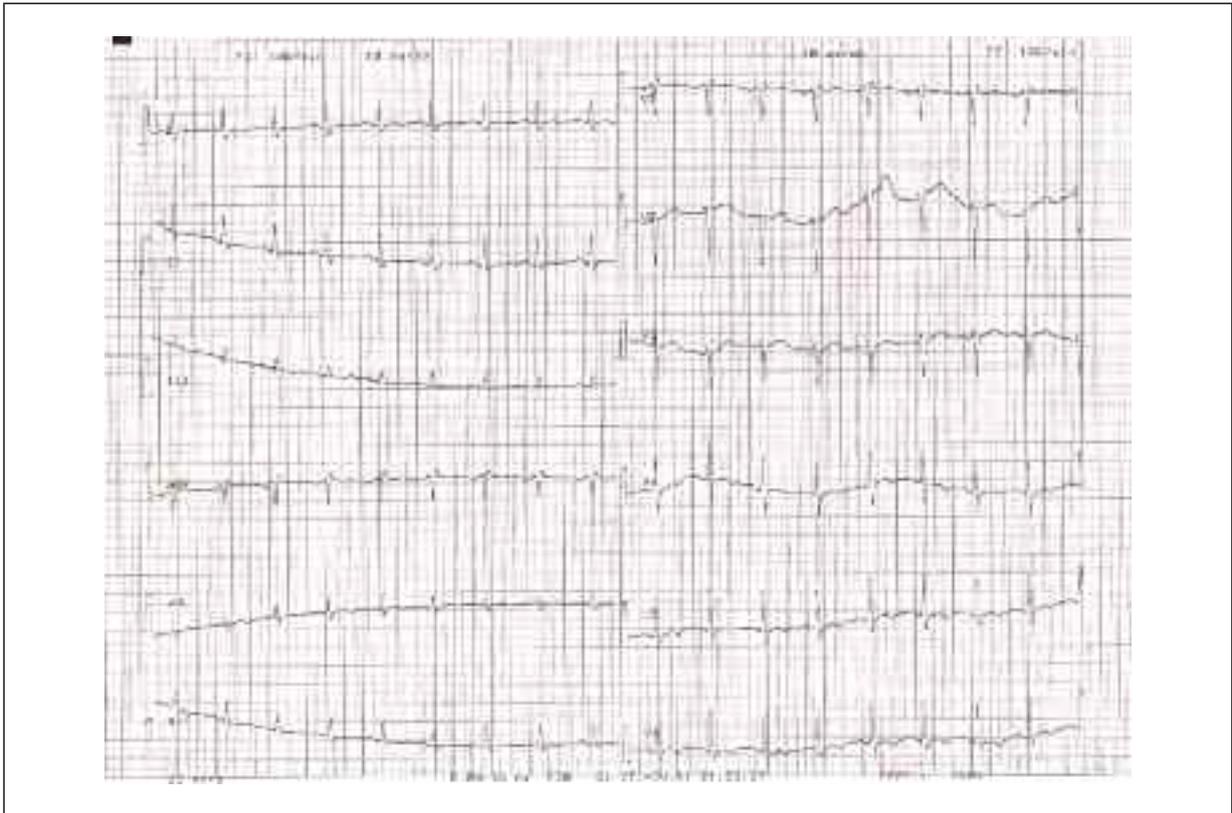
Chest X-ray and echocardiogram were normal. A coronary angiography (Innova 2100<sup>IQ</sup>, GE, Milwaukee, WI, USA) of the left system showed a 20% stenosis of the proximal portion of the left anterior descending artery (LAD), while the left circumflex coronary artery (LCX) was unable to be visualized in the standard angiography view. During the coronary angiography of the right system, the left circumflex coronary artery (LCX) was identified arising from the right sinus of Valsalva separately from the right coronary artery (RCA) (Figure 3). No significant coronary stenoses of the LCX and RCA were detected. Slow radiocontrast runoff were observed in all coronary segments. Thus, MSCT (Lightspeed VCT, GE, Milwaukee, WI, USA) was performed and confirmed the anomalous origin of the LCX from the right sinus of Valsalva, passing posteriorly to the aortic root to enter the posterior atrioventricular groove (Figure 3). There were no significant stenoses in the LAD, LCX and RCA. Thus, the patient was discharged with an appropriate medical therapy.

### Discussion

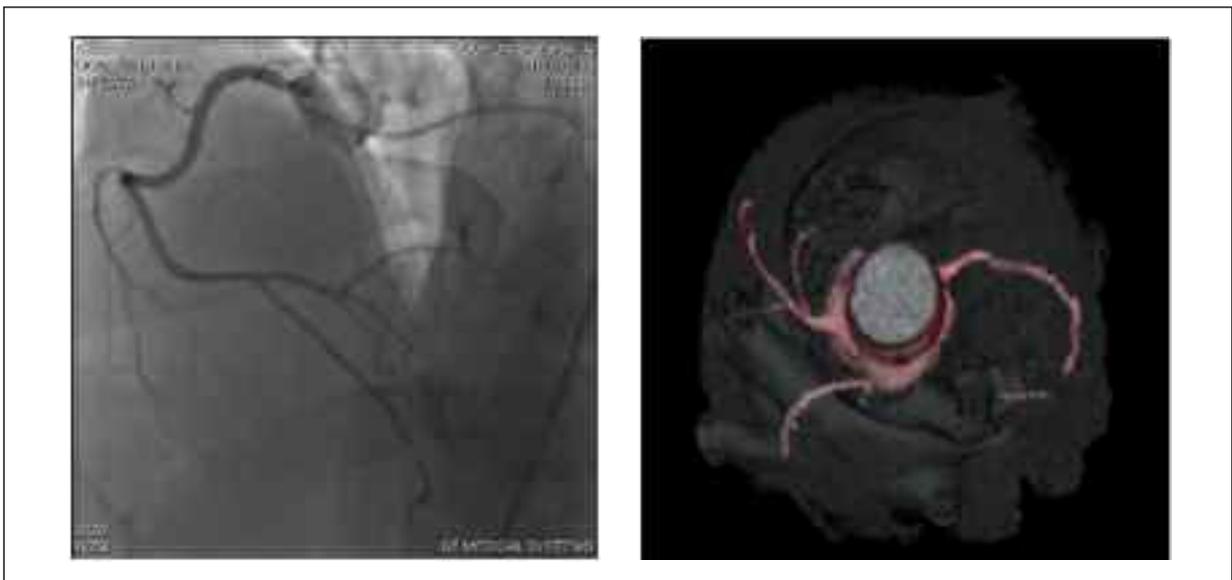
The anomalous origin of the LCX from the right sinus of Valsalva is a relatively rare congenital coronary anomaly<sup>1-4</sup>. The anomalous LCX typically originates from a separate ostium within the right sinus of Valsalva. It is well-known its association with myocardial infarction and sudden death<sup>5-7</sup>.



**Figure 1.** Resting myocardial perfusion SPECT showing a perfusion defect of the anterior and inferior-lateral of the left ventricle.



**Figure 2.** Electrocardiogram at rest showing pathological negative T waves in V4-V5-V6 leads.



**Figure 3.** Coronary angiography of the right system and MSCT image showing the anomalous origin of the LCX from the right sinus of Valsalva (*narrow*).

Myocardial ischemia and infarction, coronary spasm, cardiac arrhythmias, sudden death, myocarditis and dilated cardiomyopathy are all reported cardiovascular complications of cocaine abuse<sup>16,17</sup>.

Clinical and experimental evidence suggests a variety of theories for the cardiotoxic effects of cocaine. Cocaine blocks the reuptake of norepinephrine and dopamine on preganglionic sympathetic nerve terminals. This produces sympathetic stimulation both centrally and peripherally. These catecholamine effects acutely result in tachycardia, hypertension, increased myocardial contractility, coronary artery thrombosis and spasm. Coronary thrombosis occurring in coronary arteries free of atherosclerotic plaque suggests the role of cocaine-induced spasm, massive norepinephrine release in the heart, or possible primary thrombogenicity of cocaine or its metabolites<sup>11,16,17</sup>. Cocaine-induced spasm also may produce endothelial disruption at the surface of the plaque and promote platelet aggregation and further vasoconstriction from the release of platelet prostaglandins<sup>16,18</sup>.

In this case, the patient reported a story of nasally inhaled cocaine abuse in the last 5 years and presented with exertional chest pain and dyspnoea. The electrocardiogram at rest showed pathological negative T waves in V4-V5-V6 leads as sign of myocardial ischemia. The resting myocardial perfusion SPECT was positive for a perfusion defect of the anterior and inferior-lateral walls of the left ventricle. However, a myocardial perfusion SPECT under stress was not executed. No significant angiographic coronary stenoses were identified but the anomalous origin of the LCX from the right sinus of Valsalva was detected during coronary angiography and confirmed by the MSCT.

Generally, the anomalous LCX is a cause of myocardial ischemia in presence of a smaller coronary ostium or an extravascular coronary compression if the coronary artery runs through aorta and pulmonary trunk. Anyway, the anomalous coronary ostium was normal and the anomalous LCX runs behind the aortic root. In this case the myocardial ischemia was probably due to the association of cocaine abuse with the anomalous origin of the LCX. Cocaine increases the myocardial oxygen consumption because it induces tachycardia, hypertension, increases myocardial contractility, and promotes coronary artery thrombosis and coronary spasm in

all the coronary segments. Nevertheless, the anomalous origin of the LCX is associated to a reduced arterial inflow to a significant area of the posterior lateral left ventricle (see Figure 3). Even if the normal perfusion of this area is ensured by the small and collateral coronary arteries at rest, the increased myocardial oxygen consumption and/or a coronary spasm can induce the perfusion defect of the anterior and inferior-lateral walls of the left ventricle.

Although the angiographic identification of the congenital coronary anomalies assumes high priority because their association to syncope, sudden death and myocardial ischemia, they are quite unusual to find during routine coronary angiography. Two types of angiographic signs are proven to be reliable in recognizing and demonstrating the coronary anomalies: *indirect signs* like a profile view of the artery behind the aortic root during left aortography and ventriculography (the “aortic root sign”)<sup>(19)</sup> and the absence arterial inflow to a significant area of the posterior lateral left ventricle during selective injections of the main left coronary artery (sign of “nonperfused myocardium”); *direct sign* of the anomalous artery during its selective demonstration<sup>19</sup>.

Although the conventional coronary angiography is considered the *gold standard* imaging technique for the diagnosis of the atherosclerotic coronary stenoses, its accuracy in the detection of the congenital coronary anomalies is lower because of the lack of 3D-information related to the course of the coronary arteries to the great vessels.

The evaluation of the coronary artery disease is one of the most exciting focuses of the MSCT since its introduction. The old 4-MSCT and 16-MSCT scanners have been replaced by the 64-MSCT, which shows a better spatial and temporal resolution, making this technique suitable for the evaluation of the coronary vessels during the cardiac cycle and for the detection of the coronary stenoses (sensitivity, specificity, PPV and NPP 95-100%)<sup>20-24</sup>. The high capacity for the evaluation of the proximal tracts of the coronary vessels and the 3D-information related to the course of the coronary arteries on the myocardial surface make the MSCT an optimal imaging technique for the identification of the coronary artery anomalies.

The anomalous origin of coronary arteries is a rare but not forgotten congenital vascular anomaly that can induce and/or promote of my-

ocardial ischemia. Even if the coronary angiography is considered the gold standard for the diagnosis of the coronary artery disease, the accuracy in the diagnosis of the congenital anomalous origin of coronary vessels could be reduced by its 2-dimensional visualization of coronary arteries. Thanks to its 3D-visualization of coronary arteries and myocardial surface, the MSCT can be considered a valid alternative or complementary imaging technique in the detection of coronary artery anomalies.

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