Assessment of Coronary Arteries of Patients with Tako-Tsubo Syndrome using Multislice Computed Tomography: Lesions and Physiopathological Inferences

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SUMMARY
The presence of reversible left ventricular dysfunction induced by emotional stress has been extensively reported; however, its mechanism still remains unknown. We describe two patients with the typical clinical picture of Tako-Tsubo syndrome: chest pain following mental stress, transient left ventricular dysfunction and coronary arteriography with normal coronary arteries. Both patients underwent multislice computed tomography scans in order to explore the coronary arteries and to examine the physiopathology of the disease. The studies revealed the presence of coronary lesions similar to ruptured plaques found in acute coronary syndromes. Although these findings should be completed with subsequent studies in a greater number of patients, they suggest that the physiopathological substrate of at least one subgroup of patients with Tako-Tsubo syndrome is similar to acute coronary syndrome.


Key words > Tako-Tsubo - Acute coronary syndrome - Tomography - Multislice

Abbreviations >
ASA Acetylsalicylic acid (aspirin)
CA Coronary angiography
LAD Left anterior descending coronary artery
ECG Electrocardiogram
LVSF Left ventricular systolic function
ACS Acute coronary syndrome
MSCT Multislice computed tomography

BACKGROUND
Several recent case reports have described reversible apical left ventricular dysfunction after emotional stress associated with T wave inversion in the precordial leads (2, 6-8, 10); this condition is known as Tako-Tsubo syndrome. It has been even proposed to be a frequent condition that may account for approximately 2% of patients with suspected acute coronary syndromes (ACSs). (9) Coronary angiography (CA) shows absence of obstructive coronary artery disease, of angiographic evidence of coronary artery thrombosis, or of acute plaque rupture in the territory of the left anterior descending (LAD) coronary artery. (11)

Although the real mechanisms involved in this disease are still unknown, several hypotheses have been proposed. Postulated mechanisms include increased sympathetic activity, intermittent coronary spasm, or early resolution of a thrombotic occlusion. (4, 5, 8-10)

Conventional coronary angiography is the method used for the assessment of coronary arteries in these patients, and there are not many studies with other methodologies exploring the structural compromise of the coronary vessel, in this case the LAD.

We describe two patients with the typical clinical picture of Tako-Tsubo syndrome who were evaluated with multislice computed tomography (MSCT) scans in order to explore the anatomical features of the coronary arteries and to examine the physiopathology of the disease.

CASE REPORTS

Case 1
A 66-year-old woman presented with prolonged chest pain in the scenario of emotional stress provoked when her apartment was destroyed by fire. She had a history of hypertension, dyslipemia, diabetes and hypothyroidism. The electrocardiogram (ECG) at admission presented ST-segment elevation in the precordial leads (V1-V3) (Figure 1 A); cardiac biomarkers were increased (T troponin 0.17; CK 207). Complete medical therapy was initiated, including anticoagulant agents, and a CA showed absence of significant coronary lesions. Left ventriculography demonstrated an extended area of apical diskinesis and moderate left ventricular dysfunction (LVD). The patient presented hypotension...
that required intravenous inotropic drugs, with favorable response. Serial electrocardiographic monitoring evidenced T wave inversion in the anterior wall (Figure 1 B), and 72 hours after admission the echocardiogram showed complete resolution of apical ballooning with normal LVISF. Treatment with diahydrazin, isosorbide mononitrate, aspirin, atenolol, atorvastatin and clopidogrel was initiated. Multislice computed tomography scan showed a mixed plaque (lipid core with calcified components) in the proximal segment of the LAD with positive remodelling and 50% lumen diameter reduction. The study also revealed coronary plaques that produced a stenosis of 20% in the mid and distal LAD (Figure 2).

Case 2
A woman aged 48 years presented with chest pain after a violent argument. She was a current smoker and had a history of dyslipemia. The ECG showed ST-segment elevation in the anterior wall and T-wave inversion afterwards (Figure 3). Cardiac biomarkers presented a mild increase (Troponin 0.13; CK 135). Complete medical treatment was initiated; CA demonstrated a lesion of 30-40% in the proximal segment of the LAD and a lesion of 70% in the origin of a diagonal branch. Left ventriculography showed apical diskinesis with normal contraction of mid and basal segments. The echocardiogram evidenced mild left ventricular dysfunction (EF 49%), diskinesis of apical segments and hyperkinetic basal segments. The patient presented favorable outcomes. Medical therapy with carvedilol, ASA, clopidogrel, enalapril and atorvastatin was prescribed. Multislice computed tomography scan showed a mixed plaque in the proximal LAD with positive remodelling and plaque burden of 50% that provoked a mild reduction of the coronary lumen diameter (Figure 4).

DISCUSSION
In these two cases with typical features of Takotsubo syndrome, despite conventional coronary angiography did not show obstructive lesions in the coronary tree, MSCT demonstrated the presence of mixed athero-

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**Fig. 2.** MSCT at the level of the left anterior descending (LAD) coronary artery. A. Curved multiplanar reconstruction and orthogonal sections of the vessel (below) showing a mixed plaque in its proximal segment, positive remodelling, and 50% lumen diameter reduction (arrow). A calcified plaque in the mid segment generates a mild reduction of the lumen diameter (dotted arrow). B. Tridimensional reconstruction. C. Coronary angiography with absence of stenosis.

**Fig. 1.** A. Complete electrocardiographic evolution of case 1. B. Complete electrocardiographic evolution of case 1. T waves are inverted in leads I, II, III, V2 to V6.

**Fig. 3.** Electrocardiogram of case 2. T waves are inverted in leads I, aVL, V2 to V6, and voltage criteria for left ventricular hypertrophy.
sclerotic plaques with positive remodelling and similar features of those described in the LAD coronary artery in the setting of acute coronary syndromes. Thus, it is possible to formulate the hypothesis that coronary plaques might predispose to the onset of this syndrome.

Although the real mechanisms involved in this disease are still unknown, several hypotheses have been proposed. Sympathetic stimulation, coronary spasm, direct myocyte injury and microvascular dysfunction are some of the mechanisms postulated. (4, 5, 8-10) This ACS has been described during treadmill exercise testing, probably due to sympathetic stimulation. (4) The reason why the apical segments are more vulnerable to catecholamine excess remains unclear; a highest density of adrenoreceptors at the apical myocardium or the presence of a dynamic mid-ventricular obstruction have been proposed. (10) Most of the cases have been reported in women, suggesting a biological susceptibility.

**Characteristics of the coronary lesions associated with acute coronary syndrome in multislice computed tomography**

Motoyama et al. have recently published the characteristics of atherosclerotic plaques examined by computed tomography coronary angiography in patients with acute coronary syndrome, and they found positive remodelling, lipid core (low density) and small calcifications. (12)

In both cases with typical Tako-Tsubo syndrome and normal coronary arteries or without obstructive lesions, MSCT demonstrated the presence of coronary plaques with the aforementioned features in the left anterior descending coronary artery.

As this is the first report of the findings of MSCT in Tako-Tsubo syndrome in only two patients, additional studies are needed for further confirmation.

These findings suggest that at least a subgroup of patients with Tako-Tsubo syndrome share a similar pathophysiological substrate with classic ACS, and its outcomes might be explained as an aborted anterior myocardial infarction.

Patients who survive to the initial episode of heart failure have favorable outcomes as ventricular function recovers after few weeks from symptoms onset. Recurrences are infrequent and have been reported in only 3.5% of patients. (9)

Due to the anatomical findings in our patients, we preferred to prescribe chronic treatment for secondary prevention as if they have suffered a classic myocardial infarction.

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**RESUMEN**

**Exploración de las arterias coronarias de pacientes con síndrome de Tako-Tsubo con tomografía multislice: lesiones e interferencias fisiopatológicas**

Existen numerosos casos comunicados sobre la disfunción ventricular izquierda reversible precipitada por estrés emocional, pero su mecanismo no se conoce. En esta presentación se describe la evaluación de dos pacientes que consultaron con un cuadro clínico típico de síndrome de Tako-Tsubo, dolor precordial luego de un estrés emocional, disfunción ventricular izquierda transitoria y arterias coronarias angiográficamente normales. Con el objetivo de profundizar el conocimiento de las arterias coronarias y la fisiopatología de esta enfermedad, a ambas se les realizó una tomografía multislice, en la que se evidencieron lesiones coronarias similares a las halladas en accidentes de placa responsables de síndromes coronarios agudos. Si bien estos hallazgos deben completarse con estudios posteriores con un número mayor de pacientes, sugieren que al menos un subgrupo de pacientes con síndrome de Tako-Tsubo tiene un sustrato fisiopatológico similar a los síndromes coronarios agudos.

**Palabras clave**

Tako-Tsubo · Síndrome coronario agudo · Tomografía · Multicorte

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**BIBLIOGRAPHY**


