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Case Report Open Access

Coronary Angiography, Too Far to be a Gold Standard Technique for Identifying a Vulnerable Plaque

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Abstract

A 79 year-old woman with symptomatic heart failure and severe aortic stenosis was referred to a routine diagnostic coronary angiography previous to surgical aortic valve replacement. Coronary angiography showed severe stenosis in the left circumflex artery and in the ostium of the posterior descending artery. Four days later the patient presented an inferior ST-segment elevation acute coronary syndrome with cardiogenic shock. A rescue angioplasty was performed after failed thrombolysis. Coronary angiography revealed no changes in left coronary artery and a total acute occlusion in the middle segment of the right coronary artery, where only a mild lesion was observed four days before. A rescue angioplasty with a bare-metal stent implantation was performed with an optimal angiographic result. This case highlights the low ability of the conventional x-ray coronary angiography to identify vulnerable plaques. Even knowing the coronary anatomy four days before, we were unable to predict the culprit lesion.

Introduction

This case illustrates the low diagnostic accuracy of the conventional x-ray coronary angiography for the identification of vulnerable or unstable plaques. Coronary angiography, the current gold standard for the detection of coronary atherosclerotic disease, is able to identify obstructive and complex lesions, although does not provide data about the composition of the atherosclerotic plaque necessary to detect vulnerable plaques. Despite knowing the coronary anatomy four days before, we went unable to predict the culprit lesion [1,2]. Although a mild lesion was identified in the middle segment of the right coronary artery, this was not identified as a vulnerable plaque. Several intravascular tools, such as termography, angioscopy, spectroscopy, intravascular ultrasound and optical coherence tomography, capable of evaluating determinants of plaque vulnerability are being tested, although none have been sufficiently validated [3-8]. Further studies are compelling for defining the role of each diagnostic modality.

Case Report

A 79 year-old woman with heart failure and severe aortic stenosis was referred to a routine diagnostic coronary angiography previous to surgical aortic valve replacement. She was a non-smoker, hypertensive, dyslipidemic and diabetic patient under treatment with diuretics, beta- blockers and statins. She had a previous history of ischemic heart disease (non-ST-segment elevation acute coronary syndrome eleven years before). Then a bare-metal stent was placed in the proximal segment of the left anterior descending artery (LAD).

Severe aortic valve stenosis was diagnosed 6 months before, during a hospital admission for acute decompensated heart failure. On transthoracic echocardiography a severe calcified aortic valve stenosis was diagnosed based on a mean gradient of 64 mmHg, rejecting aortic valve replacement surgery during this episode. Five moths later patient was readmitted for acute heart failure precipitated by anemia secondary to a severe low digestive hemorrhage, requiring blood transfusion. After stabilization, patient accepted the intervention and a diagnostic coronary angiography were planned.

Coronary angiography showed severe (90%) calcified lesions in the middle segment of the left circumflex artery (LCX) and in the ostium of the posterior descending artery (PDA) and a mild lesion (30%) in the middle segment of the right coronary artery (RCA) (Figure 1). Surgery, an aortic valve replacement and aorta-coronary bypass surgery, was programmed for one week later.

Four days later, patient experienced severe, retrosternal chest pain associated with nausea and dizziness and a blood pressure of 60/40 mmHg. The electrocardiogram showed ST-segment elevation in inferior leads and ST-segment depression in leads I and aVL (Figure 2). The patient was diagnosed with acute inferior wall myocardial infarction with cardiogenic shock and was treated with intravenous thrombolytic, without reperfusion criteria, reason why a rescue angioplasty was performed. Coronary angiography revealed no changes in LCA and a total acute occlusion in the middle segment of RCA, where only a mild lesion had been observed four days before (Figure 3). A rescue angioplasty was performed with a 3.0 x 25 mm bare-metal stent placement with an optimal angiographic result.

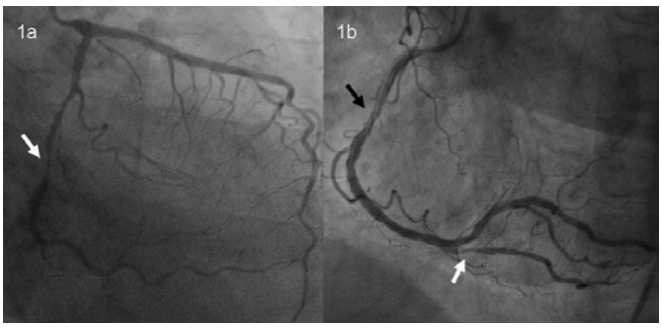

Figure 1: Conventional coronary angiogram of the right (1a) and left coronary artery (1b). Observe a mild reestenosis in the stent placed in proximal descending anterior artery, severe stenoses in circunflex artery (1a) and the ostium of posterior descending artery (1b) (white arrows) and the mild stenosis in the middle right coronary artery (black arrow).

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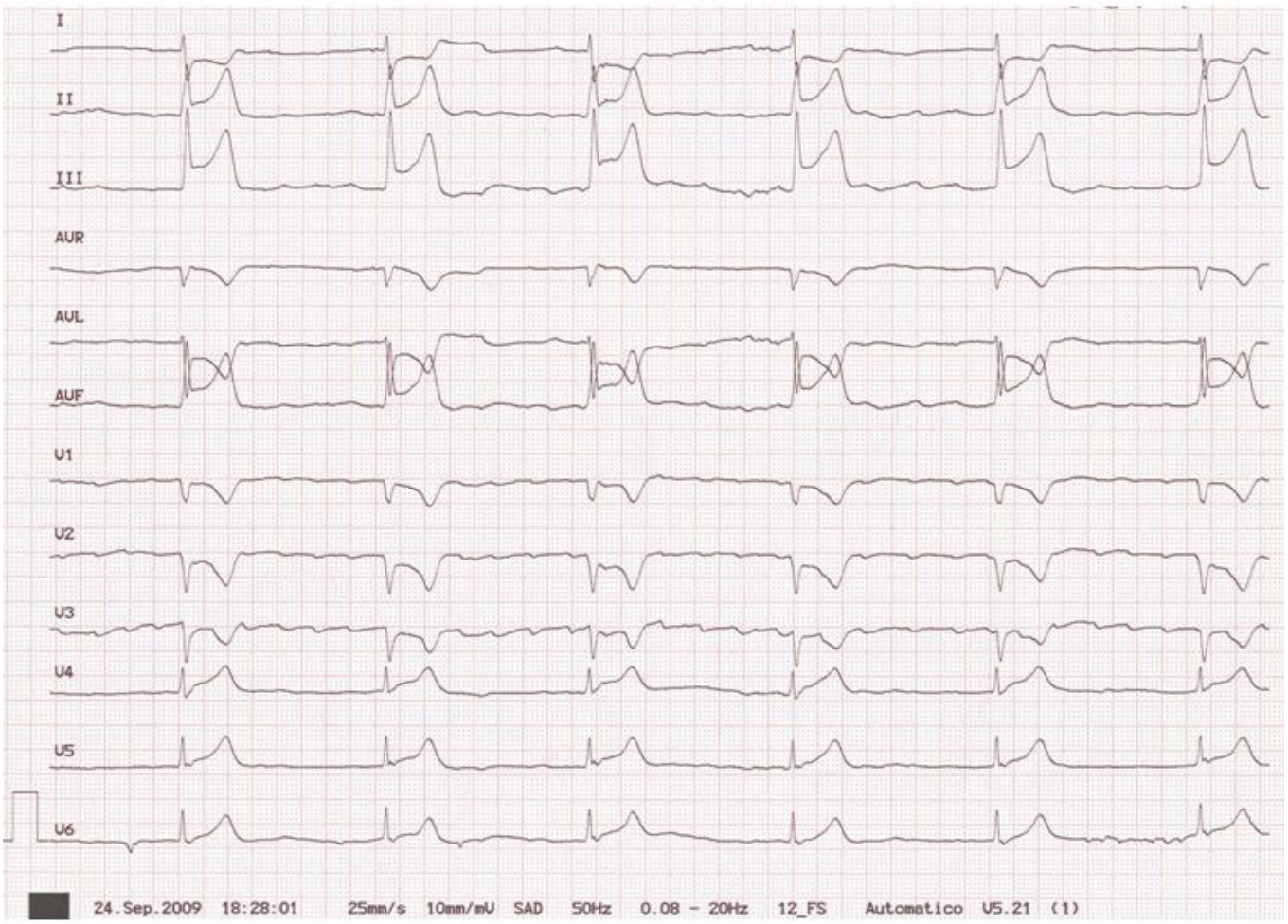

Figure 2: ECG obtained at the onset of chest pain showing ST-segment elevation in inferior leads and reciprocal ST-segment depression in leads I and aVL.

The patient developed hemodynamic instability during her stay in the coronary care unit, exhibiting an episode of ventricular tachycardia that required electrical cardio version and end tracheal intubation. Forty-eight hours after patient developed a septic shock, multiorgan failure and subsequent death.

Discussion

Silent plaque rupture is more frequent in arteries with less severe luminal narrowing [9]. According to histological studies, plaque composition, rather than stenotic severity, plays a central role in the pathogenesis of epicardial coronary occlusion, irrespective of the severity of the underlying stenosis [1].

Currently available diagnostic tools, both non-invasive and invasive, are only able to provide us data related to the stenotic severity of a coronary artery. The non-invasive testing includes stress-induced (exercise or pharmacological) ischemic changes in electrical repolarization, wall motion or myocardial radioactive-tracer uptake. Conventional x-ray coronary angiography, an invasive test, is the current gold standard to assess the presence of coronary artery disease. Although coronary angiography can identify obstructive as well as complex lesions [2], does not provide data about the composition of the atherosclerotic plaque, necessary to detect vulnerable plaques. Thus, features as vessel remodeling or plaque composition are missed, so that angiography is unable to distinguish between stable and unstable plaques and to accurately predict future cardiac events [10].

These limitations have promoted interest in alternative imaging and diagnostic modalities with the object of identifying the atherosclerotic plaques prone to rupture and hence differentiate vulnerable from stable plaques. There are several intravascular tools that are currently being tested capable of locally evaluating determinants of plaque vulnerability such as the size of the lipid core, thickness of the fibrous cap, inflammation within the cap and positive remodeling [3-8].

Intravascular ultrasound (IVUS) is the most widely used intravascular diagnostic technique due to its accessibility and its accumulated evidence. IVUS is capable of characterizing the plaque core, although with less sensitivity for soft than calcified lesions. Specific limitations remain the issues of resolution and inability to adequately discriminate between fibrous and lipid-rich plaques. Virtual histological reconstruction by intravascular ultrasound is a validated technique that allows determining the histological composition of coronary atherosclerotic plaque.

Optical coherence tomography (OCT) is an intracoronary diagnostic technique recently applied in clinical practice that provides high-quality, high-resolution cross-sectional images of the vessels. This technique provides valuable information on the characterization of

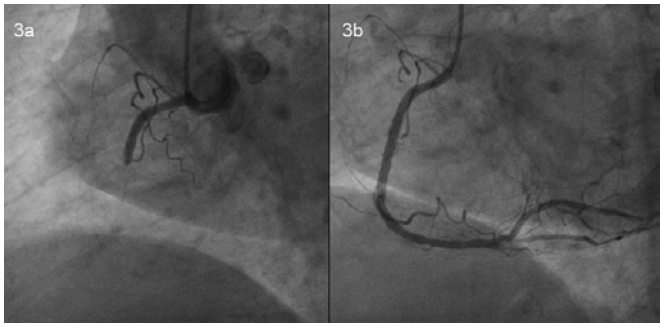

Figure 3: Coronary angiogram after failed thrombolysis showing a total acute occlusion in the middle right coronary artery (3a) and the final result after angioplasty (3b).

plaques and the mechanisms implicated in thrombosis or restenosis of coronary stents. Drawbacks are the low penetration depth into tissue and the absorbance of light by blood.

Other techniques, such as coronary angioscopy, thermography, spectroscopy and palpography are currently being tested. None of these techniques alone responds to the problem of detection of vulnerable plaque. Probably, the answer of this question will be the combination of several of them: high-resolution techniques (IVUS, OCT) to evaluate the morphologic characteristics, with others that analyze the functional characteristics of the plaque (thermography, palpography).

To date, none of the techniques described above have been sufficiently validated and, most importantly, their predictive value for adverse cardiac events remains elusive. Very rigorous and well-designed studies are compelling for defining the role of each diagnostic modality.

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