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Acute coronary syndrome *vs.* myopericarditis – not always a straightforward diagnosis

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

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Patient: Male, 58
Final Diagnosis: Myopericarditis
Symptoms: Retrosternal thoracic pain
Medication: —
Clinical Procedure: MRI
Specialty: Cardiology

Objective: Challenging differential diagnosis

Background: Patients with acute cardiac symptoms, elevated cardiac troponin, and culprit-free angiograms are a consistent proportion of patients admitted with presumed acute coronary syndromes (ACS). Current literature on this population of patients justifies the diagnostic importance of cardiovascular magnetic resonance (CMR) imaging.

Case Report: This report describes the case of a 58-year-old cyclist in which CMR allowed us to perform a diagnosis of myopericarditis mimicking acute STEMI against other evidence. There are several such reports in literature because the clinical presentation of myocarditis is quite variable.

Conclusions: This case report emphasizes the importance of cardiovascular magnetic resonance imaging in the differential diagnosis of the etiology of acute coronary syndromes. This is especially important because the signs and symptoms presented are ambiguous and equivalent to those of other diseases, such as myopericarditis, which affects mainly young athletes but also middle-aged athletes.

Key words: myopericarditis • myocardial infarction • cardiovascular magnetic resonance

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Background

Acute myocardial infarction is mostly caused by thrombosis, which is a complication of a coronary atherosclerotic plaque in the context of obstructive coronary artery disease. However, this physiopathologic criterion is not realistic: although most of the acute coronary syndromes are assignable to the coexistence of an acute thrombosis and a significative, severe obstructive, atherosclerotic disease, which appear in coronagraphy, a large minority of cases does not meet this criterion [1,2]. In fact, non-critical angiographic cases are present in 9–31% of the female patients and in 4–14% of the male patients, both with acute coronary syndromes [3–6]. It is, indeed, possible to observe patients affected by AMI with coronary spasm but healthy coronary arteries. Cocaine causes an important coronary spasm and individuals who use it can develop angina or AMI. Autoptic and angiography exams [7] demonstrated that a cocaine-induced thrombosis can occur on healthy coronary arteries or on a preexisting atheroma. Other recognized causes of AMI with healthy coronary arteries or without significative stenosis have been suggested, included coronary embolism, a small vessels disease, a variety of hematologic disease that can cause *in-situ* thrombosis in presence of healthy coronary arteries, and other cardiac causes like congenital anomalies of coronary arteries, coronary arteriovenous fistulas, and myocardial bridge. ST segment elevation is an important electrocardiographic sign that suggests a myocardial infarction in patients with an acute and prolonged thoracic pain associated with elevated cardiac enzymes. However, as already described, this ST segment elevation can be caused by a variety of other clinical conditions (Table 1); in fact, among subjects that present acute thoracic pain and elevation of ST segment, approximately 51–85% have causes different from the acute coronary syndrome [8]. An emerging and fascinating aspect of medicine and sports cardiology are pathologies already widely reported in the literature (e.g., acute myopericarditis), which simulate an acute coronary syndrome [9], particularly, a myocardial infarction [10], generating remarkable clinical, psychological, and prognostic implications for a high-level athlete's career. The clinical manifestation of myocarditis is strongly variable, but recent epidemiologic data on widely reported cases and analytical studies on less analyzed cases with MR, have demonstrated that in Europe the most common clinical picture of acute myocarditis consists of precordial pain, ECG alterations due to ischemia, and increase of biochemical markers of necrosis in presence of angiographically normal coronary arteries or with insignificant damage [11–13]. In these cases, the cardiac involvement is localized, intra-myocardial, and/or epicardial and not transmural; and as the sensitivity of echocardiography in showing such alteration in patients very low (< al 35%) [14], MR is preferable in clinical practice as an important imaging examination that can aid diagnosis of acute myocarditis and helps to distinguish it from IMA [15,16]. It is a non-invasive and radiation-free diagnostic procedure whose imaging quality allows tissue characterization, showing edema, inflammations, and necrosis zones and fibrosis with high spatial resolution. This opens the door to clinical-pathological correlation impossible before now [17,18].

Table 1. Causes of ST segment elevation in electrocardiography.

Acute myocardial infarction
Acute myocarditis
Acute pericarditis
Takotsubo cardiomyopathy
Left Ventricular hypertrophy
Left Ventricular aneurysm
Sarcoidosis
Acute aortic dissection
Polmonary embolism
Arrythmogenic right ventricular dysplasia
Brugada syndrome
Left bundle branch block
Hyperkalemia
Post electrical cardioversion
Ventricular paced rhythm
Prinzmetal's angina
Benign early repolarization (normal variant)
Osborn wave hypothermia
Acute cerebral hemorrhage
Normal variant

Case Report

A 58-year-old amateur cyclist (MTB), who was considered fit for competitive sports after a specific medical and cardiologic assessment for sports carried out in October 2011 with ECG (Figure 1) consulted a local cardiology clinic in June 2012 because of an oppressive retrosternal thoracic pain felt the day before during his participation in a competitive race. Some days earlier, he had reported a pre-flu symptomatology which had seriously weakened him. After a brief stay in a hospital cardiology department, the athlete was discharged and the diagnosis was "sub-acute inferolateral myocardial infarction in a dyslipidemic patient". Serial electrocardiographs recorded on that occasion (Figure 2) showed a high ST segment with negative T waves in the inferolateral derivations with an enzymatic increase of CPK-MB and T troponin. An echocardiographic examination showed regular left ventricular volume and preserved ejection fraction in presence of ipokinesis of inferior-basal and mid- and lateral basal walls. A further coronarography (Figure 3) was basically negative, without significative endoluminal stenosis, myocardial

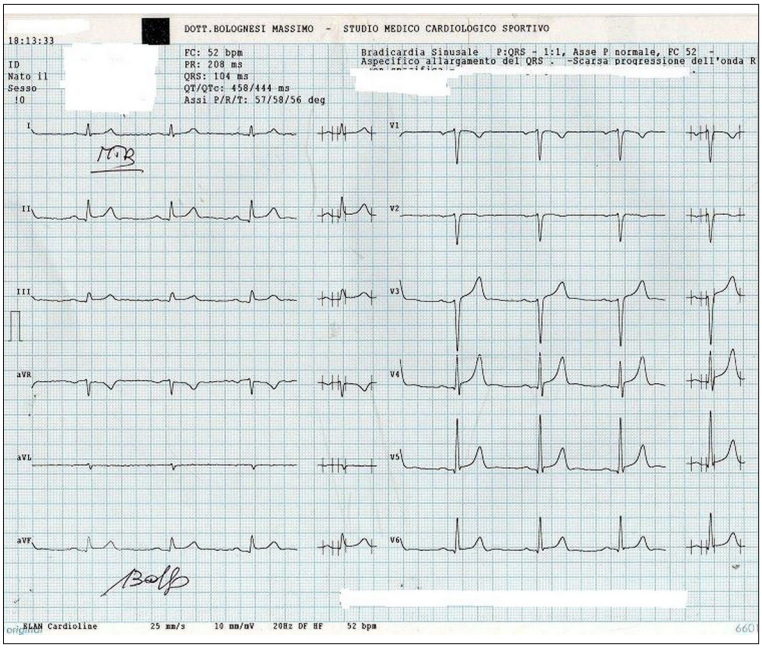


Figure 1. ECG October 2011: Normal.

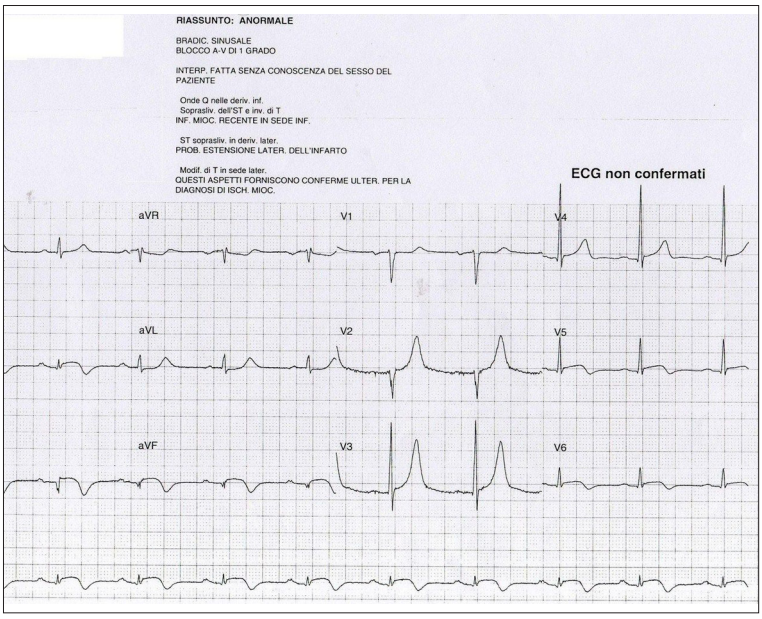


Figure 2. ECG June 2012: mild ST elevation and negative T wave on inferior – lateral leads.

bridge, or congenital anomalies in the context of a coronarography for right-sided heart failure predominance. The athlete was discharged and required a treatment of statins and antiaggregants (aspirin and clopidogrel) and was advised to rest. After 2 months, a bicycle ergometer stress test was performed in the same cardiology center and the results were negative. No other etiological hypothesis was suggested, nor was any other imaging examination made, therefore the athlete was diagnosed with ischemic heart disease and was considered unfit to perform in competitive sports (prognosis "quoad vitam"). The athlete came back to us for a visit in August 2012; he asked for an accurate diagnosis for what had happened to him, wanted to understand the triggering event of his supposed myocardial infarction, and, above all, to be informed about risks related to physical activity and to his general and sports-related prognoses. A further electrocardiographic and echocardiographic check showed a clear decrease of T wave negativity in inferior leads and its disappearance in precordial antero-lateral leads, and did not find any significant wall motion or segmental kinetic anomalies, even at an infero-lateral wall level. Thus, the athlete underwent cardiac MR examinations, which, although 2 months later, showed the following: "Presence of hyperintense signal on T2w-STIR on the inferior medio-apical wall and the lateral-median wall of the left ventricle, mainly on the

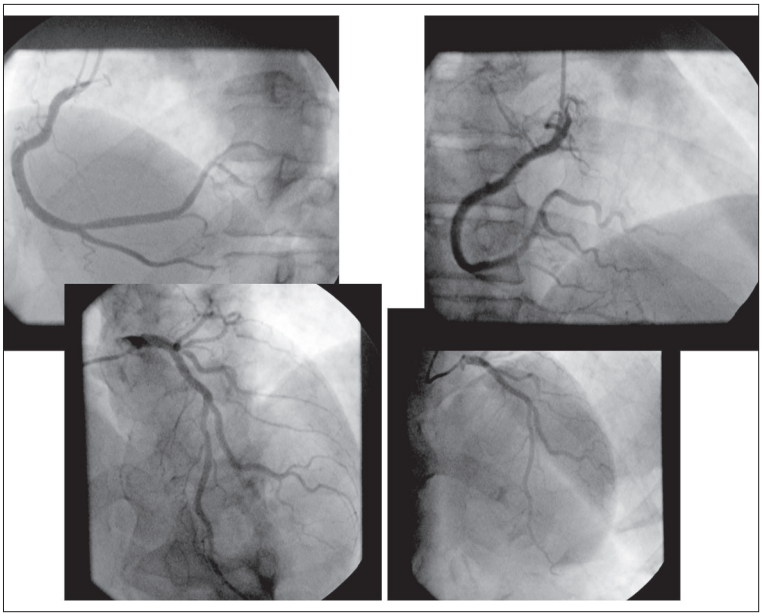
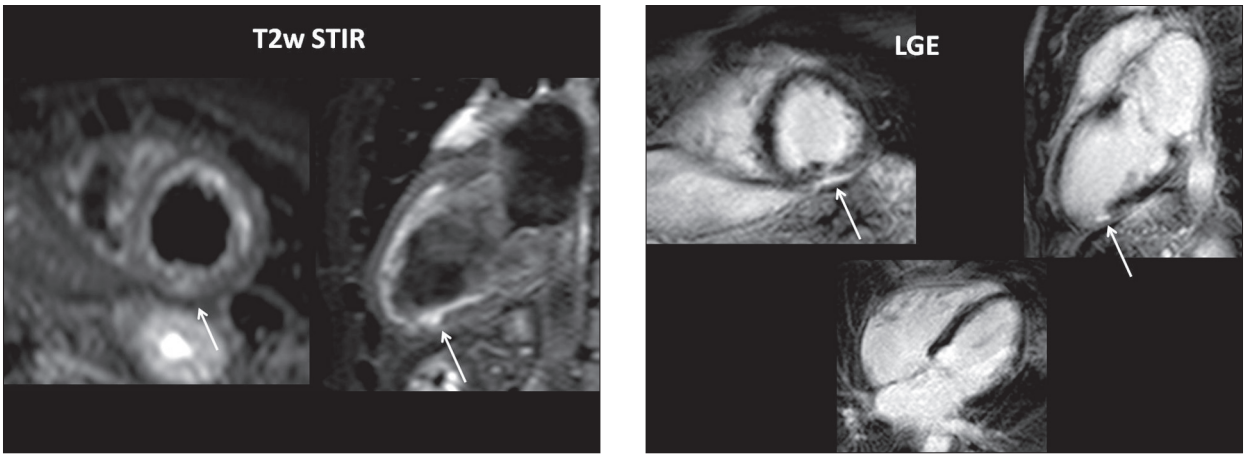


Figure 3. Coronary angiography: Patent left anterior descending artery, left circumflex artery and right coronary artery.



Figures 4. CMR: a) Delayed contrast enhancement magnetic resonance images (a horizontal long-axis, and b short axis) in a patient with acute myopericarditis. White arrows indicate a hyper-intense signal in the subepicardial layer of anterolateral and inferolateral walls. b) Delayed Enhancement (LGE) in the sequences Inversion Recovery/IR 10 minutes after IV administration of Gadolinium (sequences for the evaluation of the micro-vascular permeability and necrosis) in the intra-myocardial and sub-epicardial Short-axis, (2) long-axis, and (3) four-chamber three-dimensional delayed-enhancement T1-weighted multishot gradient-echo IR Mr images of a diffuse form of myocarditis in 58-year-old man. Nodular centromyocardial high enhancement of the inferolateral wall associated with bandlike or nodular subepicardial high enhancement predominating in the inferolateral wall of the left ventricle is seen.

intramyocardial and epicardial side. A precocious and belated homozonal enhancement (LGR) extended to the adjacent pericardium is associated to this." In conclusion, the MR context gives initial evidence of myocarditis, with traces of activity and outcomes that are still visible (Figure 4).

Discussion

This case shows the importance of differential diagnosis in patients presenting signs and symptoms of suspected or probable AMI in the absence of significative atherosclerotic disease of coronary vessels, particularly in middle-aged athletes or subjects with no cardiovascular risk factors and a history of recent influenza-like illness. The literature reports many cases of subjects affected by acute myopericarditis, which can clinically mimic a myocardial necrosis on an ischemic basis. As is widely known, clinical presentation of myocarditis is definitely variable [19]. Of course, the diagnosis of acute myocarditis is frequently empiric and is based on low probability of CAD (young age, symptomatology, no risk factors), on electrocardiographic alterations (although about 1/3 of patients with acute myocarditis

can have a normal ECG), on typical cardiac enzymatic changes, and on the presence of a coronary tree without significative lesions [20]. On the other hand, in our middle- aged patient, who was not addicted to drugs, the identification of the mechanism of myocardial damage can be crucial for correct management of disease. This case stresses the usefulness of cardiovascular magnetic resonance (CMR) imaging in distinguishing and confirming the diagnosis of acute myocarditis. Correctly evaluating the symptoms and clinical signs of a patient, even an advanced athlete, and considering all the relevant factors is crucial for preventing the medical and psychological damage caused by a wrong diagnosis. The diagnostic gold standard is currently the endomyocardial biopsy. However, this procedure, although very specific, has a low sensitivity and considerable periprocedural morbidity and mortality rates. Furthermore, endomyocardial biopsy is unnecessary or even contraindicated in patients with preserved EF [21]. For these reasons, the more reliable and practical imaging diagnostic procedure is cardiac MR, which can provide the late enhancement at the epicardial and intra-myocardial layer levels with uninjured sub-endocardium, mainly in the infero-lateral zone, although a long distance from the acute event. Recently, the International Consensus Group on CMR Diagnosis of Myocarditis has introduced some recommendations about the use of cardiac MR for detecting multifocal myocarditis [22]. These recommendations include some key points for the use of magnetic resonance, like clinical indications, standard protocols, and, above all, diagnostic criteria (Lake Louise Criteria) [23]. They suggest that cardiovascular magnetic resonance imaging is the most reliable and non-invasive diagnostic tool for multifocal myocarditis, and is a valid alternative to invasive endomyocardial biopsy.

Conclusions

Patients with acute cardiac symptoms, elevated cardiac troponin, and culprit-free angiograms are a significant proportion of patients admitted in emergency rooms or cardiac intensive care units. CMR is a useful tool for the management of ACS presenting with normal coronary angiography, as it helps to ascertain the diagnosis and guide treatment in a large proportion of cases. This case report illustrates the role that magnetic resonance imaging can play in the evaluation of an middle- aged elite athlete with suspected STEMI in the absence of coronary artery disease for all diagnostic and therapeutic implications, especially in a broader prognostic sense.

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