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LETTER TO THE EDITOR

"Role of cardiovascular magnetic resonance in assessing patients with chest pain, increased troponin levels and normal coronary arteries"

KEYWORDS
cardiovascular magnetic resonance;
Takotsubo cardiomyopathy;
myocardial infarction;
myocarditis;
myocardial fibrosis

1. Introduction

The detection of myocardial infarction with normal coronary angiography (MINCA) has recently increased due to the frequent use of cardiovascular magnetic resonance (CMR), the application of coronary angiography, the established diagnosis of Takotsubo cardiomyopathy (TTC), the diagnosis of aborted myocardial infarction (MI) and new sensitive troponin analyses. Results indicate that MINCA is more common than previously considered (7%) and affects one-third of women with MI. On the other hand, myocarditis is typically observed in younger patients and presents more often with signs of inflammation, such as elevated C-reactive protein and fever.[1] TTC was defined as a transient left ventricular dysfunction presented in patients under emotional stress.[2] It is typically triggered by emotional or physical stress and may reflect stunned myocardium due to a neurogenic cause. Functional brain MRI revealed that TTC patients had increased connectivity areas in the precuneus compared with healthy controls, presenting increased connectivity in the ventromedial prefrontal cortex.[2]

CMR is considered the best diagnostic tool for the assessment of patients with chest pain, increased troponin levels and normal coronary angiography because it provides reliable and reproducible information regarding biventricular wall motion/function and tissue characterization.[1,3,4] Given this capability, CMR can detect edema, myocardial hyperemia and fibrosis. Using this valuable information, the clinical cardiologist can reliably differentiate the pathophysiologic background behind chest pain with increased troponin and risk stratify patients to avoid unnecessary interventions. Furthermore, patients' treatment and follow-up can be guided according to etiologic diagnosis.

CMR diagnoses myocarditis using 3 indices, including edema imaging, early (EGE) and late (LGE) gadolinium enhanced images, according to JACC White paper instructions.[5] The main characteristic of TTC is the presence of extensive edema without fibrosis. In both acute myocarditis and MI, edema imaging is positive. However, the evaluation of LGE images reveals intramyocardial or subepicardial lesions in myocarditis and subendocardial or transmural lesions following the distribution of coronary vessels in MI.[4,5]

In this letter to the editor, we describe our experience from Greek patients referred to us for CMR evaluation due to chest pain with increased troponin levels and normal coronary angiography.

2. Patients-Methods

2.1. Patients

We prospectively evaluated a population of 78 patients aged 45 to 60 yrs (50 M/28 F) referred for CMR due to chest pain with increased troponin levels and normal coronary arteries. All patients provided written inform consent, and

Abbreviations: MINCA, myocardial infarction with normal coronary angiography; CMR, cardiovascular magnetic resonance; MI, myocardial infarction; STIR T2-W, Short tau inversion recovery; EGE, early gadolinium enhanced images; LGE, late gadolinium enhanced images; TTC, Takotsubo cardiomyopathy; Gd-DTPA, gadolinium DTPA; SSFP, steady-state free precession.

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the study was approved by the hospital's ethics committee. Exclusion criteria included contraindications to CMR, heart/renal/liver impairment, pregnancy and hypersensitivity to gadolinium.

STIR-T2, EGE and LGE images and left-right ventricular (LV-RV) function were evaluated. Patients positive for myocarditis according to JACC White paper criteria were considered for this study.[5]

2.2. Methods

CMR was performed using a 1.5T system between 8 to12 days after admission to the hospital due to chest pain with increased troponin and normal coronary angio-graphy. STIR T2-W and T1-W multislice spin-echo images were obtained with identical parameters before and after 0.1 mmol/kg Gd-DTPA. EGE was calculated within 1 minute of Gd-DTPA injection in the same area of the myocardium and latissimus dorsi as described for T2-W. After the second set of T1-W, 0.1 mmol/kg Gd-DTPA was administered again and LGE images were obtained 15 min later. In T2-W and EGE images, the signal ratio was measured in LV myocardium and within latissimus dorsi in the same slice. To assess LGE, all short- axis LGEs were summed to yield the total volume, which was expressed as LV proportion (% LGE). For LV-RV function, a steady-state free precession (SSFP) sequence was used. Ejection fraction (EF) was calculated as follows: EF = [(volume at end-diastole − volume at end-systole)/volume at end-diastole].[5]

3. Results

Troponin levels were 8 ± 3 ng/mL (normal values 0.01 ng/mL). None of the patients had any contraindications for CMR, such as metallic clips or devices, or contraindications to contrast agents, such as renal failure.

CMR documented TTC in 8/78 patients (7 F/1 M), acute myocarditis in 45/78 patients (30 M/15 F) according to JACC White paper criteria[5] and subendocardial MI in 25/78 (15 F/10 M). Of them, 4 with TTC, 15 with myocarditis and 8 patients with MI had reduced LVEF. RVEF was normal in all of the patients.

The T2 ratio was 3.5 ± 0.5 in the total patient population (3.2 ± 0.2 in MI, 3 ± 0.4 in acute myocarditis and 4 ± 0.5 in TTC), which was indicative of edema due to disease acuity. In patients with subendocardial MI, the scar was located in the inferior wall in 18/25 patients and the lateral wall in 7/25 patients with an extent of $7 \pm 2\%$ of LV mass. In patients with acute myocarditis, the scar was subepicardial and located in the inferolateral wall in 30/45 and the intraventricular septum in 15/45. No LGE was identified in any of TTC patients. No correlation between CMR and blood inflammatory indices (C-reactive protein and erythrocyte sedimentation rate) was identified.

A repeat CMR after 6 months of treatment was available in some patients with reduced LVEF (3 with TTC, 10 with acute myocarditis and 5 patients with MI) and documented a) disappearance of edema in all b) normalization of LV function in 2/3 TTC, 8/10 myocarditis and 4/5 patients with MI and c) disappearance in 8 and reduction of LGE in 2 myocarditis patients and reduction of LGE extent in all MI patients.

4. Discussion

In this study, we present the Greek CMR experience from patients admitted to central public hospitals of Athens due to chest pain, increased troponin levels and normal coronary angiography. According to our CMR findings, the most common pathology was acute myocarditis followed by subendocardial infarction and TTC.

Cardiac troponins (cTn) are the most sensitive and specific indices of myocardial injury. Increased cTn indicates cardiac injury, but it cannot clarify the cause of the injury. Coronary microembolization induced by small-sized microemboli and vasospastic angina may result in infarcts with normal epicardial coronary arteries.[6] In addition to MI, increased cTn is common in various diseases, including stroke, pulmonary embolism, sepsis, acute perimyocarditis, TTC, acute heart failure, and tachycardia, and may lead to increased troponin.[9] Finally, both TTC and viral myocarditis are also associated with increased cTn.[1–3,7–10]

Our findings were consistent with the results observed in the literature, demonstrating that acute myocarditis, subendocardial infarction and TTC were most common lesions in patients with chest pain, increased troponin levels and normal coronary angiography[7] and that CMR is of great value for the evaluation of both intracardiac[4,5] and extracardiac lesions.[11,12]

The following potential limitations of the study should be considered:

1. Our patients were highly selected by cardiologists who were aware of CMR applications.
2. Only patients with at least 3 increased cTn values were referred for CMR.
3. Patients with tachycardia, systemic disease or known heart failure were not included in the study.

5. Conclusions

The early application of CMR in a highly selected population admitted to public Athens hospitals enabled early etiological diagnosis, targeted treatment and individualized risk stratification. Given its excellent ability to perform tissue characterization, CMR is the ideal diagnostic tool for the assessment of these patients.

Conflict of interest

No conflict of interest for any of the authors

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