Acute Myocarditis in User of Anabolic Hormones Diagnosed by Magnetic Resonance Imaging: A Case Report

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Introduction

Myocarditis is an inflammatory disease of the myocardium that may occur locally or in different areas. Its prevalence is difficult to quantify and is the main cause of dilated cardiomyopathy in young people aged 18 or older.[1] Myocarditis accounts for 12% to 22% of cases of sudden cardiac death in people younger than 40 years of age.[1]

The most common etiology are infections of viral origin by enteroviruses and respiratory viruses. In addition, its association with other causes, such as autoimmune diseases and drugs, is questioned.

Some studies suggest that the use of hormonal anabolic agents, especially among young people for aesthetic purposes, may be associated with acute myocarditis — either by direct myocardial injury or for facilitating myocardial aggression by infectious agents.[2] The clinical picture varies widely, ranging from asymptomatic patients to those with hemodynamic instability.

Cardiac magnetic resonance imaging (CMRI) has been gaining prominence among the diagnostic techniques. It is the noninvasive method of choice, although endomyocardial biopsy remains the gold standard.[1,2]

This report describes the case of a young patient with reports of anabolic abuse, who sought emergency care complaining of chest pain, with findings suggestive of acute myocarditis on CMRI.

Case Report

A 30-year-old male patient was admitted to a tertiary hospital emergency room with possibly anginal chest pain that had started 5 hours earlier, irradiating to the left upper limb, associated with nausea and vomiting. The patient denied recent infectious episodes and comorbidities. The patient denied any history of myocarditis.

The patient reported starting, 3 weeks prior, to use the following steroid anabolic steroids: testosterone enanthate, trenbolone acetate and boldenone – the latter, for veterinary use (horses).

Keywords

Cardiomyopathy, Dilated/diagnostic imaging; Myocarditis; Anabolic Agents/adverse effects; Magnetic Resonance Imaging.

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Electrocardiography upon admission revealed unspecific abnormalities of ventricular repolarization (Figure 1), however, the myocardial necrosis markers troponin T and creatine kinase MB (CKMB) mass were positive, with troponin T of 0.543 ng/mL (reference value): 0.0 to 0.025 ng/mL) and CKMB mass of 32 ng/mL (reference value: < 6.73 ng/mL).

Initially managed as non-ST-segment elevation myocardial infarction (MI). Coronary angiography showed no coronary lesions, and ventriculography revealed severe and diffuse hypokinesia. Transthoracic echocardiography showed hypokinesia of the inferior, apical and septal left ventricular (LV) walls and LV systolic dysfunction with ejection fraction of 43%. After clinical stabilization, the patient was referred to CMRI (Figures 2 and 3). The scan revealed an extensive area of multifocal myocardial edema, adversely affecting the lateral wall (middle and basal segments), septum (middle and apical segments) and apexes. The late myocardial enhancement scans revealed the presence of non-ischemic (not respecting coronary anatomic territory and adversely affecting subepicardium and mesocardium) and multifocal fibrosis.

Discussion

Anabolic steroids are synthetic derivatives of testosterone, which have been increasingly used since the 1980s in the United States.[1] The use of anabolic steroids is directly related to increased cardiovascular risk, especially in young patients, since most of them develop dependence and use these substances in a chronic manner. Anabolic agents are associated with a number of cardiac lesions, such as increased coronary artery atherosclerotic plaques, higher blood pressure levels, left ventricular contraction deficits, ventricular hypertrophy, direct myocardial injury, AMI due to accelerated atherosclerosis or coronary thrombosis, ventricular arrhythmias, biventricular dysfunction and shortening of the QT interval.[2] Furthermore, it is worth saying that the effect of potentiating the atherosclerosis process is cumulative with the time of use of these substances, i.e., chronic users or those who use higher doses are subject to more significant atherosclerosis, which is associated with early coronary artery disease.[2]

The patients' profile includes mainly young athletes, practitioners of muscular endurance exercises, doing prolonged use and taking abusive doses of these substances. Anabolic agents have been related to relevant adverse effects, both somatic and psychiatric, and cannot always be reversed effectively, and the patient may have hemodynamic instability, acute heart failure, and even fatal outcome.[3]

Testosterone is considered a pro-inflammatory agent that acts by induction of cellular response. The hormone increases the expression of proinflammatory cytokines in the heart, such as the tumor necrosis factor alpha, and activates

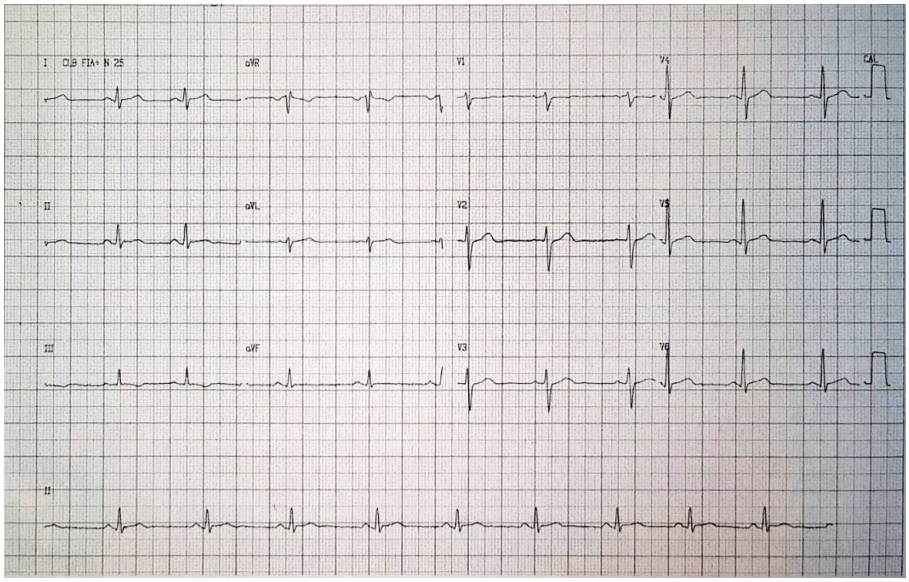

Figure 1 – *Electrocardiography revealing unspecific repolarization abnormalities.*

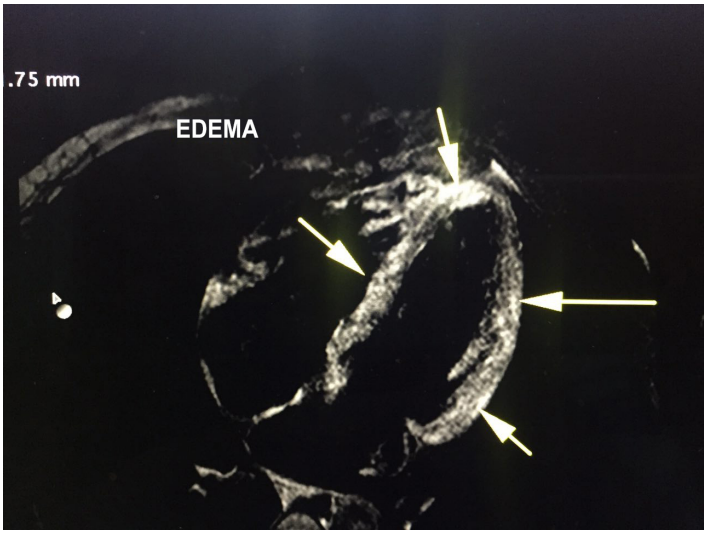

Figure 2 – *Four-chamber view T2-weighted triple IR sequence showing hypersignal area suggestive of myocardial edema.*

genes that induce apoptosis, which results in myocardial inflammation and necrosis. Testosterone also increases myocardial susceptibility to Coxsackie B virus, increasing the virus receptor expression in the myocyte. Another known action is that of inhibiting anti-inflammatory agents such as M-immunoglobulins of T cells.[4]

The clinical presentation of myocarditis of the most diverse etiologies varies widely. However, the most common form of presentation with cardiac involvement is hemodynamically decompensated acute cardiac failure.[5]

Also, myocarditis is one of the main differential diagnoses in young people admitted to the emergency room with typical thoracic pain with elevation of cardiac biomarkers, but without any history of coronary artery injury. Therefore, accurate analysis of the electrocardiogram and dosage of biomarkers are fundamental.[4,5]

Myocarditis is diagnosed by an invasive method — endomyocardial biopsy. However, this procedure has limited availability, carries considerable clinical risk, and is only considered in a few rare patients. CMRI is the noninvasive

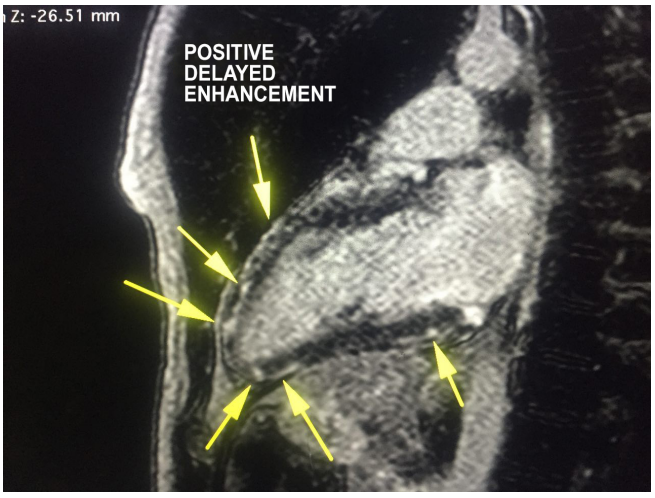

Figure 3 – *Two-chamber view post-contrast late enhancement sequence showing non-ischemic (mesoepicardial) hypersignal areas suggestive of fibrosis/necrosis.*

method of choice, as it allows to identify inflammatory lesions in the acute and subacute phases and any scars in the chronic phase. It is a noninvasive test with good accuracy, especially in the early stages.

One of the main indications of CMRI is in differential diagnosis between AMI with normal coronary arteries and myocarditis, in those with chest pain and elevated myocardial necrosis markers (Class of Recommendation: I; Level of Evidence: B).[6-8]

Specifically concerning CMRI in the diagnosis of myocarditis, it reveals myocyte damage and the areas of myocardial edema, as well as provides functional cardiac evaluation. A frequent finding is the presence of late myocardial enhancement, which begins in the epicardial region and heads in the subendocardial direction, accentuating such enhancement at this site. In the acute phase of this type of cardiomyopathy, there is hypersignal in the T2-weighted sequence, indicating myocardial edema.[4] Although the classical late enhancement is mesoepicardial, the hypersignal can be multifocal, heterogeneous and not respectful of the coronary territories.

In this context, the use of CMRI should be emphasized, as it is a method of high specificity and sensitivity, non-invasive and free of radiation exposure. Therefore, it is the non-invasive method of choice. This method can check global and segmental function; and find lesions, areas of cardiac edema, areas with abnormal signal reception and myocyte damage, as well as abnormal contractility and damage to the cardiac chambers. The images are obtained in sequence T1 and T2, which evaluate the degree of global or localized myocardial edema, which is characteristic of the acute and subacute phases of myocarditis. The basic difference between myocarditis and AMI in this test refers to the distribution of myocardial damage evaluated by both T1-weighted late myocardial enhancement and T2 (edema). In myocarditis, these findings are often multifocal and found in the mesocardium and subepicardium, while in AMI there is compromise of the subendocardium (which can be transmural), respecting the coronary territory.[7,8]

Besides this, the presence of abnormalities found in the acute or chronic phase, in this test, provides sensitivity of about 67% and specificity of 97%, and 91% positive predictive value. In acute myocardial processes, such as myocarditis and ischemic lesions, the area of edema is bigger than that of myocardial lesion, whereas in cases of non-ischemic myocardiopathies, such as hypertrophic cardiomyopathy, the area of edema is smaller. In cases of high clinical suspicion, but with MRI without criteria for myocarditis, it is suggested to repeat the scan in 1 or 2 weeks. Finally, it is worth mentioning that up to 88% of patients with myocarditis have MRI findings consistent with the analysis of endomyocardial biopsy of the affected areas.[4] Therefore, MRI findings should be assessed according to the coronary arterial supply, intramural distribution, and comparison of the areas of contrast uptake.[9]

Treatment of acute myocarditis is mainly based on clinical and hemodynamic support, and may include inotropic agents, intra-aortic balloon or ventricular assist devices in more severe cases. In cases with giant cells, hypersensitivity and association with systemic diseases such as sarcoidosis and lupus, treatment with immunosuppressants may be considered.

Conclusion

This case brings an alert about the risks of abusive use of anabolic substances, and its practice should be discouraged for non-medical purposes and under strict control of a medical specialist. Studies have shown an increasing number of users of anabolic steroids, mainly due to widespread sales on the internet. While assisting and investigating young patients with cardiac involvement without apparent risk factors, it is worthy inquiring about the use of such substances. In this context, it is important to conduct cardiac magnetic resonance imaging to support this diagnosis, as it is a non-invasive method that is very useful for differential diagnosis.[10]

Authors' contributions

Research creation and design: Sobreira Filho FM, Alcantara ACB; data acquisition: Sobreira Filho FM; manuscript writing: Sobreira Filho FM, Lino DOC, Rocha RPS, Lima CJM, Alcantara ACB; critical revision of the manuscript for important intellectual content: Sobreira Filho FM, Lino DOC, Belém LS, Rocha RPS, Lima CJM, Alcantara ACB.

Potential Conflicts of Interest

There are no relevant conflicts of interest.

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Academic Association

This study is not associated with any graduate program.

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