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Acute myocardial infarction induced by pre-workout supplement in a young patient

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Abstract

There is the concept that acute myocardial infarction (AMI) is uncommon in individuals under 45 years old, since it affects only 4 to 10% of this population. Considering, however, in absolute numbers, it seems that the manifestation of it in this age group is not infrequent. Only in Brazilian hospitals, according to the Ministry of Health in 2001, 4,763 patients under 45 years were hospitalized due to AMI.

Smoking is the major risk factor in young people, being present in approximately 80% of the patients under 45 years old who suffered an AMI. However, due to the spread and easier access to chemical stimulants used by young individuals worldwide, who aim to optimize their performance in competitions, an increased morbidity and mortality rates associated with the use of those stimulants have been noticed and recorded. Here we report an AMI case of ST-Segment–Elevation Myocardial Infarction (STEMI) in a young athlete-patient without comorbidities, which was triggered by the use of pre-workout supplement.

Keywords

coronary artery disease; acute coronary syndrome; food supplement; young patient

Introduction

Despite the fact that Coronary Artery Disease (CAD) usually affects patients over 40 years old, young adults may also be involved. Most of related studies has used the period between the ages of 40 to 45 years old in order to define "young patients" with CAD and AMI [1].

The prevalence of CAD in young individuals is difficult to be situated, since it regards to an often silent development. Aiming to determine it, an autopsy study on 760 patients at the age between 15 and 34 years old, who were victims of accidents, suicides and/or homicides, has found: advanced atheromatous coronary artery disease in 2% of the men but in none of the women at the age of 15 and 19 years old; moderate lesion in 20% and 8% of men and women between the age of 30 and 34 years old, and a stenosis percentage over 40% in the anterior descending artery in 19% and 8% of men and women individuals respectively [1]. In the Framingham Study, the occurrence of AMI after a 10-year follow-up was at a rate of 12.9/1000 in 30-to-34-year-old men and 5.2/1000 in 35-to-44-year-old women, while in

the population at the age of 55 to 64 years old those numbers are 8 to 9 times higher. Additionally, a European prospective study followed 108 patients during 6.5 years and collected data, which suggested that AMI young patients are smokers, have a high incidence of angiographically normal coronary arteries and present an excellent prognosis in the long and short term [2,3].

However, an occurrence increase of cardiovascular diseases has been registered and associated with the spread of access to chemical stimulants.

American data from *Centers for Disease Control and Prevention* (CDC) estimates that 40% of the North American population between the age of 2 months and over 40 years old make use of any sort of dietary supplement, and some of those may be directly or indirectly associated with increased cardiovascular risk.

CAD consists in a relevant health problem because of its devastating effects in young adults notwithstanding it being less frequent in that group, who have a more active lifestyle.

Furthermore, these patients have risk factor profiles and also different clinical presentation and prognosis, which should be taken in regards when dealing with youngsters with CAD.

The following report describes an AMI case, which was probably triggered by the use of pre-workout supplements and it was diagnosed in a young patient lacking classical risk factors which would lead to CAD.

Case Report

A 29-year-old male athlete-patient was admitted to the emergency unit of Hospital São Paulo (UNIFESP/EPM) with a history of spontaneous retrosternal chest pain, two hours after the ingestion of 10 food-supplement pills, which contained α-ketoglutarate, creatine monohydrate, β-alanine, caffeine, 1.3- dimethylamylamine and Schizandrol. The patient denied pathological antecedents and use of illegal drugs, however, related the use of 1 supplement pill before training (4x/week). The initial clinical examination revealed pain facies, regular cardiac rhythm, blood pressure at 110x80mmHg and pulse at 76bpm. The electrocardiogram showed ST-Segment elevation in the following leads:D2, D3, avF, V7 e V8 (Figure 1); and the echocardiogram showed hypokinesia of inferior wall with global left ventricular function preserved (Figure 2).

The patient received clinical treatment for AMI and thrombolysis after 4 hours of the beginning of the pain and presented reperfusion criteria, keeping Killip & Kimball I the whole time. He was submitted to a coronary angiography in 48 hours, which showed a 70%-lesion at the medium-proximal third of the right coronary artery (Figure 2), followed by a successful conventional stent implantation through angioplasty. The patient was discharged two days later.

Discussion

In 1930, Kelly and Henderson were the first to roundly stipulate the influence of food supplements in nutrition of African natives using randomized clinical trial [4]. Since then, common individuals and athletes have been seeking to improve their performance through the ingestion of a variety of supplementary substances [5]. In 2004, *Centers for Disease Control and Prevention* (CDC) issued a report on the third *National Health and Nutrition Examination Survey* (NHANES III), which estimated that 40%

of the North American population between the age of 2 months and over 40 years old make use of any sort of dietary supplement [6].

The 1.3 – dimethylamylamine (DMAA) is a derivative-substance of geranium oil, its sympathomimetic property is originally used as a nasal decongestant, and then as a food supplement due to its stimulant effect. Sympathomimetic medicines operate through seven main mechanisms of action, which are: peripheral excitatory action on certain types of smooth muscle, such as blood vessels which irrigate the skin, kidneys and mucosa, and also on gland cells such as salivary and sweat glands; peripheral inhibitory action on other types of smooth muscle, such as the ones on the intestinal wall, the bronchial tree and the blood vessels which supply the skeletal muscle; cardiac excitatory action, which is responsible for the cardiac rate and power of contraction increase; metabolic activity, such as increased rate of gluconeogenesis and release of fatty acids from the adipose tissue; endocrine actions, such as modulation of insulin, renin and pituitary hormones secretion; actions on the central nervous system, such as respiratory stimulation and in some cases increased alertness and psychomotor activity, in addition to appetite reduction; presynaptic actions, which results in inhibition or facilitation of neurotransmitter release such as norepinephrine and acetylcholine [7].

A case of hemorrhagic stroke due to DMAA ingestion was reported in 2010, which caused that drug to be considered as doping by the World Anti-doping Agency[8], and in 2012 a reverse Takotsubo cardiomyopathy was reported due to the ingestion of energy drink also containing DMAA [9].

Caffeine is an alkaloid derivative from xanthine, it presents a variety of dose-dependent effects, such as tachycardia, blood pressure and diuresis increase and fine tremor. Current evidences point to its action as an adenosine receptor antagonist, causing a lipolysis, plasmatic concentration and free fatty acids increase. It is used both *in vitro* and *in situ* in order to potentiate the sarcoplasmic reticulum calcium release, which occasions muscle contraction [8].

Creatine is a compound synthesized by the liver from the amino acids arginine and glycine. It provides storage for the rephosphorylation of adenosine diphosphate (ADP), it turns into a temporary energy storage, especially for the first 6-8 seconds of muscle contraction, which is the moment when the aerobic glycolysis becomes predominant. There are reports of adverse reactions to supplementation, however, only gastrointestinal discomfort was proven, affecting 5% of users [8].

The Schizandrol is one of the compounds of Schisandrachinensis fruit and induces the hepatic cytochrome P-450, promoting metabolic anabolism through protein biosynthesis and gluconeogenesis. Anti-inflammatory activity through the inhibited production of nitric oxide and prostaglandinE_2 was observed, in addition to decrease in the expression of the cyclooxygenase-2 and nitric oxide synthase [7,8].

The main pre-workout supplements and their cardiovascular adverse events are described in the table 1 (7-18).

In the case reported, due to the components of the supplement, it is possible that the increased heart rate and blood pressure have generated an elevation of the myocardial consumption, causing a stress on the region of the atheromatous plaque and triggering myocardial ischemia. Other possible mechanism involved in the right coronary artery lesion occurrence is the vasospasm of the vessel due to

the vasoconstricting effect from drugs present in the supplement.

The fact that a serum dosage of the elements contained in the ingested food supplement have not been performed represents a limitation in reporting the case, in addition to the lack of an intracoronary ultrasound, which would deliver additional information in regards to the lesion mechanism.

During the data collection, no similar report was found in the related literature, which requires more studies in order to assess the effects of these supplements on the cardiovascular system.

Table

Table 1: Cardiovascular adverse events of the main pre-work supplements.

Drug	Cardiovascular adverse effects
Creatine	No stablished cardiovascular adverse effects
Betaine	No stablished cardiovascular adverse effects
Caffeine	Increased blood pressure, heart rate and diuresis/ Increased homocysteine, and arterial stiffness / impaired endothelial function / Dizziness
1,3-dimethylamylamine	Increased blood pressure and heart rate/ Dizziness/Homorragic stroke/Takotsubo cardiomyopathy
Arginine alpha-ketoglutarate	Increased heart rate, hypotension, headache, dizziness, vomting and syncope
Schizandrol	No stablished cardiovascular adverse effects
Beta-Alanine	No stablished cardiovascular adverse effects

Figures

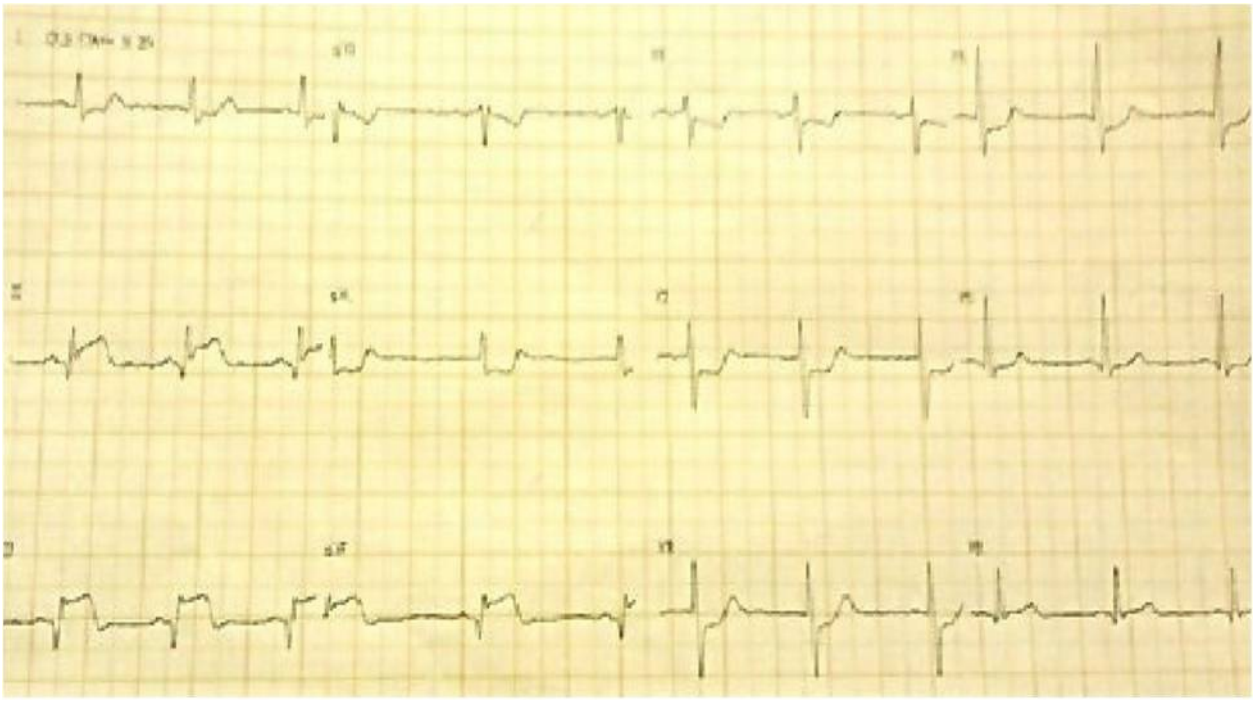

Figure 1: Electrocardiogram at admission.

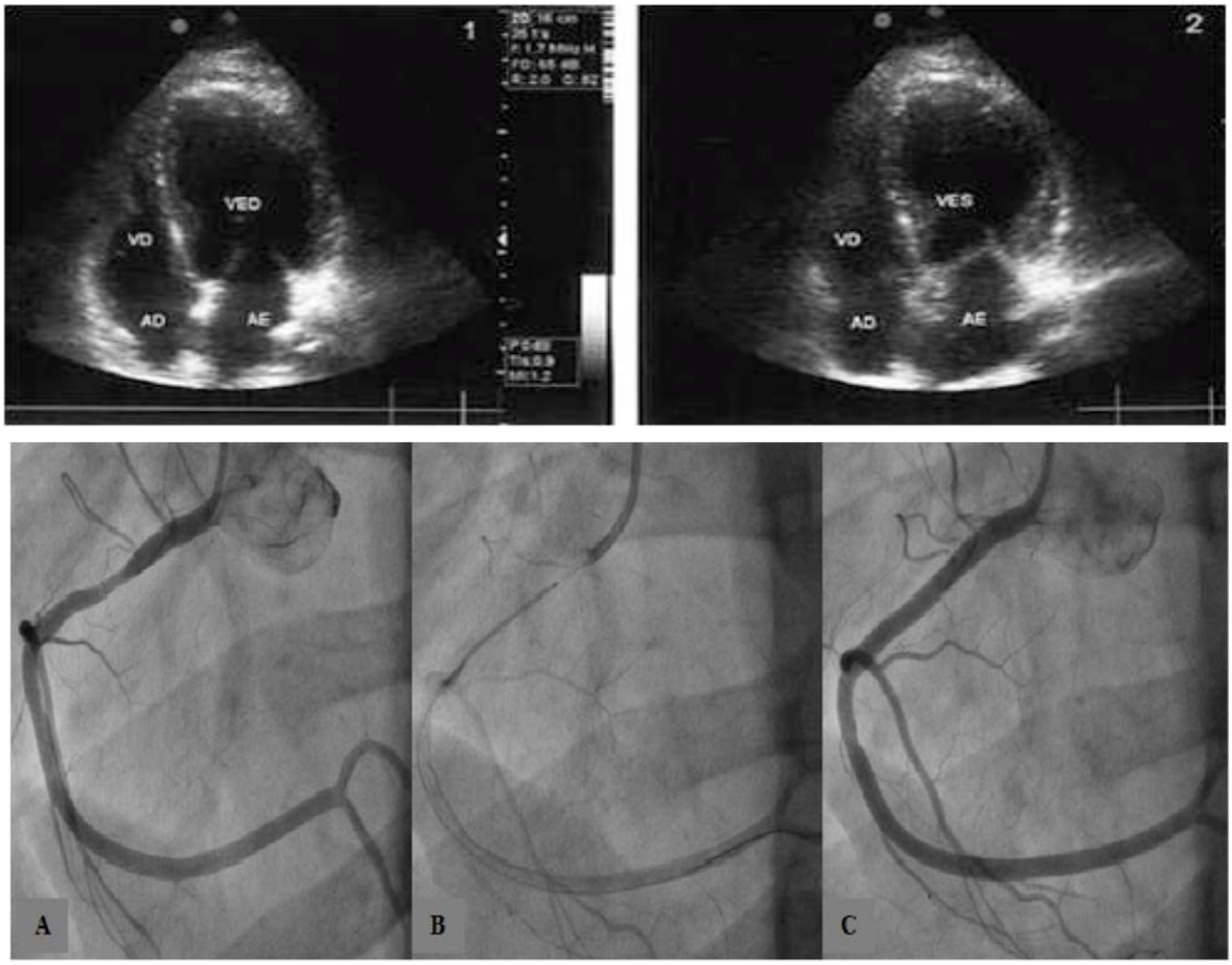

Figure 2: Echocardiogram at admission: Hypokinesia of inferior wall with global left ventricular function preserved.

A – Right coronary artery (RCA) - 30° LAO projection.B – RCA - 30° LAO projection with a 4,0 x 24 mm stent placement.C – RCA - 30° LAO projection after stent release.

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