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Editorial

The Cardiovascular Effects of Energy Drinks

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Abstract

Energy drinks are generally consumed by young people to increase athletic performance and concentration. Energy drinks contain high concentrations of caffeine, sugar, vitamin B complex, taurine, ginseng and guarana. There are not enough studies on these stimulants but past case-reports and small studies about energy drinks have been associated with cardiovascular complications. Especially with the use of alcohol or abuse drugs increase their undesirable effects and it may lead to cardiac morbidity and mortality. In this review, we aimed to focus on the effects and complications of energy drinks on the cardiovascular system.

Key words: prediabetes; cardivascular effect

Introduction

Energy drinks are one of the most frequently consumed drinks especially by young people in today. The production of energy drinks started in the 1960s and gradually increased in popularity [1]. Due to its fast growing market, industrial centers interested in the production of beverages are increasing day by day [2]. Energy drinks are often used to increase weight loss, athletic performance and concentration. The most popular brands in the USA are Red Bull, Rockstar, Monster, Full Throttle and Amp [3]. Energy drinks included caffeine, ginseng, taurine, guarana, B vitamine complex and sugar. Although there are more brands in markets, their components are not more different each other's [4].

Energy drink generally contains 0.34 mg of caffeine, it has approximately 2-4 times more caffeine components from tea and soda. Although there is no specific consensus on the upper limit of daily caffeine consumption, it has been reported that caffeine can be safely consumed up to 400 mg per day [5]. The use of Red Bull has been banned in France but the prohibition has been removed because of the lack of evidence of its toxicity by the European Union [6]. However, the number of visits to the emergency department has been increased due to the adverse events that occurred depending on the substances contained in these beverages [7]. It has been reported that the consumption of energy drinks may be associated with various medical complications such as seizures, anxiety, agitation, hallucinations, migraines, pontine myelinolysis, gastrointestinal upset, rhabdomyolysis, metabolic acidosis, insomnia, arrhythmias, chest pain, and cardiovascular complications [8]. Especially the use of energy drinks together alcohol or drugs may increase the potential effects of energy drinks [9]. Moreover, cardiovascular changes caused by energy drinks may cause morbidity and mortality [10].

The components of energy drinks:

Caffeine is the cornerstone of energy drinks and energy drink contains various ingredients that cause stimulant effects. The other components are guarana, taurine, theophylline, ginkgo biloba, ginseng, vitamins, L-carnitine [11].

Caffeine

Caffeine is a methylxanthine derivative that causes activation in the sympathetic nervous system. Although there are many studies on the cardiovascular effects of caffeine, unfortunately the results are contradictory. Caffeine causes positive inotropic effects on miyocardium with inhibiton of phospodiesterase enzyme and in contrast, caffeine causes vasoconstriction by inhibiting adenosine inhibition, platelet aggregation, and catecholamine and renin secretion. Caffeine may trigger endothelial dysfunction through sympathetic activation. The effects of caffeine on arrhythmia are variable.The use of overdose may trigger arrhythmia. However, there are many conflicting studies on the effects of caffeine on arrhythmia. Furthermore, the different cardiovascular effects of caffeine on people may be due to the CYP1A2 enzyme gene polymorphism, which is responsible for the primary metabolism of caffeine and the caffeine dose [6].

Taurine

Taurine is an amino acid derivative and is highly present in the heart and skeletal system [12]. Taurine causes negative chronotropic effects by reducing myocaridal calcium sensitivity. It provides vasodilation by suppressing the angiotensin 2 system. The caffeine consumption improves lipid profile by increasing LDL receptor upregulation and LDL uptake into the liver [13,14].

Ginseng

Ginseng is one of the populer plants grown in eastern Asia. This plant has stress-reducing, diabetes-healing, erectile dysfunction relief and memory-improving benefits [15]. It has been shown that it increases energy level and contributes to physical performance [16]. But excessive consumption can cause drowsiness, headache, agitation, dizziness, hypertension [17].

L-Carnitine

L-carnitine is a naturally occurring amino acid produced predominantly by the liver and kidneys. It plays a role in beta oxidation of fatty acids so it can lead to changes in energy metabolism. It is also involved in the suppression of programmed deaths of immune cells, in the prevention of cellular damage and in the stimulation of hematopesis [18]. Studies have shown that the cardiovascular effects of ginseng are contradictory. In one of the studies, it was shown that ginseng contributed to atherosclerosis but in another study it was claimed that left ventricular remodeling decreased [19, 20].

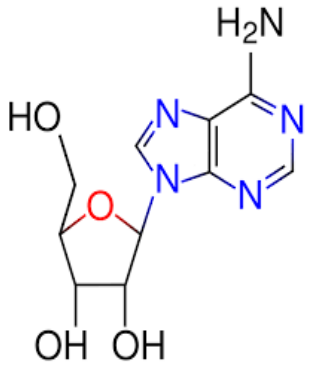

Figure 1: The chemical structure of energy drink

The Cardiovascular Effects of Energy Drinks:

1) Elevated blood pressure: Many studies have shown that energy drinks may increase blood pressure. In a study, 3 different energy drinks and placebo were presented volunteers one our before the test and their blood pressure were measured 15 minutes after the test. The blood pressures of the participants drinking 3 different energy consumed (163.87 mmhg, 166.47 mmhg, and 165.00 mmhg) were higher than placebo (156 mmhg) [21]. In another study, Stein et al. reported that blood pressure and heart rate may elevate a few hours after consumption of the energy drinks [22]. In another study, the redbull energy drink has been elevated blood pressure by increasing cardiac output on echocardiography [23]. Consumption of energy drinks in healthy individuals may trigger small fluctuations in blood pressure but blood pressure returns to normal after discontinuation of consumption. But this status may be deferred or difficult in hypertensive patients, so hypertensive individuals should avoid consumption of energy drinks [24].

2) Increased heart rate: The comsumption of energy drinks may increase heart rate., In a study with volunteers, blood pressure, heart rate and electrocardiograms of the participants were measured 48 hours after consumption of energy drink. Although there was no significant change in the electrocardiograms of the participants, their blood pressures increased by 10 mmhg and heart rate by 7 beats [22].

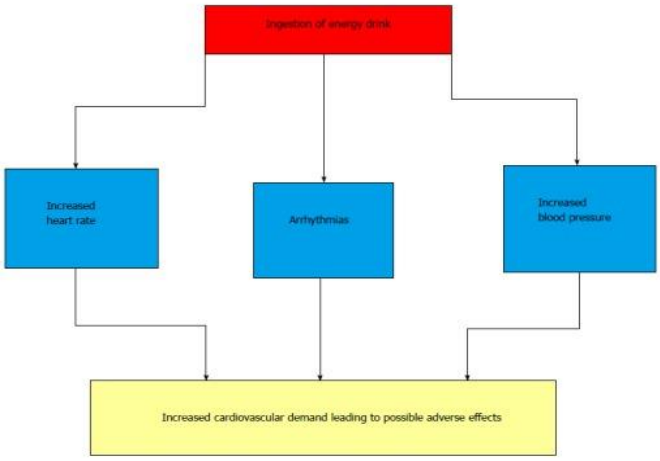

Figure 2: The hemodynamic cardiovasculer effects of energy drinks

3) Cardiac arrhythmia: Components in energy drinks may trigger supraventricular arrhythmias, especially atrial fibrillation in young people. This hypothesis is controversial, although genetic predisposition has been suggested as to who triggers atrial fibrillation [25]. In a case report, a young patient presented to the emergency department with chest pain and palpitation after taking energy drink The electrocardiography was consistent with supraventricular tachycardia attack. Vagal maneuver and carotid sinus massage were not successful. The patient returned to sinus rhythm only after adenosine was applied [26]. Nevertheless there is no evidence that chronic energy drink consumption triggers arrhythmia. Several reasons have been proposed about the mechanisms by which energy drink consumption can trigger ventricular arrhythmia. These are increased levels of circulating cathelolamine, causing dose-proportional hypokalemia and suppressing sodium channel conduction [27]. Patients with ventricular arrhythmia usually have underlying structural heart disease, cardiomyopathies and canalopathies [28].

4) QT prolongation: Studies showing the effect of energy drink consumption on electrocardiogram are few and contradictory. In a study with healthy volunteers, it was observed that the energy drinks temporarily prolonged the QTc duration by 10-20 ms. However, QTC duration was prolonged more than 50 ms in two volunteers. But none of the components of the energy drink are stimulant enough to trigger ventricular arrhythmia. Only an uncommon cause of sudden cardiac arrest secondary to ventricular fibrillation in some individuals may be underlying canopathies [29]. In a previous report record, a 22-year-old woman applied to emergency service with torsades de pointes after consuming 6 cans of energy drink in four hours. The patient was followed up in the intensive care unit and the QTc interval, which was initially 526 ms, decreased to 419 ms. KCNQ1 mutation causing long QT syndrome type 1 was detected in the patient's genetic test [30].

5) Coronary artery vasospasm: Energy drink may cause coronary artery vasospasm by accelerating calcium flow from smooth muscle cells with inhibition of adenosine receptor and increasing catecholamine release. Taurine can disrupt intracellular and extracellular classium signal flow at toxic levels [31,32]. A 27-year-old man admitted to the emergency department with chest pain and ST elevation myocardial infarction was detected in him. When intrcoronary nitroglycerin and verapamil were administered to him, the coronary arteries were detected normal and the patient was diagnosed with vasospastic angina [33].

6) Coronary artery thrombosis and dissection: Concomitant use of alcohol and energy drink may cause coronary artery thrombosis. In one reported case, a young patient presented with typical retrosternal pain and underwent angiography because of elevated troponin and electrocardiogram findings and. Several thrombi were detected in the patient. [34] In another case-report, echocardiography revealed apical hypokinesia in a patient admitted to the emergency department with chest pain and electrocardiogram changes. Angiography determined dissection of the left anterior descending artery in patient [35].

7) Aortic Dissection: There are very few pretentious case-reports that the energy drinks may cause aortic dissection. The triggering mechanism of aortic dissectionhas been estimated to be an increase in caffeine-induced acute blood pressure [36].

8) Sudden Cardiac Death: The energy drink consumption before physical performance may increase the oxygen demand of miyocardium during physical performance. This situation may be concluded by fatal arrhythmias secondary to ischemia, resulting in sudden cardiac death [5].

9) Miyocardial infraction: Caffeine inhibits adenosine receptors and increases catecholamine release. Caffeine alone may not contribute sufficiently to the development of atherosclerosis but other components of the energy drink may contribute to this process. In a study with healthy participants, endothelial function and platelet aggregation were evaluated after consuming energy drinks. The result of study, it has been claimed that energy drinks may contribute developing small amount of endothelial dysfunction and increasing 14% platelet aggregation [37, 38]. In another case-report, 26 age male patient consuming 8-10 energy drinks per a day was admitted to the catheter laboratory with the diagnosis of inferior STEMI and the circumflex artery was 100% occluded in patient. The balloon angioplasty with drug-coated stent was applied to the guilty lesion [36].

Elevated blood pressure and heart rate
Supraventricular and ventricular tachyarrhythmias
QTc prolongation
Aortic dissection
Myocardial ischemia, infarction and coronary artery vasospasm
Coronary artery thrombosis and spontan coronary artery dissection
Sudden cardiac death

Table 1: The effects of energy drinks on cardiovascular system

Conclusion

The previously reported records and small studies suggest that energy drinks may be associated with arrhythmia, QT prolongation, myocardial ischemia and infarction, aortic dissection etc. In particular, the cardiovascular effect of these beverages may be more pronounced in young people with underlying structural heart disease, cardiomyopathy, and canalopathy. By prohibiting or restricting the legal production and sale of these beverages, cardiovascular complications of energy drinks can be prevented. However, further investigations and randomized controlled trials are needed to initiate this legal process and to determine the precise effects of these beverages on cardiovascular health.

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Conflicts of interest

There are no conflicts of interest.

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