Case Report / Olgu Sunumu

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Energy Drink Associated Severe Myocardial Injury in a Child: A Case Report

Çocukta Enerji İçeceği ile İlişkili Şiddetli Miyokardiyal Hasar: Olgu Sunumu

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Abstract

Energy drinks are sugary beverages containing stimulant compounds that are marketed as providing mental and physical stimulation. Consumption of energy drinks has been associated with tachycardia, and in rare cases, myocardial infarction, myocardial injury and sudden cardiac arrest. In this study, we present the case of a 14-year-old male who experienced severe myocardial injury following repeated consumption of energy drinks. This previously healthy patient presented at the hospital complaining of palpitations, chest pain, breathlessness and vomiting following the consumption of four energy drinks. He was admitted to the intensive care unit due to clinical signs of cardiogenic shock and pulmonary oedema. His echocardiogram revealed ventricular dysfunction and his laboratory findings showed elevated cardiac enzymes and electrocardiogram evidence of myocardial injury. After excluding other possible infectious and non-infectious causes, myocardial injury due to energy drink consumption was suspected. The patient was given oxygen, intravenous fluids, epinephrine, milrinone and diuretics. His clinical and laboratory findings improved completely during follow-up and he was discharged in good health. In conclusion, we would like to emphasise that energy drinks, which are increasingly consumed during adolescence, can cause serious, life-threatening myocardial damage in children when consumed repeatedly and in large quantities.

Keywords: Energy drink, myocardial damage, child

Öz

Enerji içecekleri uyarıcı bileşikler içeren ve zihinsel ve fiziksel uyarıcılar olarak pazarlanan şekerli içeceklerdir. Enerji içeceği tüketimi taşikardi, nadir durumlarda miyokard enfarktüsü, miyokard hasarı ve ani kalp durması ile ilişkilendirilmiştir. Burada, art arda enerji içeceği tükettikten sonra ciddi miyokard hasarı gelişen 14 yaşında bir erkek adölesanı sunuyoruz. Daha önce sağlıklı olan hasta, 4 enerji içeceği içtikten sonra çarpıntı, göğüs ağrısı, nefes darlığı ve kusma şikayetleriyle hastaneye başvurdu. Çocuk, kardiyojenik şok ve pulmoner ödem klinik bulguları nedeniyle yoğun bakım ünitesine yatırıldı. Hastanın ekokardiyogramında ventriküler disfonksiyon, laboratuvar bulgularında kardiyak enzimlerde yükselme ve elektrokardiyogramda miyokard hasar bulguları görüldü. Hastada diğer olası enfeksiyöz ve enfeksiyöz olmayan nedenler dışlandıktan sonra, enerji içeceği tüketimine bağlı miyokardiyal hasar düşünüldü. Hastaya oksijen, intravenöz sıvılar, epinefrin, milrinon ve diüretikler uygulandı. Takip sırasında klinik ve laboratuvar bulguları tamamen düzeldi ve sağlıklı olarak taburcu edildi. Sonuç olarak, ergenlikte giderek daha fazla tüketilen enerji içeceklerinin, arka arkaya ve büyük miktarlarda tüketildiğinde çocuklarda ciddi, hayatı tehdit eden miyokardiyal hasara neden olabileceğini vurgulamak isteriz.

Anahtar Kelimeler: Enerji içeceği, miyokardiyal hasar, çocuk

Introduction

Energy drinks (ED) (e.g., Monster, Redbull, and Rockstar) are defined as beverages containing stimulants such as caffeine and guarana, as well as varying amounts of carbohydrates, amino acids, protein, sodium, vitamins, and other added minerals.[1] The consumption of ED has increased over the last twenty years, as has the number of emergency calls due to their negative effects.[2] Popular among adolescents, especially young men, ED cause numerous side effects on

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the neurological, psychiatric, gastrointestinal, renal, and cardiovascular systems due to their high sugar, caffeine, taurine, and other stimulant content.[3] The tendency to consume these drinks with alcohol has also increased. This combination poses a risk to the health of children and adolescents as it accelerates adverse cardiovascular events.[4] Although ED are marketed as performance enhancers, their safety profile remains a cause for concern.

When consumed repeatedly or alongside other substances, they can cause severe, life-threatening myocardial damage, arrhythmias, infections and autoimmune processes.[2,5] Here, we present the case of a patient admitted to the paediatric intensive care unit (PICU) with myocardial ischaemia, heart failure, pulmonary oedema, and cardiogenic shock who had consumed several ED at once.

Case Report

A fourteen-year-old male patient was admitted to the pediatric emergency department of another city, complaining of palpitations, compressive chest pain radiating to the left arm, and vomiting. As the patient had clinically severe breathing difficulties and required intensive care, we agreed to admit the patient. The patient was admitted to Ankara University, by ground transport vehicle. On admission to our PICU, physical examination revealed tachycardia, tachypnea, diminished breath sounds in the right lower lobe, and bilateral diffuse rales. The liver was palpable under the ribs. The other examinations were normal. The chest radiograph showed an elevation of the cardiothoracic index and interstitial edema. The patient's medical and family history was unremarkable. However, it was revealed that he consumed ED 1-2 times per week and 4, the day before his admission to the hospital. It was stated that the symptoms started approximately 6 hours after ingestion of the ED.

In the complete blood count taken at application: leukocytes (WBC): 17.72x10^9/L (4.5-12.5), hemoglobin: 16.7 g/dL (12.5-16.2), neutrophil count: 14.43x10^9/L (1.5-8). The biochemical parameters were as follows: aspartate aminotransferase 251 u/L (0-50), alanine aminotransferase 66 u/L (0-50), and lactate dehydrogenase 1344 u/L (120-300). An increase in acute phase reactants (C-reactive protein: 111.2 mg/L, normal <5 mg/L; fibrinogen: 5.72 g/L, normal=2-3.93 g/L) was noted. Chest computed tomography showed significant pulmonary edema in both lungs, especially in the right lung. Electrocardiogram (ECG): sinus tachycardia, widespread ST-segment elevation, T-wave inversions in leads V2-V6 were observed, and there was no voltage suppression (Figure 1). These ECG findings indicated severe myocardial ischemia in the patient. Echocardiography (ECHO) revealed left ventricular (LV) dysfunction and a left ventricular ejection fraction (LVEF) of 27%. Increase in cardiac markers [creatine kinase-muscle/brain (mass)]: 116.80 ng/mL (n=0-4.87 ng/mL), troponin T: 4016 pg/mL (n=0-14 pg/mL), N-terminal pro B-type natriuretic peptide: 8795 pg/mL (n=0-125 pg/mL) was noted.

To rule out possible causes of myocarditis, viral (parvovirus B19, human herpesvirus-6, Epstein-Barr virus, cytomegalovirus, hepatitis A/B/C, human immunodeficiency virus, varicella, herpes simplex virus 1/2, rubella) and bacterial (*Mycoplasma, Bordetella, Chlamydia, Legionella, Streptococcus*) tests are performed, and serological tests (*Brucella*) were negative. The tests for respiratory viruses (influenza A/B, parainfluenza 1/2/3/4, coronavirus OC43/NL63/229E/HKU1, respiratory syncytial virus A/B, rhinovirus, bocavirus, metapneumovirus A/B, adenovirus, enterovirus, parechovirus) were also negative. The metabolic screening (very long-chain fatty acids, carnitine/acylcarnitine analysis) was normal. Blood ethanol and a urine.

The toxicology panel (marijuana, cocaine, and opiates) was not performed because the history and physical examination revealed no evidence. When the patient's history, clinical findings, and laboratory results were evaluated, the patient was diagnosed with ED-induced severe myocardial injury.

The patient was started on intravenous fluids of 1000 cc/m^2, and inotropic treatment (epinephrine 0.1 mcg/kg/min and milrinone 0.5 mcg/kg/min). To treat pulmonary edema while reducing cardiac workload, a furosemide infusion was administered at a rate of 0.1 mg/kg/hour. Intravenous fluid intake was restricted to 750 cc/m^2. Since bacterial infection could not be ruled out with the patient's current clinical findings, intravenous treatment with ceftriaxone 75 mg/kg/day was started. During follow-up, it was observed that the tachycardia decreased and the systolic functions of the heart improved. Serial echocardiograms were conducted. On the second day of follow-up in the intensive care unit, the ECG showed a significant decrease in ST elevation and T wave inversion in V2-V6 leads.

During the seven-day follow-up in the PICU, a gradual clinical improvement was observed. An improvement in cardiac markers was also observed (Figure 2). The patient's LVEF

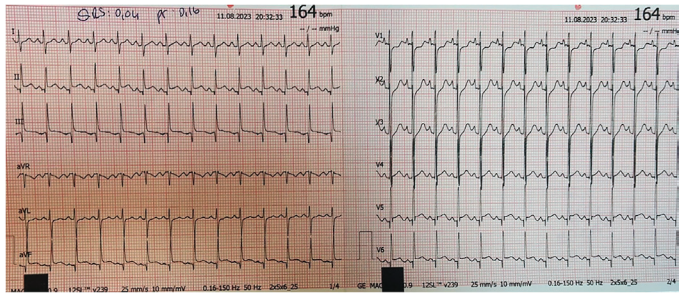

Figure 1. In the first electrocardiogram: sinus tachycardia, widespread ST-segment elevation, T-wave inversions in leads V2-V6 can be seen

increased to 62% on follow-up ECHO, and he was transferred to pediatric cardiology on the seventh day.

On the ward, on the 11th day of his hospitalization, the follow-up ECHO showed an ejection fraction of 62% (Figure 3). Milrinone treatment was discontinued. Antibiotic treatment was discontinued due to lack of growth in the blood culture. On the 12th day, he was discharged with the plan to continue the metaprolol and enalapril treatment that was started for heart failure, and was continued as an outpatient. The medical history and physical examination at the outpatient follow-up after discharge revealed no pathologic findings. There were no abnormalities in the cardiac markers, blood count or biochemical parameters. The ECG was in normal sinus rhythm. At ECHO: LVEF is 62%, with normal systolic function and minimal mitral regurgitation. Informed consent for participating in the study was obtained from the patient's parents.

Discussion

In recent years, the cardiac effects of caffeine have been extensively studied and reported, including tachyarrhythmias, increased blood pressure, decreased vasodilation, and new onset atrial fibrillation.[6] The stimulant content of ED can lead to increased sympathetic activity, vasoconstriction, and cardiac arrhythmia. It is reported in the literature that caffeinated ED, which are considered a significant source of caffeine, contain about 32 mg of caffeine in 100 mL, doses can contain up to about 152-160 mg of caffeine.

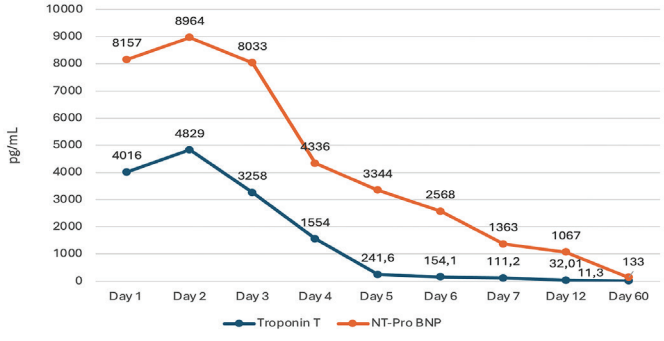

Figure 2. Troponin T and NT-Pro BNP values by day
NT-Pro BNP: N-terminal pro B-type natriuretic peptide

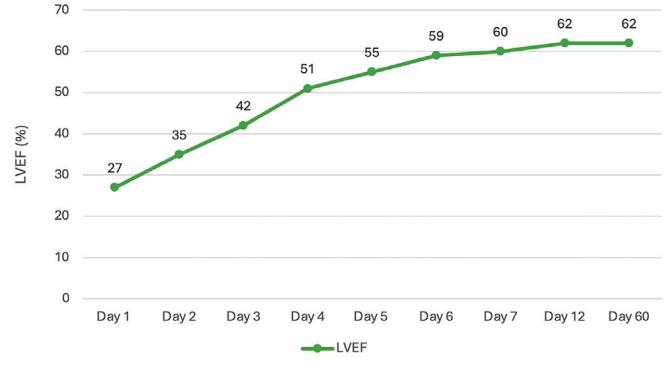

Figure 3. Level of LVEF by day
LVEF: Left ventricular ejection fraction

A 250 mL pack of Redbull® ED available in Türkiye contains 80 mg of caffeine, which is more than the amount of caffeine in the same amount of black tea (57 mg). Both acute consumption (>480 mg per day) and chronic consumption (>200 mg per day for more than one week) of caffeine in our patient were associated with adverse cardiovascular events. In addition, the excess of catecholamines stimulated by caffeine, leads to an increase in heart rate and blood pressure as a result of the positive inotropism produced by increased systemic vascular resistance and increased intracellular cyclic adenosine monophosphate. It is known that the taurine contained in these ED has a positive inotropic effect and an arterial antihypertensive effect by attenuating angiotensin II. Hypotension developed in our patient owing to severe myocardial injury-related left ventricular dysfunction. That was a cardiogenic shock state. We improved this clinical condition with inotropics and diuretic drugs.

Another ingredient, guarana, contains xanthine alkaloids such as theobromine, theophylline, and more caffeine than coffee beans.[7-10] In our case, the presence of symptoms of myocardial ischemia and ventricular dysfunction suggested cardiovascular involvement. In addition, interstitial pulmonary edema developed due to cardiac dysfunction.

The World Health Organization (WHO) points out that ED pose serious health risks, especially for children and adolescents. The high levels of caffeine and other stimulants contained in ED can pose serious health risks to children and adolescents.[10] The negative effects of ED on children include serious health problems such as headaches, sleep disorders, poor school performance, and even problems with heart failure. For these reasons, the sale of ED to children is banned or restricted in some countries. A UK study found that almost half of children from low-income families and a third of children in the UK consume ED at least once a week, demonstrating a link between poverty and ED consumption.[11] It has also been observed that, children who are better informed about the contents of ED consume them less. for this reason, the WHO recommends raising awareness of the harmful effects of ED and limiting or preventing the consumption of these drinks by children.

The Centers for Disease Control and Prevention report on the adverse effects of ED on children and adolescents is consistent with the recommendations of the WHO.[10]

Our patient had the cardiovascular effects mentioned above, but no neuropsychiatric disorder was observed. Moderate to severe adverse effects such as palpitations, shortness

of breath, uncontrolled muscle twitching, severe nausea, anxiety, irritability, and electrocardiogram changes have been observed in some young adults when more than one liter of ED is consumed, exceeding the safe amount of caffeine.[1]

Many studies have shown that ED are associated with causing a greater increase in high blood pressure compared to placebos. In a recent study, runners were asked to complete an exercise test. The subjects drank one of three ED or a placebo one hour before the test. The results showed that blood pressure was higher in the group that drank than in the placebo group.[10] Among the cardiac side effects of ED, cardiac arrhythmias (35%), coronary vasospasm, aortic aneurysm and dissection, cardiac arrest, QT prolongation, acute cardiomyopathies, hypertension, reversible postural tachycardia syndrome, acute coronary thrombosis and ST elevation myocardial infarction were reported. Caffeine and taurine are associated with compounds that have been shown to increase platelet aggregation, impair endothelial function, and possibly cause hypertension-induced vasospasm.[11]

In the study, 27 children and adolescents with an average age of 14.49 years consumed ED and a placebo on two consecutive days in accordance with the maximum amount of caffeine recommended by the European Food Safety Authority. The consumption of ED caused a significant increase in the number of supraventricular extrasystoles compared to placebo. Supraventricular tachycardia or malignant ventricular arrhythmias were not observed. It was found that the average heart rate was significantly higher after taking ED. In contrast, corrected QT (QTc) intervals were not affected by ED.[5]

Another prospective study was conducted in our country by Elitok et al.[12] Serious cardiovascular side effects and cardiac arrhythmias have been reported in the literature following the consumption of ED. In this study, the acute effects of the ED Redbull® on ventricular repolarization were investigated using the time between the peak and the end of the electrocardiographic T wave (Tp-e) and the Tp-e/QT ratio. After an eight-hour fast, 50 healthy young participants consumed 355 mL of the ED Redbull®. The Tp-e interval, the Tp-e/QTc ratio and some other electrocardiographic parameters were measured before and two hours after the consumption of Redbull®. Although consumption of the ED Redbull® increases heart rate and diastolic and systolic blood pressure, it does not cause changes in ventricular repolarization when looking at the Tp-e interval and the Tp-e/QTc ratio.

Conclusion

In conclusion, ED can be categorized as dietary supplements, which are not as strictly regulated as foods. For example, the US Food and Drug Administration regulates the caffeine content of sodas, but not the caffeine content of ED. It is recommended that children eat properly and get enough sleep to boost their energy. Pediatricians, parents and educators should be aware of the potential risks associated with ED consumption in children. Caution and education are important to prevent adverse effects.

Further research is needed to establish the factors that make people susceptible, the safe level of ED consumption, and the underlying mechanisms of toxicity.

Ethics

Informed Consent: Informed consent for participating in the study was obtained from the patient's parents.

Footnotes

Authorship Contributions

Surgical and Medical Practices: B.B., M.H., T.K., Concept: B.B., T.K., Design: B.B., E.E., A.D.A., T.K., Data Collection or Processing: B.B., E.E., Analysis or Interpretation: M.H., T.K., Literature Search: B.B., E.E., A.D.A., Writing: B.B., T.K.

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