

Case Report

Do energy drinks cause epileptic seizure and ischemic stroke?

Abstract

Energy drinks are popular among young individuals and marketed to college students, athletes, and active individuals between the ages of 21 and 35 years. We report a case that had ischemic stroke and epileptic seizure after intake of energy drink with alcohol. To the best of our knowledge, the following case is the first report of ischemic stroke after intake of energy drink. A previously healthy 37-year-old man was brought to the emergency department after a witnessed tonicclonic seizure. According to his wife's testimony, just before loss of consciousness, the patient had been drinking 3 boxes of energy drinks (Redbull, Istanbul, Turkey, 250 mL) with vodka on an empty stomach. He did not have a history of seizures, head trauma, or family history of seizures or another disease. In cranial diffusion magnetic resonance imaging, there were hyperintense signal changes in bilateral occipital area (more pronounced in the left occipital lobe), right temporal lobe, frontal lobe, and posterior parietal lobe. All tests associated with possible etiologic causes of ischemic stroke in young patients were negative. Herein, we want to attract attention to adverse effect of energy drink usage.

The market value for energy drinks is continually growing, and the annual worldwide energy drink consumption is increasing. However, issues related to energy drink ingredients and the potential for adverse health consequences remain to be elucidated. Energy drinks are popular among young individuals and marketed to college students, athletes, and active individuals between the ages of 21 and 35 years. Energy drinks typically contain high levels of caffeine, sugar, and other ingredients such as taurine, B-complex vitamins, ginseng, and guarana seed extract [1]. Recent reports suggest that these drinks may be associated with cerebral vasculopathy, acute mania, coronary artery vasospasm, and cardiac arrest severe cases [2-5]. Caffeine is known to induce seizures in susceptible individuals, especially in the sleep-deprived state. No clear link has www.elsevier.com/locate/ajem

been described between seizures and energy drinks. However, some cases established new adult-onset seizure episodes without any evidence of intracranial abnormalities or electroencephalography after high-volume consumption of energy drinks [6]. Herein, we report a case that had ischemic stroke and epileptic seizure after intake of energy drink with alcohol. To the best of our knowledge, the following case is the first report of ischemic stroke after intake of energy drink.

A previously healthy 37-year-old man was brought to the emergency department after a witnessed tonic-clonic seizure. According to the witness, the patient had "convulsive body shaking" for about 10 minutes and then loss of consciousness. He was smoker for 20 years (2 packets per day). There was a history of alcohol consumption (35 cl in every evening), occasionally with energy drinks. According to his wife's testimony, just before loss of consciousness, the patient had been drinking 3 boxes of energy drinks (Redbull, Istanbul, Turkey, 250 mL) with vodka on an empty stomach. On physical examination, he was stupor, Babinski sign was bilaterally positive, and motor function was 4/5 in the upper and lower extremities. Pupillary reflex was bilaterally positive. Nystagmus in all 4 directions was present. There was double vision and slurred speech. Initial vital signs revealed a blood pressure of 150/90 mm Hg, heart rates of 108 beats per minute, respirations of 16 breaths per minute, and oxygen saturation 100% on room air. Cardiovascular and pulmonary examination was normal. He denied any seizureprovoking factors, such as sleep deprivation, excess caffeine intake, fevers, infections, illicit drugs, and headaches. He did not have a history of seizures, head trauma, or family history of seizures or another disease. Laboratory analyses revealed hemoglobin level of 9.79 g/dL; hematocrit, 32.1; mean corpuscular hemoglobin (MCH) level, 73.6 fL; serum Fe, 34 μ g/dL (low); and Fe-binding capacity, 424 μ g/dL (high). Peripheral smear was consistent with iron-deficiency anemia. The reason of iron-deficiency anemia was hemorrhoid. Thrombocyte, blood urea nitrogen, glucose, thyroid hormones, vitamin B_{12} , and homocysteine levels were normal limits. Cranial diffusion magnetic resonance imaging (MRI) was performed. The lesions on diffusion-limited showed in



Fig. 1 Diffusion-weighted MRI revealed hyperintense lesions in B-1000 images (A and D), hypointense lesions in ADC mapping (B and E), and hyperintense lesions in FLAIR images (C and F) compatible with acute stroke.

the cerebellar hemisphere, medulla oblongata, left occipital lob, and bilateral cerebral hemisphere to be more pronounced on the right (Fig. 1). Cranial magnetic resonance venography was normal. The patient was diagnosed as epileptic seizure and cerebral ischemia, and he was admitted to neurology clinic. Heparin infusion and antiepileptic therapy were started. Reasons that may probably account for etiology of stroke in younger patients, such as factor 5 Leiden mutation, protein C, protein S, antithrombin 3, MTHFR mutation, human immunodeficiency virus Ag, VDRL-RPR, Brucella agglutination test, Borrelia burgdorferi immunoglobin G (IgG), Borrelia burgdorferi immunoglobin M (IgM), antiphospholipid antibody, ANA, AMA, anti-ds DNA, anticardiolipin IgG, and anticardiolipin IgM, were negative. There was no structural cardiac abnormality found from transthoracic and transesophageal echocardiography. Bilateral vertebral carotid artery ultrasonography and abdominal ultrasonography were normal. An electroencephalography performed the following morning (48 hours after presentation) was also normal. On the fourth day of admission, patient's consciousness was clear. After treatment, lesions that had signal characteristics of regressed diffusion

restriction and compatible with long-term changes were seen in control MRI (Fig. 2). Because of any epileptic seizure that has not occurred after admission, prophylactic antiepileptic therapy has not been started.

Stroke is a major public health problem. Stroke is also the most common neurologic condition causing long-term disability and has enormous emotional and socioeconomic consequences in patients, their families, and health services. The incidence of stroke rises with age, hence low in young adults. Nevertheless, ischemic stroke in young adults is a common cause of admission to stroke units and referral to neurology departments. Traditional risk factors for stroke such as hypertension and diabetes are not very frequent in young adults; however, some other permanent or transient risk factors such as smoking, use of oral contraceptives, migraine, trauma, use of illicit drugs, and pregnancy or puerperium have a more important role in this age group than in older adults. The main clinical challenge in management of a young adult with acute stroke is the identification of its cause. Although large extracranial and intracranial atheroma, small vessel disease, and atrial fibrillation have a major role in cases of stroke in older adults, these disorders are much



Fig. 2 Diffusion-weighted MRI showed that regression the diffusion restriction (A, B, D, and E). In addition, hyperintense lesions and partial atrophic changes showed in FLAIR images (C and F).

less frequent in young adults [7]. Recently, improved techniques such as imaging, genetics, and cardiac electrophysiological have led to better illuminating of stroke etiology especially in young patients.

Energy drinks containing caffeine, taurine, and herbal supplements are popular among college students and athletes. Most of these energy drinks contain guarana, taurine, and caffeine. Guarana seed extract is derived from seeds of the guarana plant. Guarana seed extract contains guaranine, a mixture of the methylxanthines (caffeine, theophylline, and theobromine). Methylxanthines, including caffeine, are stimulants of the cardiac and central nervous systems (CNSs) [8]. Taurine is an essential amino acid. Long-term administration of taurine in drinking water results in increased susceptibility to seizures and a decreased latency for clonic seizures in kainic acid-induced seizure models in rats [9]. Caffeine is a natural stimulant found in coffee and tea. In humans, seizures have been documented after caffeine overdose [10]. In patients with epilepsy, it is known that excessive caffeine lowers the seizure threshold. It is not clear whether caffeine or taurine has more hazardous effects when combined with alcohol consumption. However, suspected deaths linked to energy drinks in combination with alcohol

have been reported in United States, Sweden, Australia, and Ireland. Although some popular articles have suggested possible links between seizures and energy drinks, a direct correlation between energy drinks and seizures has not been established [11,12].

Alcohol misuse is also an independent risk factor for ischemic stroke in young and middle-aged adults [13]. In our case, when high-volume energy drinks have been consumed with vodka on an empty stomach, rapid absorption and the concurrent increase in the CNS may cause more adverse effects.

In the literature, there was a 17-year-old man who had been diagnosed with transient coronary vasospasms because of drinking a disproportionate amount of caffeinated energy drinks [4]. This case strongly suggests that overuse of stimulants, such as caffeine in energy drinks, should be considered in patients presenting with coronary vasospasms, particularly in teenagers and young adults. In our case, because of the epileptic seizure and ischemic stroke that were seen after ingestion of energy drinks, it may account for ischemic stroke and epileptic seizure. We thought that caffeine in energy drinks (containing 80 mg) and guarana reach quite a high level when energy drinks are combined with alcohol because some studies have suggested that the caffeine content of guarana (40-80 mg per gram of extract), which is not always stated in packaging and is additional to the listed caffeine dose that the patient has consumed, may be higher than the authors have calculated [14].

Components of energy drinks were cardiovascular changes characterized by increase in platelet aggregation, impairment of endothelial function, and increase in blood pressure [15,16]. In addition, glucuronolactone, which is one of the energy drink content, may provide to these cardiovascular changes [16]. Steinke et al [17] reported that, after the energy drink intake of 500 mL regular weekly, heart rate increased 5 to 7 beats per minute, and maximum mean systolic blood pressure increased 10 mm Hg. Intake of high-energy drink with vodka on an empty stomach may be contributing ischemic stroke by increasing blood pressure and heart rate. Furthermore, the patient has iron-deficiency anemia due to hemorrhoid. Iron-deficiency anemia may contribute to the ischemic stroke [18].

As a result, all test results associated with possible etiologic causes of ischemic stroke in young patients were negative in our case. So, we thought that intake of energy drink with alcohol on an empty stomach may cause epileptic seizure and ischemic stroke. We did not find any data that may be related to ischemic stroke due to energy drinks. This is the unique case of patient who presented ischemic stroke and epileptic seizure related to energy drinks. Energy drinks are very popular, especially among young people. Because of that, herein, we want to attract attention to adverse effect of energy drink usage. Nevertheless, further study is needed to evaluate the accurate CNS effects and mechanisms of action of these popular stimulants and how genetic makeup may contribute to susceptibility epileptic seizure and ischemic stroke.

Suber Dikici MD

Duzce University Medical Faculty Department of Neurology, Duzce 81620, Turkey E-mail address: suberdikici@gmail.com

Ayhan Saritas MD

Duzce University Medical Faculty Department of Emergency Medicine, Duzce 81620, Turkey

Fahri Halit Besir MD

Duzce University Medical Faculty Department of Radiology, Duzce 81620, Turkey

Ahmet Hakan Tasci MD Duzce University Medical Faculty Department of Neurology, Duzce 81620, Turkey Hayati Kandis MD Duzce University Medical Faculty Department of Emergency Medicine, Duzce 81620, Turkey

http://dx.doi.org/10.1016/j.ajem.2012.05.018

References

- Pennay AE, Lubman DI. Energy drinks: health risks and toxicity. Med J Aust 2012;196(7):442.
- [2] Worrall BB, Phillips CD, Henderson KK. Herbal energy drinks, phenylpropanoid compounds, and cerebral vasculopathy. Neurology 2005;65:1137-8.
- [3] Machado-Vieira R, Viale CI, Kapczinski F. Mania associated with an energy drink: the possible role of caffeine, taurine, and inositol. Can J Psychiatry 2001;46:454-5.
- [4] Wilson RE, Kado HS, Samson R, et al. A case of caffeine-induced coronary artery vasospasm of a 17-year-old male. Cardiovasc Toxicol 2012;12(2):175-9.
- [5] Berger AJ, Alford K. Cardiac arrest in a young man following excess consumption of caffeinated "energy drinks". Med J Aust 2009;190(1): 41-3.
- [6] Iyadurai SJ, Chung SS. New-onset seizures in adults: possible association with consumption of popular energy drinks. Epilepsy Behav 2007;10(3):504-8.
- [7] Feigin VL, Lawes CM, Bennett DA, et al. Stroke epidemiology: a review of population-based studies of incidence, prevalence, and casefatality in the late 20th century. Lancet Neurol 2003;2:43-53.
- [8] Dalvi RR. Acute and chronic toxicity of caffeine: a review. Vet Hum Toxicol 1986;28(2):144-50.
- [9] Eppler B, Patterson TA, Zhou W, et al. Kainic acid (KA)–induced seizures in Sprague-Dawley rats and the effect of dietary taurine (TAU) supplementation or deficiency. Amino Acids 1999;16(2): 133-47.
- [10] Cohen SM, Laurito CE, Curran MJ. Grand mal seizure in a postpartum patient following intravenous infusion of caffeine sodium benzoate to treat persistent headache. J Clin Anesth 1992;4(1):48-51.
- [11] Arria AM, O'Brien MC. The "high" risk of energy drinks. JAMA 2011;305(6):600-1.
- [12] Kapner D. Ephedra and energy drinks on college campuses. Infofacts Resources. April 2004 ed: The Higher Education Center for Alcohol and Other Drug Abuse and Violence Prevention; 2004.
- [13] Sundell L, Salomaa V, Vartiainen E, et al. Increased stroke risk is related to a binge-drinking habit. Stroke 2008;39:3179-84.
- [14] Seifert SM, Schaechter JL, Hershorin ER, et al. Health effects of energy drinks on children, adolescents, and young adults. Pediatrics 2011;127(3):511-28.
- [15] Sanaei-Zadeh H. With which mechanism the overuse of energy drinks may induce acute myocardial ischemia? Cardiovasc Toxicol 2012;21, http://dx.doi.org/10.1007/s12012-012-9160-4 Epub ahead of print.
- [16] Worthley MI, Prabhu A, De Sciscio P, et al. Detrimental effects of energy drink consumption on platelet and endothelial function. Am J Med 2010;123(2):184-7.
- [17] Steinke L, Lanfear DE, Dhanapal V, et al. Effect of "energy drink" consumption on hemodynamic and electrocardiographic parameters in healthy young adults. Ann Pharmacother 2009;43(4):596-602.
- [18] Şenol MG, Toğrol E, Kaşikçi T, et al. Cerebral venous thrombosis: analysis of sixteen cases. Düzce Med J 2009;11(1):32-7.