

# High-energy Drinks May Provoke Aortic Dissection

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## ABSTRACT

*High-energy drinks have become extremely popular after Red Bull's promotion at 1987 in Austria and 1997 in the United States. Since then, we witnessed spectacular increase in different brands, caffeine content and market consumption all over the world. However, there are no reports published in the scientific literature related with detrimental side effects after heavy consumption of high-energy drinks. We report a series of three high-risk cardiovascular patients who had aortic dissection (De Bakey type I and II) following significant consumption of high-energy drinks. All of them required emergency surgical procedure and were remaining stable after surgery. We propose that uncontrolled consumption of high-energy drinks, especially in patients with underlying heart disease, could provoke potentially lethal cardiovascular events as well as acute aortic dissection.*

**Key words:** aorta, aortic dissection, cardiac, nutrition

## Introduction

High-energy drinks have recently becoming one of the most popular drinks among adolescents, athletes and some night shift workers. At the top of the list are drinks with high content of caffeine, taurine, guarana and effedra. All of these components are marked as active ingredients that improves vigilance, cognitive, physical and emotional performance and »gives you wings« in normal life<sup>1,2</sup>. That is why high-energy drinks were quickly recognized as stimulant drinks. Popularity of these products demonstrated the exploding effect on US market; with an annual increase in sales of nearly 20% and industry profit of nearly 5.7 billion dollars in 2006<sup>3</sup>. New industry continues to grow up with a variety of makers, ingredient contents, size and mixture. High-energy drinks are usually presented by Consumer Advertising Companies as »dietary supplements« with limited data on the effects of some individual ingredients, their combination, or possible side effects<sup>2</sup>.

Our perception of high-energy drinks and their safety was started to change after several reports of unexplained sudden cardiac deaths that may be related to consumption of stimulant drinks. The incident reports were initially recorded in Ireland, Australia and Sweden in young, healthy adults possibly due to cardiac dysrhythmia<sup>1,3,4</sup>. Much controversy was addressed to high-en-

ergy drinks after Stimulant Drinks Committee reports published in several countries at the beginning of the 21<sup>st</sup> century that summarizes labeling, safety and current legislation in stimulant drink industry<sup>5</sup>. Unfortunately, lack of scientific data raises numerous questions regarding safety of these products, their pharmacology and interactions with food, nicotine or alcohol especially in athletes and patients with some underlying cardiovascular disease. Here, we report a case series of three high-risk cardiovascular patients who presented with aortic dissection (DeBakey type I and II) after heavy consumption of stimulant drinks. Although high-energy drinks were associated with cardiovascular changes, this report is novel in an attempt to create connection between potentially lethal cardiovascular incident (acute aortic dissection) and heavy consumption of high-energy drinks, especially in high risk cardiovascular patients.

## Material and Methods

Informed consent was obtained from each patient and the study protocol conforms to the ethical guidelines of the 1975 Declaration of Helsinki as reflected in a *priori* approval by the institution's human research committee.

## Results

### Case 1

The patient was a 54 years-old Caucasian man, referred from the outside hospital due to chest pain, fatigue, and shortness of breath. Symptoms started 5 days prior to admission. The patient stated that he is professional truck driver and he casually consumes 4–5 high-energy drinks (mostly Red Bull) *per* night while driving. Patient's past medical history was positive for uncontrolled severe arterial hypertension and obesity. His toxicology screen was negative; however, laboratory evaluation confirmed increased systemic inflammatory reaction, and multiorgan failure. General examination confirmed severe arterial hypertension (190/110 mmHg), and tachycardia (heart rate=110 bpm). Transthoracic echocardiography and CT chest scan was positive for subacute aortic dissection (De Bakey type I). Patient had urgent reconstructive surgery of the ascending aorta with flap resection and interposition of the vascular prosthesis (Vascutec #30). Patient was discharged on the postoperative day #10. Clinical outcome after surgery was complete, and he was staying well and without complications a year after surgery.

### Case 2

The patient was a 26 years-old Caucasian man with chest pain 5 hours prior to admission. Patient's past medical history was positive for bicuspid aortic valve and dilation of the ascending aorta (5.0 cm), and he was scheduled for elective surgery in other institution. Patient confirmed that chest pain started just after a party where he was taking 5–6 high-energy drinks *per* night. His general examination was unremarkable and was significant only for hypertension (systolic blood pressure=145 mmHg). His toxicology screen was negative; however, echocardiography and CT chest scan confirmed acute aortic dissection (De Bakey type II). Patient had emergency surgery of the aortic root with aortic valve replacement (St. Jude mechanical prosthesis #21) and resection of the dissecting flap with vascular grafting (Vascutec prosthesis #28). Clinical outcome after surgery was complete, and the patient was discharged from the hospital on the postoperative day #8, without complications.

### Case 3

The patient was a 48 years-old Caucasian man with severe chest pain 3 hours prior to admission. Patient's past medical history was unremarkable; however, family history was positive for arterial hypertension and myocardial infarction. Patient confirmed that chest pain started while driving a van at night. He also admitted that he took several high-energy drinks just before the incident to stay awake. His laboratory and toxicology screen was negative; general examination was unremarkable and was significant only for arterial hypertension (blood pressure=145/95 mmHg). Echocardiography confirmed acute aortic dissection (De Bakey type I), and the

patient was scheduled for emergency surgery. Surgical resection of the dissecting aorta was performed, and vascular prosthesis (Vascutec #28) was implanted in the ascending aorta. Clinical outcome after surgery was uneventful, and the patient was discharged from the hospital on the postoperative day #9, without complications.

## Discussion and Conclusion

The definition of high-energy drinks is not particularly well established. However, there is a widely accepted description that those drinks usually contains high content of caffeine, taurine, guarana, effedra, some vitamins, energy source (i.e. carbohydrate) and other substances that provide real or perceived enhancement in physical and/or mental performances<sup>1,2,6</sup>. There are no official standards for the doses of active ingredients in high-energy drinks. However, the traditional perceptions that herbal/natural products are innately safe open the gate for makers to increase its content.

Caffeine is one of the most respected high-energy drink ingredients. It comes alone or in combination with guarana, which is also herbal/natural source of caffeine. It is usually described as a stimulant that increases heart rate and blood pressure<sup>7–9</sup>. The usual content of caffeine is >80 mg *per* can. This is the same as the amount of caffeine provided by an average strength cup of coffee, and about twice that in a cup of tea. It is also about twice the level of caffeine found in a can of carbonated, cola-flavored soft drink.

In addition to caffeine, high-energy drinks contain a significant amount of taurine (1000 mg *per* can). However, the role of this amino acid is unclear. Caffeine-aurine combination was named as »magic combination«; however, incredible profit and permanent sale increase »improved« stimulant drink recipe with synthetic supplements based on effedra-caffeine effect. Those changes have made additional pressure to some National Food and Drug Committees who officially announced those products as dietary or weight-loss supplements without documented scientific findings<sup>2</sup>. Such conclusions were based on anecdotal reports and cynical opinions about safety of high-energy drinks, and that was quietly accepted by the society.

It is extremely well documented that caffeine consumption may cause significant changes in electrocardiographic and hemodynamic values 5 hours after ingestion<sup>8,10,11</sup>. Such effect is even more detectable in professional athletes, just after moderate physical training<sup>7</sup>. Caffeine demonstrated an increase in systolic blood pressure and stroke index but decrease in systolic time ratio<sup>8</sup>. Other reported that previous findings were accompanied with hand tremor, jitteriness, queasiness or »not feeling quite right« effect<sup>2,10,11</sup>. Energy drinks are also used as mixers with alcohol. This combination, in addition with nicotine, carries a number of dangers. Energy drinks are stimulants, and alcohol is a depressant. However, the combination can mask the level of alcohol intoxication and provoke further alcohol ingestion. When the stimu-

lant effect wears off, the depressant effect remains and could cause vomiting, or even respiratory depression<sup>1,2</sup>. It is necessary to emphasize that all published studies were performed on young, healthy individuals. However, professional athletes and patients with weakness of the aortic media or other underlying cardiovascular diseases are more likely to have catastrophic cardiovascular incident including acute aortic dissection due to sudden changes in haemodynamic shear stress<sup>12</sup> or other changes in cardiovascular dynamics<sup>7,9,13</sup>.

The average number of patient with aortic dissection operated on in our institution is 20/year, with postoperative mortality (30 days) of 14.7%. The percentage of high-energy drinker in such group of patient is low (1–3%). However, our findings clearly indicate that high-energy drinks consumption in the amount of 5 cans *per* night (e.g. 400 mg of caffeine; 5000 mg of taurine) may provoke potentially lethal cardiovascular incident in high-risk population. Two patients in our report (case 1 and 3) had several risk factors essential for development of cardiovascular disease (i.e. high blood pressure, positive family history, obesity, cigarette smoking). Case #2 had high-risk congenital anomaly and was scheduled for

elective surgery. However, documented risk factors, such as chronic hypertension or a connective tissue disorder, were not taking into serious consideration, which indicate low primary care in those individuals.

There are several limitations in our observations primarily due to insufficient data about high-energy drink dosage, comorbid conditions and dose-response relationship. It is also unclear which ingredient or combination of ingredients may provoke pharmacokinetic or pharmacodynamic interactions that cause the effects seen in this study. Finally, this study has extremely limited number of patients to make a final conclusion. That is why further investigation is needed to provide more information relevant to our findings.

In conclusion, we report a series of three patients who had aortic dissection (De Bakey type I and II) following significant consumption of high-energy drinks. All of them required emergency surgical procedure and were remaining stable after surgery. We propose that uncontrolled consumption of high-energy drinks, especially in patients with underlying heart disease, could provoke potentially lethal cardiovascular event as well as acute aortic dissection.

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## VISOKO-ENERGETSKA PIĆA MOGU IZAZVATI AORTALNU DISEKCIJU

### S A Ž E T A K

Visoko-energetska pića su postala izuzetno popularna nakon što je Red Bull promoviran u 1987. u Austriji i 1997. u Sjedinjenim Američkim Državama. Od tada svjedoci smo spektakularnog rasta različitih marki, sadržaja kofeina i tržišne potrošnje u cijelom svijetu. Međutim, ne postoje izvješća objavljena u znanstvenoj literaturi vezana za štetne nuspojave nakon konzumiranja teških visoko-energetskih pića. Prikazali smo niz od tri visokorizičnih kardiovaskularnih bolesnika koji su imali aortalnu disekciju (De Bakey tip I i II), nakon značajne potrošnje high-energetskih pića. Na svakom od njih morao je biti izveden hitan kirurški zahvat, a njihovo stanje je postalo stabilno nakon operacije. Autori upozoravaju da bi nekontrolirano konzumiranje visokoenergetskih pića, osobito u sportaša i bolesnika s kroničnim bolestima srca, moglo izazvati potencijalno smrtonosne kardiovaskularne događaje kao i akutnu disekciju aorte.