Long term energy drink consumption is associated with arrhythmias in young people!

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Disclosures

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Energy Drink: a category of drinks that contains variable amounts of caffeine, taurine, glucuronolactone and other ingredients that may include sugar, vitamins and minerals

Caffeine (average 32mg/100 ml)

= 80 mg

Taurine

Sugar (or aspartame), vitamins and minerals

Caffeine is a nonselective competitive antagonist of adenosine receptor subtypes A1 and A2A in concentrations typically consumed by humans. At higher concentrations, caffeine can induce intracellular calcium release and phosphodiesterase inhibition, mimicking the effects of epinephrine. At higher doses not typically consumed, can cause gamma-aminobutyric acid inhibition. It is suggested that 100 mg can increase alertness in humans. Increases in blood pressure are noted at 250 mg, and the lethal dose has been estimated to be 10 g.

Metabolites:

- Paraxanthine: Increases lipolysis, leading to elevated glycerol and free fatty acid levels in the blood plasma. Also increases the amounts of Ca++ in the skeletal muscle
- Theobromine: Dilates blood vessels and mildly increases urine production.
- Theophylline: Relaxes smooth muscles of the bronchi. Can cause nausea and arrhithmias

Each of these metabolites is further metabolized and then excreted in the urine.

Why does caffeine keep me awake?

In the absence of caffeine and when a person is awake and alert, little adenosine is present in CNS neurons. With a continued wakeful state, over time it accumulates in the neuronal synapse, in turn binding to and activating adenosine receptors found on certain CNS neurons; when activated, these receptors produce a cellular response that ultimately increases drowisness. When caffeine is consumed, it antagonizes adenosine receptors;

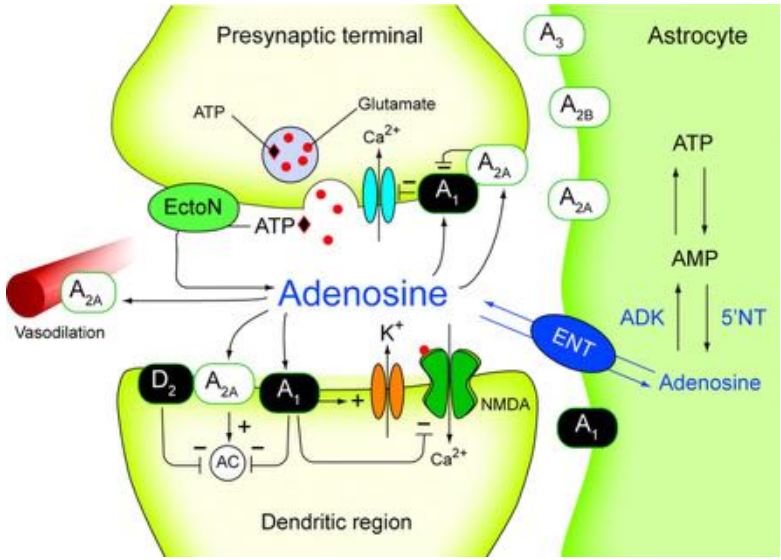
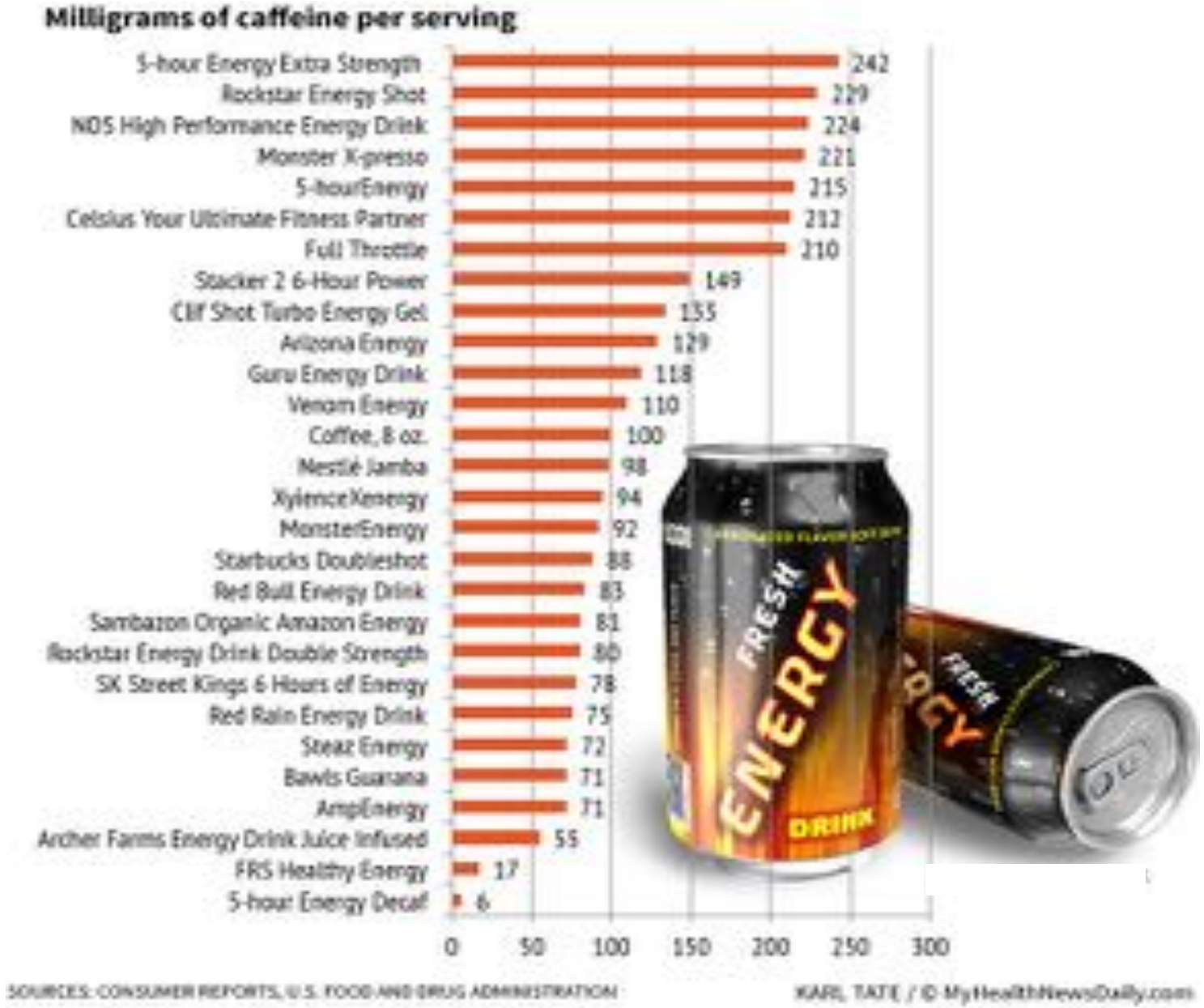


Table 1 | **The caffeine content of various beverages, foods and drugs**

Beverages, foods and drugs	*Caffeine content (mg)
Sprite or Fanta (12 oz/360 ml)	0
Decaffeinated coffee (8 oz/240 ml)	1–5
Milk chocolate (1 oz/28 g)	6
Green tea (8 oz/240 ml)	15–20
Dark chocolate (1 oz/28 g)	20
Pepsi Cola (12 oz/360 ml)	38
Dr Pepper (12 oz/360 ml)	40
Coca-Cola (12 oz/360 ml)	46
Black tea (8 oz/240 ml)	40–60
Espresso (2 oz/60 ml)	50–120
Red Bull (8.2 oz/246 ml)	80
Instant coffee (8 oz/240 ml)	65–100
Brewed coffee (8 oz/240ml)	80–135
Drip coffee (8 oz/240ml)	115–175
Typical caffeine pill	200

*Values supplied by the US Food and Drug Administration.

Caffeine in Energy Drinks



Overdose Effects

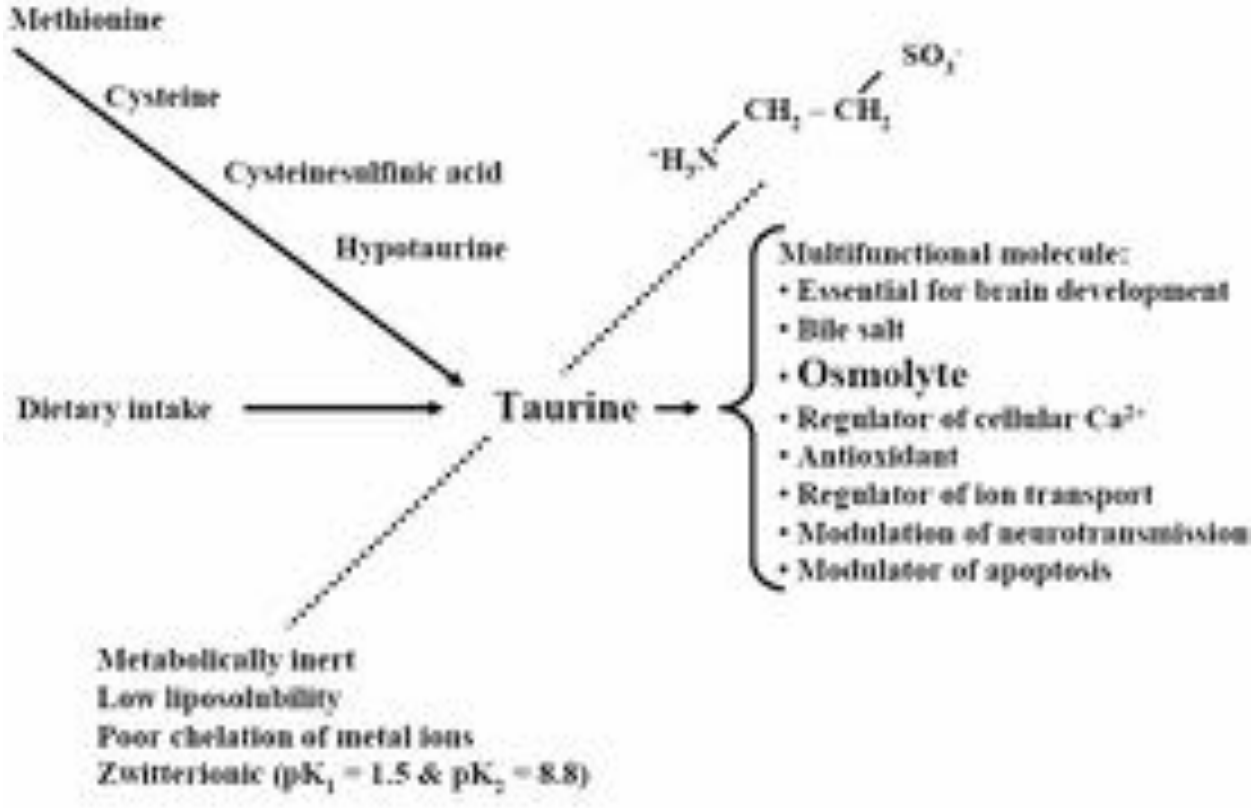
Minor (excess of 300 milligrams, dependent on body weight/tolerance)

- Causes over-stimulation in Central Nervous System
- Common Problems: restlessness, nervousness, excitement, insomnia, flushing of the face, increased urination, gastrointestinal disturbance, muscle twitching, a rambling flow of thought and speech, irritability, irregular or rapid heart beat, and psycho motor agitation.

Major (≥ 1000-1500 milligrams): mania, depression, disorientation, hallucinations and psychosis, vomiting, tremor, seizures, tachycardia, dysrhythmias, hypotension, hypokalemia, rhabdomyolysis and metabolic acidosis

Lethal intoxication when blood concentration = 500 mg/l caffeine

Taurine or **2-aminoethanesulfonic acid**, is an organic acid widely distributed in animal tissues. It is a major constituent of bile and can be found in the large intestine. Taurine has many fundamental biological roles, such as conjugation of bile acids, antioxidation, osmoregulation, membrane stabilization, and modulation of calcium signaling.



Taurine occurs naturally in fish and meat. The mean daily intake from omnivore diets was determined to be around 58 mg (range from 9 to 372 mg) and to be low or negligible from a strict vegan diet. In another study, taurine intake was estimated to be generally less than 200 mg/day, even in individuals eating a high-meat diet. Average intake with ED is about 1000 mg per serving

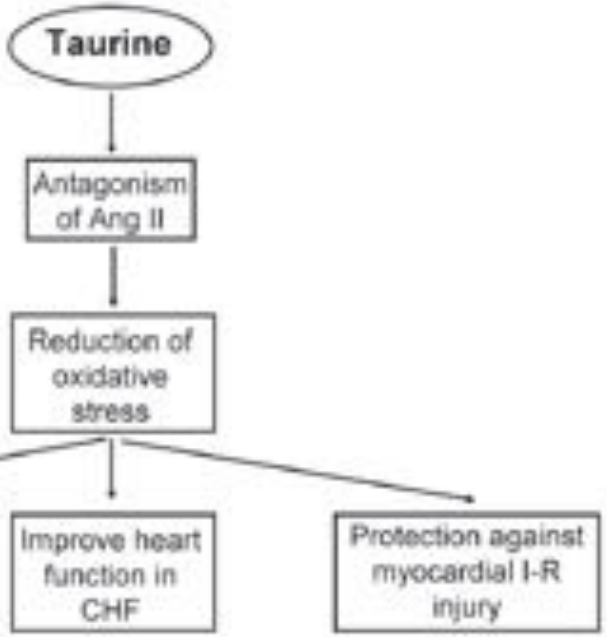
Biological Effect of Taurine	*Mechanism*
Antioxidant action	By inhibiting ROS generation at mitochondria
Osmoregulation	By counteracting osmotic inbalance through cellular membrane due to hyperglycaemia
Antiinflammatory effects	By interfering the formation of inflammatory mediators
Glucose Homeostasis	By interfering the insulin signalling pathway acting upon UCP2 protein

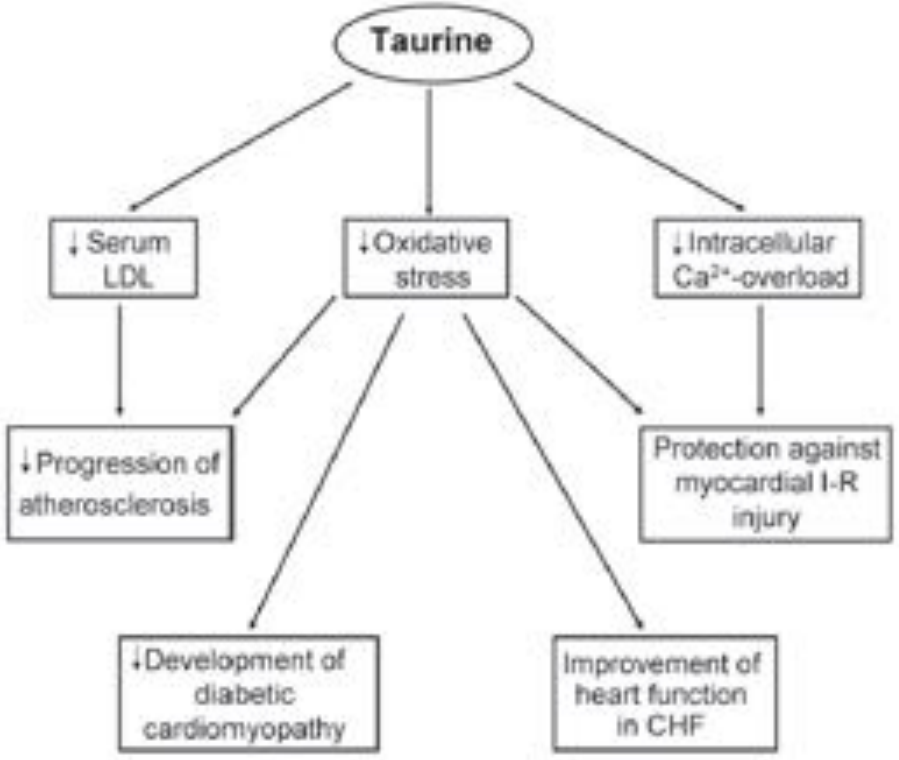
Although no minimum level of intake with adverse effect has been set for taurine, a recent risk assessment study designated the upper level of taurine supplementation at 3 g per day. This assessment was based on toxicological evidence from a review of all human clinical trials with taurine supplementation.

Regul Toxicol Pharmacol 2008;50:376–99

Taurine and cardiovascular system

There is a wealth of experimental information and some clinical evidence available in the literature suggesting that taurine could be of benefit in cardiovascular disease of different etiologies. However, double-blind long-term clinical trials need to be conducted before taurine can be unequivocally recommended as a nutritional intervention for the prevention and/or treatment of cardiovascular disease.





Exp ClinCardiol 2008;13(2):57-65

In 2006, almost 500 new brands of energy drinks were released worldwide. The energy drink industry is booming, with sales of energy drinks estimated to be over 12.5 billion USD in 2012, an increase of 60% from 2008 to 2012

In 2011, the European Food Safety Authority) commissioned a study to gather consumption data for energy drinks in 16 countries of the European Union. They found that 68% of adolescents (aged 10–18 years old), 30% of adults, and 18% of children (<10 years old) consumed energy drinks. The average consumption was 2 l in adolescents and 0.49 l in children

Mixing up energy drinks

Energy drinks are frequently mixed with alchool: 71% of adolescents who use ED usualy mix them with alchool.

The consumption of caffeinated EDs reduces drowsiness without diminishing the effects of alcohol resulting in a state of “wide awake drunkenness,” keeping the individual awake longer with the opportunity to continue drinking. Combining energy drinks and alcohol has also been associated with increased heavy drinking sessions and episodes of weekly drunkenness.

Similarly to alchool, illicit drugs like amphetamine or cocaine may be mixed with EDs with deleterious effects

Last, EDs may be mixed with other stimulants (ginseng, guarana, caffeine pills) resulting in caffeine intoxication

Energy drinks: getting wings at what cost?

No randomized trial exists on consumption of ED. Few case reports on atrial and ventricular arrhythmias as well as on myocardial ischemia inducted by ED raised concerns on safety of these beverages

Seifert et al. analyzed cases of **energy drink exposures reported to the US National Poison Data System** (NPDS) between October 1, 2010 and September 30, 2011:

- 4854 (0,2%) energy drink-related cases

- 1480 non-alcoholic energy drink cases, 50.7% were children < 6 years old; 76.7% were unintentional; and 60.8% were males.

The incidence of moderate to major adverse effects of energy drink-related toxicity was 15.2% and 39.3% for non-alcoholic and alcoholic energy drinks, respectively. Major adverse effects consisted of three cases of seizure, two of non-ventricular dysrhythmia, one ventricular dysrhythmia, and one tachypnea. Of the 182 caffeinated alcoholic energy drink cases, 68.2% were < 20 years old; 76.7% were referred to a health care facility.

Clin Toxicol (Phila). 2013 Aug

Acute effects of *Red Bull* energy drink on ventricular repolarization in healthy young volunteers: a prospective study

After an 8h fast, 50 young, healthy subject consumed 355 ml f Red Bull ED. As result Heart rate, diastolic and blood pressure increased after 1 and 2 hours but no other differences were found (no alteration in PR, QRS, QT, QTc, ST segment)

Table 3. Heart rate and electrocardiographic and blood pressure parameters before and after 2 h of energy drink (ED) consumption

	Before ED Mean±SD (n=50)	After 2 h ED Mean±SD (n=50)	*P* value
Heart rate, bmp	77.96±14.94	84.8±10.7	0.005
Systolic BP, mm Hg	112±6.1	121±7.4	0.006
Diastolic BP, mm Hg	73±5.3	76.3±6.2	0.008
PR interval, ms	167.2±26.1	171±28.5	0.71
QRS duration, ms	90.5±9.7	94±11.1	0.7
QT interval, ms	384.1±14.3	386±11.6	0.37
QTc interval, ms	406.4±20.6	417.4±24.7	0.34
Tp-e, ms	67.3±15.9	68.8±16.1	0.5
cTp-e, ms	69.3±16.8	71.2±15.9	0.53
Tp-e/QT	0.17±0.03	0.18±0.02	0.45
Tp-e/QTc	0.16±0.02	0.17±0.03	0.36

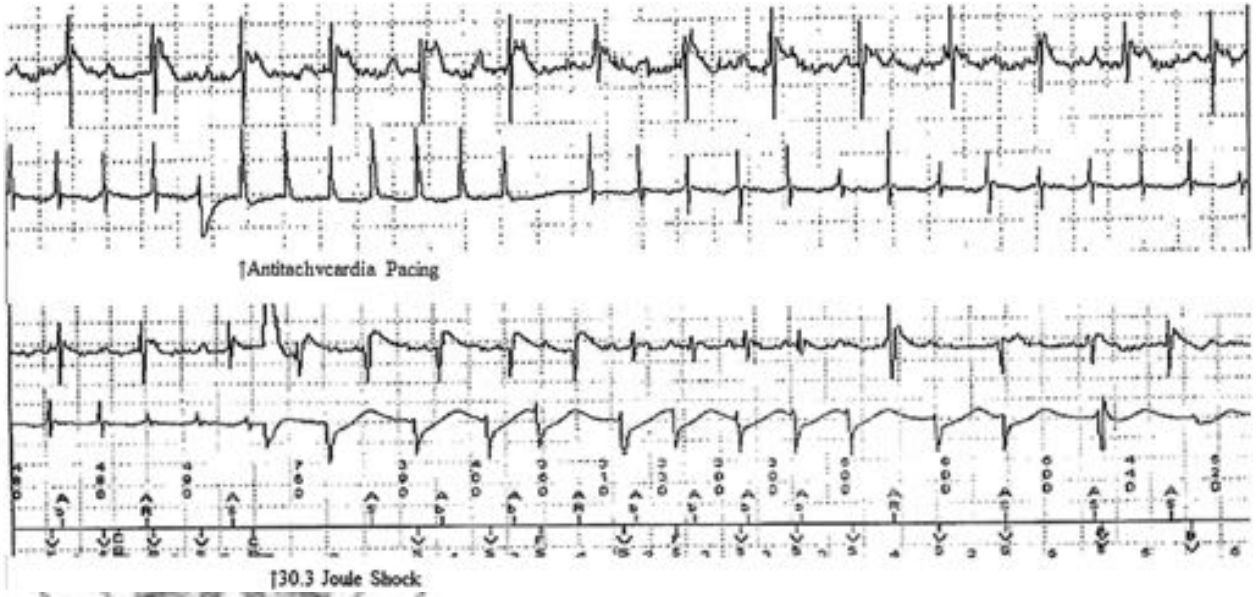
BP - blood pressure; bmp - beats/minute; ms - milliseconds; Tp-e - distance between the peak and the end of the T wave

Anatol J Cardiol. 2015 Mar 5

Energy Drink–Induced Near-Fatal Ventricular Arrhythmia Prevented by an Intracardiac Defibrillator Decades After Operative "Repair" of Tetralogy of Fallot

Alexandra E. Ward, MD[a], Steven E. Lipshultz, MD[b,*], and Stacy D. Fisher, MD[c]

A 45-year-old man who underwent "repair" of tetralogy of Fallot at the age of 5 years using a patch in the right ventricular outflow tract and had an automatic implantable cardiac defibrillator (AICD) placed at the age of 40 years reported to his cardiologist because of his first AICD shock. He had been hospitalized several times previously for heart failure. His left ventricular ejection fraction was approximately 25%. He awoke tired for an early workday and over 3 to 4 hours consumed 3 Red Bull energy drinks. The AICD shock occurred within 30 minutes after he finished the third drink



Am J Cardiol. 2014 Oct 1;114(7)

Consumption of energy drinks: A new provocation test for primary arrhythmogenic diseases?

Belinda Gray [a,b], Jipin Das K. [b,c], Christopher Semsarian [a,b,c,*]

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Three recent reports suggest that energy drinks can not only trigger cardiac events, but much like an exercise test, or an adrenaline or flecainide-challenge, can unmask an underlying primary pathogenic disorder, such as long QT (LQTS) or Brugada syndrome

Dufendach et al. reported a case of a 13-year-old girl who presented with palpitations and chest pain following consumption of an energy drink. She was noted to have a severely prolonged QTc (624 ms) on admission ECG that normalised the day after admission (453ms). The patient's energy drink consumption acted essentially as an adrenaline challenge test. Subsequently the patientwas diagnosed with familial LQTS type 1 and a KCNQ1 mutation identified. Two further family emberswere also diagnosedwith LQT-1 through genetic screening of first-degree relatives

Int J Cardiol. 2012 Aug 9;159(1)

Letter to the Editor

It took a Redbull to unmask Brugada syndrome

Michael Rutledge, Anthony Witthed, Rami N. Khouzam *

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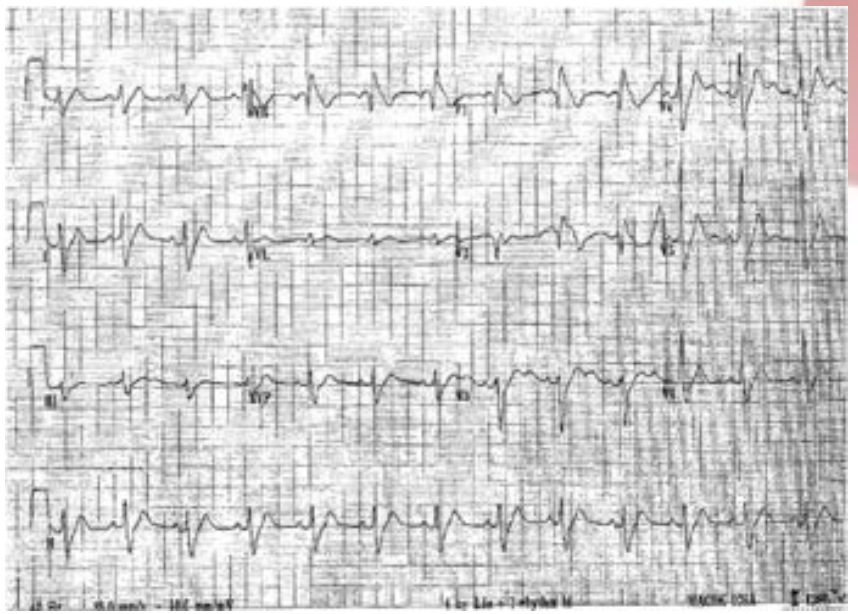
A 24 year old male with no previous medical history after consuming a Red Bull energy drink containing 80 mg caffeine and 1000 mg of taurine combined with Vodka collapsed after only a few sips. As he became unresponsive, a bystander began to perform CPR. Emergency Medical Services arrived and found the patient to be in VF. He was subsequently intubated and given amiodarone, and epinephrine. The patient was defibrillated 6 times, and he subsequently converted to sinus rhythm with demonstration of Brugada patern

The patient's family stated that he had a recent bout of diarrhea, but no other recent illnesses. It was reported that throughout the last year the patient has had occasional symptomatic palpitations, but no previous syncopal episodes.

Serum potassium was 2,7 mEq/l Blood alcohol level was: 0.017% (0.08%) and urine drug screen was negative.



Int J Cardiol 2012 Nov 1;161(1)

Letter to the Editor

Cardiac arrest due to long QT syndrome associated with excessive consumption of energy drinks

D. Rottlaender *, L.J. Motloch, S. Reda, R. Larbig, U.C. Hoppe

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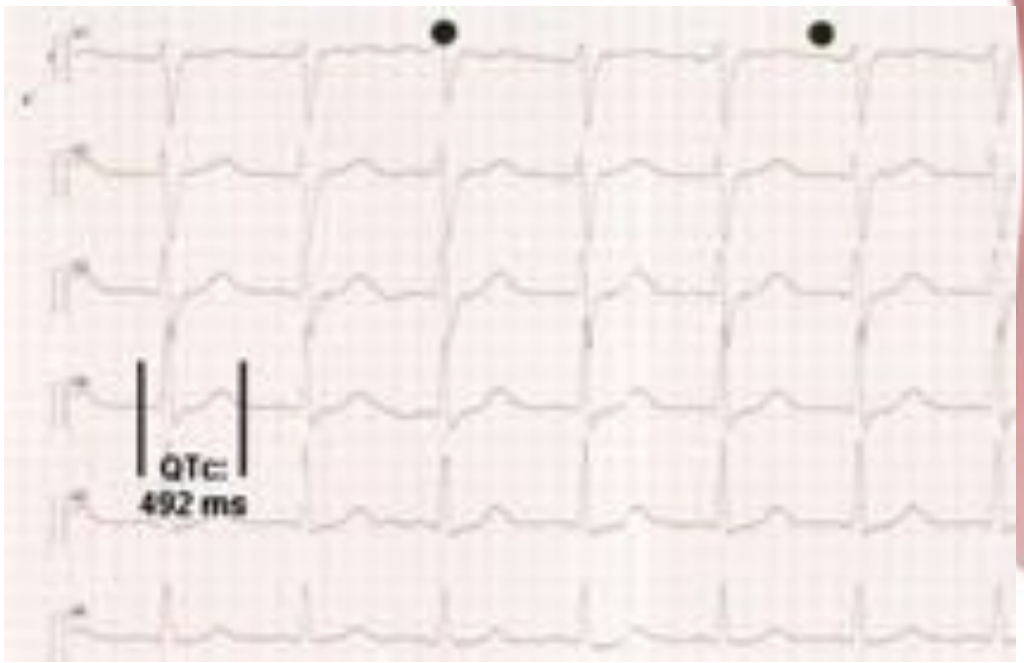
A 22 year old female experienced out of hospital cardiac arrest (OHCA) due to initial torsades de pointes tachycardia and secondary degenerating to ventricular fibrillation. Sudden cardiac death occurred without prodrome in a discotheque after consuming six can of caffeinated ED within 4 hours. Patient was resuscitated by EMS. At hospital admission QTc interval was 492 ms, indicating long QT syndrome. Three days after admission the QTc in follow-up ECGs was normalized (419 ms). Serum potassium was 4,4 mEq/l and urinary screening was negative for drugs.



Genetic testing revealed a LQTS-1 (KCNQ1 mutation).

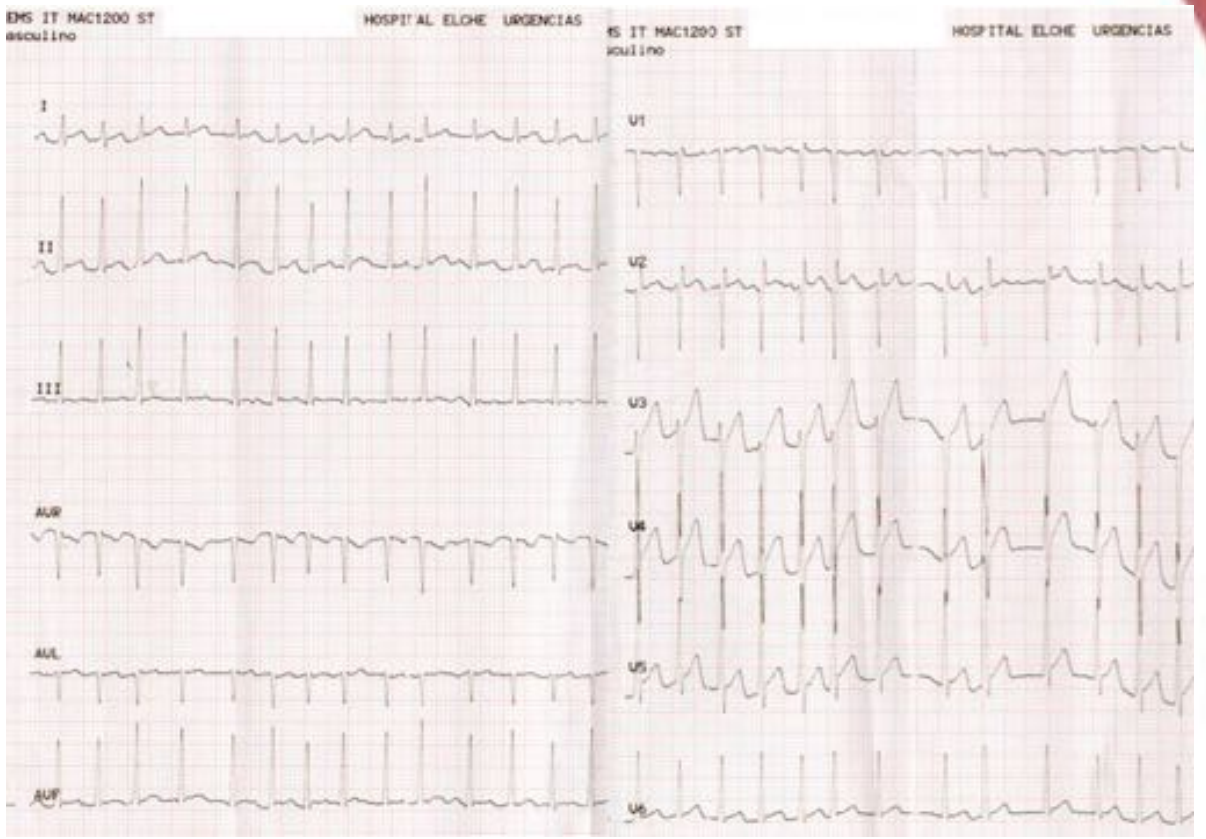
Int. J Cardiol 2012 Jul 26;158(3)

ED and atrial arrhythimias

A 13 year old boy during a football match referred palpitation, dyspnea and syncope (resolved spontaneusly). The patient was referred to ER and atrial fibrillation was found on EKG.

No family history of CVD, structural heart diseas or alterations in blood exams (including TSH and T4) were found during visit and echocardiography.

The patient referred usual consumption of ED and ingestion of a can of ED before the match (volume 250 ml caffeine 341 mg/l taurine 4g/l)



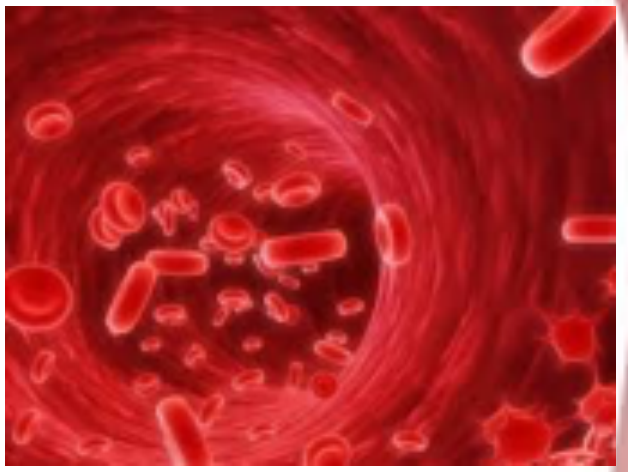
Izquierdo et al. An Pediatr (Barc). 2012 Dec;77(6):417-9

Di Rocco et al. reported two cases of two young adolescent, without structural heart disease, that presented AF after ingestion of uknown quantity of ED

J Med Case Rep 2011 Jan 19;5:18

Energy drinks and myocardial ischemia

Detrimental effects of energy drink consumption on platelet and endothelial function was tested on 50 healthy volunteers: platelet aggregation and endothelial function were tested before, and 1 hour after, the consumption of 250 mL (1 can) of a sugar-free energy drink. Platelet function was assessed by adenosine diphosphate-induced (1 micromol/L) optical aggregometry in platelet-rich plasma. Endothelial function was assessed via changes in peripheral arterial tonometry and expressed as the reactive hyperemia index (RHI).



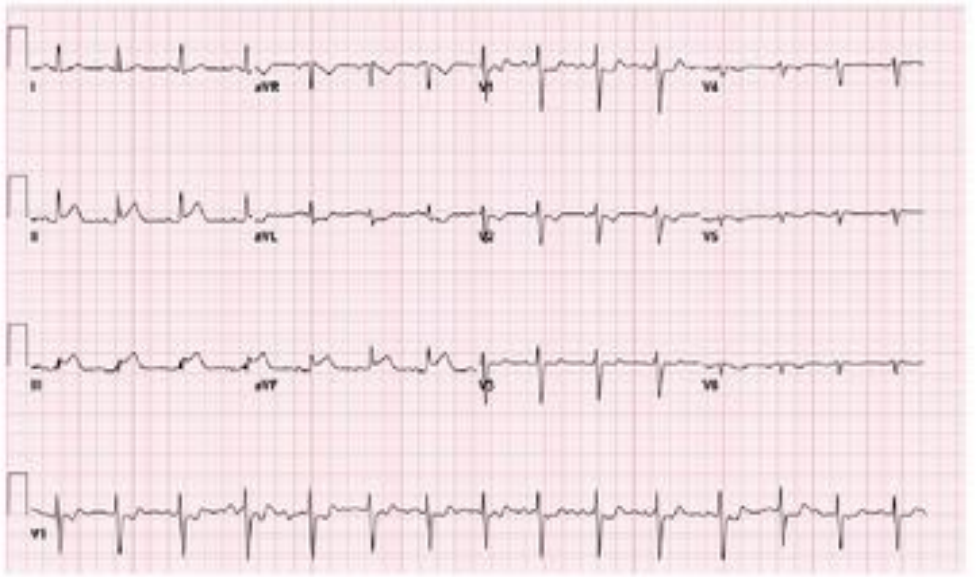
Compared with baseline values, there was a significant increase in platelet aggregation following energy drink consumption. Similarly, RHI decreased following energy drink consumption. Mean arterial pressure significantly increased following energy drink consumption, compared with control. Heart rate was unaffected by energy drink consumption.

Am J Med. 2010 Feb;123(2):184-7

Energy drinks and myocardial ischemia

Solomin et al. Reported a case of 26 year-old male with chest pain admitted to the emergency department following drinking **his usual quantity (about 4L)** of “Monster,” “Rock Star,” and other similar brands of energy drinks. Patient had inferior STEMI and underwemt cardiac catheterization and primary PCI on occluded circumflex coronary artery. No familiar history of CAD, structural heart disease or other CV risk factors but cigarette smoking (1 pack/die) were found. No illicit drugs were found on urine toxicology screening

Case Rep Emerg Med. 2015;



Shlomo HI et al. reported a case of 24-year-old Caucasian man presented to the ER with a one-hour history of crushing chest pain, nausea, and vomiting after consuming about 20 cans of energy drink (XL). Patient presented with widespread ST segment elevation and developed wide QRS tachycardia and VF resulting in arrhythmic death. Urine analysis resulted positive to MDMA

World J Emerg Med. 2012; 3(4)

American Journal of Emergency Medicine 31 (2013) 1624.e3–1624.e4

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Case Report

Death of a young man after overuse of energy drink

A 28-year-old-man admitted to emergency department with ventricular tachycardia. Patient had drunk 3 cans of 250-mL energy drink 5 hours before the basketball match; he had palpitation and nausea before the match. After 30 minutes of the match, during the break, patient lost his consciousness. On admission, normal cardiac rhythm was achieved by cardioversion after 15 minutes of CPR, and the patient was hospitalized. Patient did not awake during hospitalization (GCS =3; Brain TC was normal) and died on the third day of sudden cardiac arrest. No abnormal findings on EKG were found. Coronary angiography was not performed.

Why are energy drinks related to such adverse events?

- ✓ EDs are frequently mixed with alchool and stimulant drugs
- ✓ EDs overconsumption isn' t rare and binges of EDs leads to caffeine intossication
- ✓ Childrens are easily exposed to EDs, with higer probability of adverse events
- ✓ EDs toxicity may be henanced in the presence of underlying cardiac disease

Thank you

for your

attention