Caffeinated Energy Drinks

Risks Assumed With Consumption When Competing, Working, and Drinking

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Recently, we had a 21-year-old patient admitted for severe anxiety, resting tremor, and chest pain. An assessment revealed that the young man had consumed multiple caffeinated energy drinks and shots with alcohol. Caffeine toxicity was the discharge diagnosis and intoxication. All other drug screens were negative.

I was surprised how significant the symptoms were. Based on reports from the patient and his friends, the symptoms of tremor, nausea, and tachycardia occurred very soon after ingestion of multiple energy drinks in a short period. How common is caffeine toxicity? Why are there not more health warnings regarding use of these products? They certainly don’t appear dangerous.

Found in a wide variety of beverages and pharmaceuticals, caffeine is known for its thermogenic and appetite suppression properties. With an average half-life of 4.9 hours (can increase to 5–10 hours in women taking oral contraceptives), this adenosine and benzodiazepine receptor antagonist, phosphodiesterase inhibitor, and stimulant are the primary active ingredients in the explosion of energy drinks (EDs) in the marketplace.1,2 Typical EDs contain up to 300 mg of caffeine.3

Table 1 describes some of the ingredients added to EDs. Guarana, taurine, l-carnitine, ginseng, yohimbine, or cocoa and other unregulated contributions of caffeine are generally not accounted for in labeling because the elements are claimed as “dietary supplements.”1–3 Energy drinks may also contain vitamins, significant sugar, or artificial sweeteners. Marketed to improve energy, increase stamina, reduce fatigue, and enhance performance, EDs have become part of the cultural landscape.1–3

Evidence suggests that 30% to 50% of US teens consume EDs, and 62% drink at least 1 sports drink a day.4 In fact, consumption of EDs by children and adolescents is increasing at alarming rates, which may be a function of ignorance and/or intense media and Web marketing.4,5 With promises of relief from fatigue and energy for the long haul, the differences between sports versus EDs are increasingly becoming blurred. Sports drinks and EDs are not the same as described in Table 2.5–7

ENERGY DRINKS ARE NOT SPORTS DRINKS

Energy drinks have been described as “pharmacological Molotov cocktails” because of the combinations of ingredients such as of antianxiety elements (eg, taurine) and antidepressants (eg, inositol) that when used in combination with caffeine result in conflicted biochemical interactions.1 These biochemical interactions place excessive stress on kidneys, liver, and brain. Energy drinks are also called “energy parasites” because of the facilitated rapid release and depletion of adrenaline following consumption. Over a brief period, the consumer finds that another ED is needed to maintain energy or to find the “high” knowingly or unknowingly experienced after consumption of the first EDs. Because EDs are legal and socially acceptable, having another is not a problem.1

This picture is strangely familiar in that it mirrors the vicious cycles of dependency experienced with other substances of abuse. Remember too that the marketing and societal responses for cigarettes began in the same way.1
Even scarier is the relationship of caffeine use with anxiety and depression. Insomnia associated with caffeine use often precedes depression and other mental disorders because sleep is necessary to restore daily neurotransmitters for neurological and emotional health. Evidence suggests that rising use of EDs may be one explanation for the climbing rates of clinical depression and behavior disorders in young persons.1,2,8

ENERGY DRINKS WITH AND WITHOUT ALCOHOL

Binge drinking without EDs (defined as ≥4 drinks for women and ≥5 for men on 1 occasion) is already linked to greater than half the deaths related to excessive drinking and is associated with driving under the influence, interpersonal violence, and risky sexual behaviors.8

Mixing alcohol with EDs (caffeinated alcoholic beverages or CABs) has become a popular practice worldwide because the caffeine and other plant-based stimulants mask the depressant effects of alcohol. Even though the user “feels” awake and engaged while intoxicated, the pathways for liver metabolism, breath alcohol concentrations, and the harms of alcohol abuse are unchanged.8 In a recent study on student athletes (257 men and 144 women) regarding CAB use, of the 315 alcohol users, 92% participated in binge drinking, and 47.6% consumed CABs. Men and women were not different for CABs binging, which is defined as 3 or more CABs consumed during 1 occasion.9

In a recent randomized, double-blind, pretest-posttest design study, 18 volunteers aged 20 to 35 years received EDs with either 120 mg caffeine or 360 mg caffeine or placebo. The 120-mg caffeine dose did not significantly affect blood pressure or heart rate compared with placebo. However, the 360-mg dose had significant effects including

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### Table 1. Brief Description of Commonly Found Elements Found in Energy Drinks1–3

<table>
<thead>
<tr>
<th>Element</th>
<th>Type/Purpose</th>
<th>Toxicity Expression</th>
</tr>
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<tbody>
<tr>
<td>Caffeine</td>
<td>• Adenosine receptor antagonist</td>
<td>• Central nervous system stimulant&lt;br&gt;• Tachycardia, nausea, vomiting, increased intracranial pressure, cerebral edema</td>
</tr>
<tr>
<td>Yohimbine hydrochloride</td>
<td>• Herbal stimulant&lt;br&gt;• Aphrodisiac&lt;br&gt;• Treat erectile dysfunction</td>
<td>• Anxiety, rapid heart rate, panic attack, hallucinations&lt;br&gt;• Should not be consumed by anyone with kidney, liver, and/or heart disorders</td>
</tr>
<tr>
<td>Ginseng</td>
<td>• Ergogenic herb East Asia&lt;br&gt;• Aphrodisiac&lt;br&gt;• Enhance memory</td>
<td>• Insomnia, headache, nose bleeds, blood pressure alterations, nausea, breast pain&lt;br&gt;• Serotonin syndrome and exacerbation of extrapyramidal effects if mixed with antidepressants or other behavioral medications&lt;br&gt;• Vaginal bleeding&lt;br&gt;• Mania</td>
</tr>
<tr>
<td>Taurine</td>
<td>• Central nervous system amino acid for growth and regulation</td>
<td>• Increases dopamine production&lt;br&gt;• Improves locomotor activity&lt;br&gt;• Reduces alcohol-related amnesia&lt;br&gt;• Antianxiety activity by enhancing γ-aminobutyric acid receptors (gateway pathway for alcohol and drug abuse)&lt;br&gt;• Decreases blood pressure&lt;br&gt;• Used to treat alcohol withdrawal, heart failure, cystic fibrosis&lt;br&gt;• No evidence that exercise performance is improved with use</td>
</tr>
<tr>
<td>Guarana</td>
<td>• South American plant caffeine, theobromine, theophylline, and tannins</td>
<td>• Caffeine toxicity&lt;br&gt;• Caffeine dose is not always declared in labeling; therefore, actual caffeine amount may be higher</td>
</tr>
</tbody>
</table>

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### Table 2. Sports Drinks Versus Energy Drinks5–7

<table>
<thead>
<tr>
<th>Element</th>
<th>Sports Drinks</th>
<th>Energy Drinks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduced</td>
<td>1960s</td>
<td>1990s</td>
</tr>
<tr>
<td>Properties</td>
<td>• Carbohydrates&lt;br&gt;• Electrolytes (sodium, potassium, magnesium)</td>
<td>• High and unregulated amounts of caffeine&lt;br&gt;• Carbohydrates</td>
</tr>
<tr>
<td>Purposes</td>
<td>• Prevent dehydration&lt;br&gt;• Replace lost carbohydrates&lt;br&gt;• Replace lost electrolytes</td>
<td>• Improve energy&lt;br&gt;• Lose weight&lt;br&gt;• Provide stamina&lt;br&gt;• Improve performance&lt;br&gt;• Improve concentration</td>
</tr>
</tbody>
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increased mean systolic blood pressure (+9.0 mm Hg, \( P = 0.033 \)), diastolic blood pressure (+9.4 mm Hg, \( P = 0.042 \)) compared with placebo. Every subject who consumed 360 mg of caffeine experienced tachycardia, anxiety, and insomnia. Chain drinking of high-caffeine products puts persons significantly at risk, and additional symptoms can include agitation, tremors, and gastrointestinal distress.  

Of the 5448 US caffeine overdoses reported in 2007, 46% occurred in those younger than 19 years. Serious health effects are magnified in children, adolescents, and young adults with histories of seizures, mood or behavioral disorders, diabetes, hyperthyroidism, and cardiac disease, which may be a function of interaction with disease expression or interaction with the treatment pharmacotherapy. Of particular risk for cardiac events with ED use are children and adolescents with eating disorders or ADHD.

In a retrospective study of 7 years of ED and CAB exposure reports in an Australian Poison Control Center, evidence revealed rising reports of palpitations, agitation, tremors, and gastrointestinal upset. For the 297 exposures, the mean age was 17 years, and 57% of the sample was male with CABs being the most common substance ingested. Twenty-one patients experienced significant cardiac and/or neurological toxicity, and 128 required hospitalization. Sixty-two children ranging in age from 7 to 120 months with a mean of 38 months accidentally ingested EDs, of which 9 required hospitalization.

In another study of 5 men and 5 women (aged 19–30 years), heart rate variability was examined after consuming ED and CAB before maximal exercise on a bicycle ergometer for 30 minutes. Although no clinically significant arrhythmias occurred, postexercise recovery in heart rate was slower. Blunted cardiac autonomic modulation occurred after consuming EDs mixed with alcohol. Findings suggested there may be significant increase risks for malignant cardiac arrhythmia particularly in persons with congenital heart disease or those with cardiac autonomic dysfunction who consume CABs.

Finally, there may be significant risks to dental health with use of EDs. In an in vitro multiple exposure model comparing energy and sports drinks acidity and effect on enamel, the acidity of EDs was significantly higher compared with sports drinks (\( P < .001 \)), and both drink types were below the critical value of 5.5, below which enamel demineralization may occur. Enamel weight loss varied inversely with the pH of the drinks, and enamel weight loss was significantly higher after exposure to EDs compared with sports drinks.  

In a statement issued May 2, 2012, the American Beverage Association wrote that because the study was not conducted in human subjects, findings could not be applied to “real-life situations” and that EDs were never intended for children.

**CLINICAL NURSE SPECIALIST RESPONSES**

There is significant variance in caffeine and mixed chemical compositions in EDs and CABs which exert significant threats for toxicity.  

Energy drink caffeine levels can range from 50 to 505 mg per serving compared with a 12 oz cola that provides 34 to 54 mg caffeine. Particularly deceptive are the low-volume energy shots that can deliver 100 to 350 mg of caffeine in a few swallows.

When caring for adolescents and young adults, screen for EDs and CABs use and provide education on the risks regardless of the patient reports. Evidence suggests that persons who report greater ED consumption consumed more alcohol and more likely to consume CABs and have more episodes of heavy drinking. So, nonjudgmental screening for alcohol abuse is also required.

Caffeine in coffee drinks also varies. However, because coffee is generally consumed hot, caffeine consumption is slower compared with EDs. Combining alcohol with EDs or consuming CABs creates a wide awake drunk who greatly underestimates the level of intoxication and impairment. So persons drinking more may provide a significant foundation for future alcoholism.

Energy drinks have no therapeutic benefit, and many ingredients are understudied and unregulated. The known and unknown pharmacology of EDs and CABs as well as emerging evidence suggests there are significant risks to mental and physical health in the colorful and “hip” can or bottle found in the drive through, gas station, and grocery store. The clinical nurse specialist can teach the vulnerable and screen for consumption and toxicity especially in athletes and young adults who are drowning in media hype showing all the fun and none of the risk.

**References**


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