

# Acute Liver Failure Following One Year of Daily Consumption of a Sugar-Free Energy Drink

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## Abstract

We report a 36-year-old man who presented with 1 week of right upper quadrant abdominal pain, jaundice, and fatigue. He consumed 3 sugar-free energy drinks daily for the past year with binge alcohol use. His liver function progressively deteriorated, requiring orthotopic liver transplantation. Submassive hepatic necrosis with eosinophilic infiltrate was seen on pathology, consistent with drug-induced liver injury. Further investigation is warranted into identifying which individuals are susceptible to liver failure from energy drink consumption.

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## Introduction

Since the early 2000s, energy drinks have become an increasingly popular beverage choice in the United States, especially among adolescents and young adults.<sup>1,2</sup> In recent years, public concerns regarding increasing complications of these energy drinks has led to heightened media scrutiny of the safety profile of these products.<sup>3</sup>

## Case Report

A 36-year-old healthy white male presented with 1 week of right upper quadrant abdominal pain and jaundice. The patient reported that he was in good health until initial symptom onset 2 weeks prior. Since then, he reported fatigue, decreased appetite, and a 10-pound weight loss over the past year. The patient admitted to weekend binge alcohol drinking for the past 15 years, and drank 10 beers 3 hours prior to symptom onset. The patient denied taking herbal remedies, medications, or supplements. He noted that he was drinking 3 Rockstar energy drinks (Rockstar, Inc., Las Vegas, NV) per day for the past year. On physical exam, the patient was alert and coherent. He was jaundiced, had a single spider nevus on his back, and had a benign abdomen without ascites.

He was found to have abnormal liver tests with aspartate transaminase (AST) 1,541 U/L, alanine transaminase (ALT) 2,995 U/L, alkaline phosphatase 231 U/L, total bilirubin 16.1  $\mu\text{mol/L}$ , and international normalized ratio (INR) 1.0. Computed tomography (CT) showed a normal-appearing liver and no biliary dilatation. Liver values subsequently increased to AST 2,160 U/L, ALT 2,566 U/L, and total bilirubin 1.3  $\mu\text{mol/L}$  (Table 1). Laboratory investigation was negative for HIV, herpes simplex virus, varicella zoster virus, *Cytomegalovirus*, Epstein-Barr virus, hepatitis A, B, C, and E serologies, anti-LKM antibody, anti-soluble liver antigen, antinuclear antibody, anti-mitochondrial antibody, anti-smooth muscle antibody, acetaminophen/salicylate level, alpha-1 antitrypsin, and ceruloplasmin. Liver biopsy showed severe active hepatitis, bridging necrosis, and lymphocytic infiltrate with eosinophils, consistent with an herbal/drug-toxicity pattern.

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**Table 1.** Laboratory Values

Value	Reference Range	8 Days Prior to First Admission <sup>a</sup>	First Admission	Second Admission	Discharge 6 Days After Procedure
White blood cells, 1000/ $\mu$ L	4.16–9.95	4.3	3.6	4	7.5
Hemoglobin, g/dL	13.5–17.1	15.6	14.5	15.3	11.8
Platelets, 1000/ $\mu$ L	143–398	185	159	207	113
Creatinine, mg/dL	0.5–1.3	–	1	1.3	0.6
AST, U/L	7–36	1541	2253	1250	26
ALT, U/L	4–45	2995	2432	1004	114
Alkaline phosphatase, U/L	31–103	231	183	116	66
Total bilirubin, mg/dL	0.2–1.1	16.1	15.6	23.1	3.4
INR	N/A	1	1.6	3.7	1.1

ALT = alanine transaminase; AST = aspartate transaminase; INR = international normalized ratio.  
<sup>a</sup>At an outside hospital.

One week later, labs showed deteriorating liver function with INR 3.2, total bilirubin 23.1  $\mu$ mol/L, and creatinine 1.3 mg/dL. The patient began to show signs of hepatic encephalopathy, which was treated with lactulose and rifaximin. He had episodes of hypoglycemia requiring intravenous dextrose infusion. He was given a short course of steroids empirically for seronegative autoimmune hepatitis, but this was discontinued given lack of any therapeutic response. He underwent successful orthotopic liver transplant. Histologic evaluation of the explanted liver showed massive hepatocellular necrosis and parenchymal collapse in the context of extensive lymphocytic infiltrate with eosinophils, neutrophils, and plasma cells. No fibrosis was seen on trichrome stain.

## Discussion

Energy drinks contain many additives including caffeine, taurine, B-vitamins, and other ingredients (Box 1). Niacin (vitamin B3) has been shown to cause hepatotoxicity ranging from mild elevations in the aminotransferases to fulminant hepatic failure.<sup>4</sup> Available data suggest a greater than 50% chance of hepatotoxicity when doses of niacin exceed 2,000 mg/day.<sup>5</sup> Vivekanandarajah et al described a young woman who drank 10 cans of an energy drink over 2 weeks, resulting in acute hepatitis.<sup>6</sup> She had consumed 300 mg per day of niacin, and they concluded this was most likely the cause of her acute hepatitis. Our patient drank three 8-oz cans of the sugar-free Rockstar energy drink every day for

1 year, equivalent to 120 mg of niacin per day. This is lower than previously reported dosages of niacin causing hepatotoxicity, suggesting that perhaps a cumulative effect may have been involved in the development of liver failure, or that the patient's binge alcohol use made his liver more vulnerable to further injury. Previous studies have suggested that chronic alcohol ingestion induces CYP2E1, while niacin inhibits its activity.<sup>2,3</sup> The Maria and Victorino scoring system is used to determine causality in drug-induced liver injury and was applied to our patient, who presented with a score of 10 points, implying a "possible" causality for our patient's drug-induced liver injury.<sup>4</sup> Further investigation is warranted into identifying the mechanism and effects that these ingredients have on cytochrome activity, liver metabolism, and drug-induced liver injury.

## Disclosures

Author contributions: B. Huang performed the chart review, wrote the first draft of the manuscript, and is the article guarantor. D. Kunkel and M. El Kabany conceptualized and supervised this case report and made edits on subsequent drafts.

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### Box 1. Ingredients of Implicated Energy Drink<sup>a</sup>

Taurine	Vitamin B2 (Riboflavin)
Caffeine	Vitamin B3 (Niacin)
Inositol	Vitamin B5 (Pantothenic Acid)
L-Carnitine	Vitamin B6 (Pyridoxine)
Milk Thistle Extract	Vitamin B12 (Cobalamin)
Guarana Seed Extract	Panax Ginseng Root Extract

<sup>a</sup>Other ingredients include carbonated water, citric acid, natural and artificial flavors, sodium citrate, caramel color, benzoic acid, sorbic acid, acesulfame potassium, and sucralose.

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