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Cardiovascular Effects of Energy Drinks in Familial Long QT Syndrome: A Randomized Cross-Over Study

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ABSTRACT

Background: Caffeinated energy drinks may trigger serious cardiac effects. The aim of this study was to determine the cardiovascular effects of caffeinated energy drink consumption in patients with familial long QT syndrome (LQTS).

Methods and Results: From 2014–2016, 24 LQTS patients aged 16–50 years were recruited to a randomized, double-blind, cross-over study of energy drink (ED) versus control (CD) with participants acting as their own controls (one week washout). The primary study outcome was an increase in corrected QT interval (QTc) by >20ms. Secondary outcomes were changes in systolic and diastolic blood pressure.

In 24 patients with LQTS (no dropout), mean age was 29 ± 9 years, 13/24 (54%) were female, and 8/24 (33%) were probands. Intention to treat analysis revealed no significant change in QTc with ED compared with CD (12 ± 28 ms vs 16 ± 27 ms, 3% vs 4%, p = 0.71). The systolic and diastolic blood pressure significantly increased with ED compared to CD (peak change 7 ± 16 mmHg vs 1 ± 16 mmHg, 6% vs 0.8%, p = 0.046 and 8 ± 10 vs 2 ± 9 mmHg, 11% vs 3% p = 0.01 respectively). These changes correlated with significant increases in serum caffeine (14.6 ± 11.3 vs 0.5 ± 0.1 μmol/L, p < 0.001) and serum taurine (737 ± 199 vs -59 ± 22 μmol/L, p < 0.001). There were three patients with dangerous QTc prolongation of ≥50ms following energy drink consumption.

Conclusion: Caffeinated energy drinks have significant haemodynamic effects in patients with LQTS, especifically an acute increase in blood pressure. Since dangerous QTc prolongation was seen in some LQTS patients, we recommend caution in young patients with LQTS consuming energy drinks.

1. Introduction

Caffeinated energy drinks may cause life-threatening arrhythmias amongst individuals with no previous history of heart disease [1–3], and can unmask an underlying primary arrhythmogenic disease such as familial long QT syndrome (LQTS) [4–7]. The haemodynamic effects of energy drinks in healthy young adults has been previously assessed with varying results, including increased blood pressure, but no change in heart rate [8–10]. Energy drinks may have specific adverse cardiovascular effects in patients with primary arrhythmogenic diseases, including risk of arrhythmias and other haemodynamic effects, especially in those exacerbated by adrenergic stimulation such as in LQTS.

Few studies have systematically assessed the cardiovascular effects of caffeinated energy drinks in higher risk disease populations. This study sought to assess the acute cardiovascular responses to energy drink consumption in patients with LQTS compared to placebo control, and to determine whether any identified cardiovascular effects correlate with changes in blood levels of the active ingredients, caffeine and taurine.

2. Methods

2.1. Patient Selection

LQTS patients aged 16–50 years were recruited between 2014 and 2016 from the Genetic Heart Disease Clinic at Royal Prince Alfred Hospital, Sydney Australia, and the Australian Genetic Heart Disease

Abbreviations: LQTS, long QT syndrome; QTc, corrected QT interval; ED, energy drink; CD, control drink; ECG, electrocardiogram.

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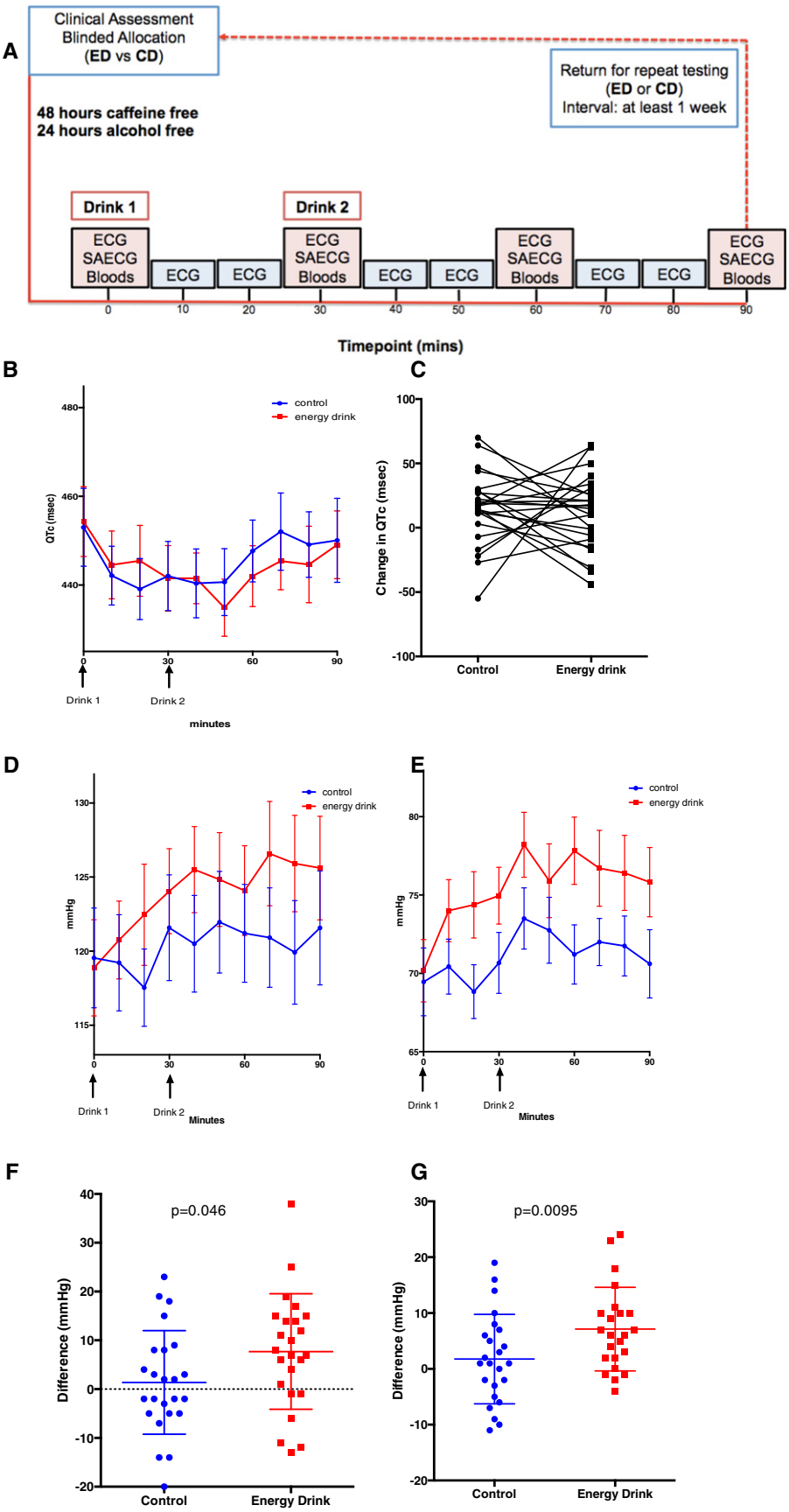

Fig. 1. **(A)** Study Protocol: Randomized, double-blind, cross-over study with participants acting as their own controls (one week washout period). Participants received two doses of drinks at zero and 30 min and were observed for a total of 90 min. Comparison between energy drink and control drink: overall **(B)** QTc and **(C)** maximum change in QTc; overall **(D)** systolic and **(E)** diastolic blood pressure changes during the study; peak **(F)** systolic and **(G)** diastolic blood pressure changes (paired *t*-test). Results shown as mean ± SEM. ED - energy drink, CD - control drink, ECG - electrocardiogram, SAECG - signal averaged ECG, Bloods - caffeine and taurine levels