

A case of taurine-containing drink induced anaphylaxis

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Taurine is one of most abundant free amino acids in mammalian tissue. It has been used for various health functional foods as a main ingredient in food industry. A 33-year-old female patient repeatedly experienced generalized itching, urticaria, dyspnea and dizziness after drinking taurine-containing drinks. The patient showed positive response to oral challenge tests with taurine-containing drinks. The patient also showed positive response with synthetic taurine but not with natural taurine. Skin prick test and basophil activation test with the synthetic taurine were negative. To our knowledge, there has been no report of taurine-induced hypersensitivity reactions. We herein report the first case of taurine-containing drink induced anaphylaxis, especially by synthetic taurine.

Key words: Anaphylaxis; Taurine; Energy drinks

INTRODUCTION

Since 19th century taurine was originally isolated from ox bile, many investigators have made an effort to elucidate the physiologic role of taurine and its beneficial effects [1]. It has been reported that taurine was associated with lower cardiovascular disease risks, prevention of hypertension and therapeutic benefit in hypercholesterolemia on several epidemiologic and

experimental studies [2]. Because of the variable evidence for the beneficial effects of taurine supplementation, taurine has been used extensively for health functional foods. The combination of taurine and caffeine in energy drinks has been known to have synergic effect on cognitive performance [3]. To our knowledge, there has been no report of taurine-containing energy drink induced allergy to date. Here, we report a case of taurine-containing drink induced anaphylaxis, which was confirmed

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by oral provocation with taurine-containing drinks and also with synthetic taurine.

CASE REPORT

A 33-year-old female patient visited allergy clinic in Seoul National University Bundang Hospital because of an event happened on her summer vacation. The patient experienced generalized itching, urticaria, dyspnea and dizziness 10 min after ingestion of a bottle (100 mL) of energy drink ("Drink A" in below) and then she was treated in the emergency department of a nearby hospital. She had experienced similar symptoms after drinking another beverage ("Drink B" in below) which was commonly used for hangover 2 years before the event.

When visiting our clinic, the patient had no remained symptom and showed no abnormality on the physical examination. Complete blood count, liver function test, renal function test and serum electrolytes were within normal limits and serum total IgE level was elevated to 685 IU/mL. History of food allergy and any other diseases were denied by the patient. There was no family member of food or respiratory allergy and she was working at a bank.

The first, oral challenge test with Drink B was performed to ascertain that the patient had allergic reaction actually. At 50 min after ingestion of 50 mL, the patient complained of itching on her both palms with erythema. At 90 min, she had facial itching and angioedema on her lips. We concluded that the oral challenge test

was positive. We investigated the common ingredients in Drink A (synthetic taurine 20 mg/mL) and B (synthetic taurine 20 mg/mL), and found that both drinks contain synthetic taurine and nicotinamide (the maximum dosages are 2,000 mg and 50 mg, respectively). Oral challenge test with synthetic taurine, natural taurine and nicotinamide were performed on different days. The laboratory in the manufacturing company of Drink B offered us synthetic taurine, natural taurine and nicotinamide in powder form. On the test with synthetic taurine, she had itching on her face and palm with erythema at 30 min after ingestion of 1,000 mg synthetic taurine. We performed oral challenge test with another taurine-containing energy drink ("Drink D" in Table 1) which the patient never had drunken, and the result was positive. However, the patient had no symptom or sign with 1,500 mg natural taurine and 45 mg nicotinamide as the cumulative dose. Skin prick test with synthetic taurine and natural taurine (20 mg/mL, the same concentration with Drink A) showed negative responses. Basophil activation test was performed with various concentrations of synthetic taurine (0.2-20 mg/mL), but the results were negative. The results of allergy tests were summarized in Table 1.

Although we could not elucidate the mechanism of hypersensitivity reaction in this patient, the results of oral challenge test indicated that her symptoms were associated with synthetic taurine. The patient was diagnosed as synthetic taurine related anaphylaxis and advised life-long avoidance of synthetic taurine containing beverage.

Table 1. Summary of the patient's allergy test results

Test	Result	Symptom and sign
Skin prick test		
Synthetic taurine*	Negative	Wheal size 1 × 1 mm, flare (-), (Histamine 3 × 3 mm)
Natural taurine*	Negative	Wheal size 0 × 0 mm, flare (-)
Oral provocation test		
Drink B (Synthetic taurine 20 mg/mL)	Positive	At 50 min after drinking 50 mL (1,000 mg of synthetic taurine), itching and erythema at palms At 90 min, facial itching and lips angioedema
Drink D [†] (Synthetic taurine 4 mg/mL)	Positive	At 30 min after drinking 250 mL (1,000 mg of synthetic taurine), whole body itching At 90 min, lips angioedema and dyspnea
Synthetic taurine	Positive	At 30 min after ingestion of 1,000 mg, itching on face and palm with erythema At 60 min, itching on face and chest discomfort
Natural taurine	Negative	No symptom and sign (up to ingestion of 1,000 mg)
Nicotinamide	Negative	No symptom and sign (up to ingestion of 25 mg)

*20 mg/mL in normal saline. [†]Drink D: another energy drink containing synthetic taurine which the patient never had drunken.

DISCUSSION

Taurine is one of the most abundant free amino acids in all mammalian tissue, and it is not an amino acid in the usual meaning as a component of protein, called an amino acid in the meaning of an acid containing amino group [4, 5]. Taurine is mainly biosynthesized from cysteine in the liver, known to have many important roles such as conjugation of bile acids, antioxidation, osmoregulation, detoxification, membrane stabilization and modulation of calcium reflux [4, 6]. Also, it contributes to cardiovascular function, and development and function of skeletal muscle, retina and central nervous system [7].

Taurine presents naturally in food, especially in meat and seafood. Although the mean daily intake from diet was reported to be less than 400 mg/day in several studies [8, 9], the European Food Safety Authority reported that up to 1,000 mg/kg/day of taurine have no adverse effects. In Korea, popular energy drinks generally contain 2,000 mg taurine in one bottle (100 mL). Most energy drinks sold in worldwide contain 1,000 mg taurine. By literature searching, there is no available data about toxicity or hypersensitivity of taurine in human. Only a few studies reported that excess dosage of taurine led to haemosiderine deposition in the lung [10] or fatty infiltration of the liver [11] on animal experiments.

Our patients showed hypersensitivity reaction with synthetic taurine, but in the test of natural taurine, she had no symptom. We could not find other case of anaphylaxis to synthetic amino acid. There are just a few reports on anaphylaxis caused by compound amino acid solutions. Although the authors could not elucidate the mechanism of anaphylaxis, they suggested the additives for stabilization of amino acid like sulfites, butylates hydroxyanisole, butylated hydroxytoluene, polysorbate emulsifier could be the cause of symptoms [12, 13]. As an example of difference in synthetic and natural materials, Smith et al. [14] reported a case of recurrent anaphylaxis only to synthetic folic acid, but not to dietary folates. They postulated that synthetic folic acid acted as a hapten with different mechanism from dietary folates. Although taurine is only small molecular weight of amino acid, not a peptide, it seems that only synthetic taurine is intolerable to our patient by unknown mechanism. Our patient showed positive responses in oral challenge test with synthetic taurine-containing drinks and synthetic taurine, but skin prick test and basophil activation test with synthetic taurine were negative. Most synthetic taurine used in the food products and drinks are prepared by amination

at elevated pressure of isothionic acid salt from ethylene oxide and sodium hydrosulfite [15]. Synthetic taurine might be slightly different from original natural taurine through its industrial processing and some hidden materials happened to be contained within it. However, as far as we know, synthetic taurine is not different from natural taurine in its molecular structure, and the purity of synthetic taurine we used was nearly 100%.

Hence we postulated that anaphylaxis in this patient was caused by non-immunologic mechanism or by haptization. Recently, as the consumption of energy drinks increase, the safety of ingredients of energy drinks has been of concern worldwide. We hereby reported the first case of taurine-containing drinks induced anaphylaxis, especially by synthetic taurine.

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