CASE REPORT

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A Case of Hypokalemia-induced Rhabdomyolysis Caused by Licorice Root Consumption

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ABSTRACT Licorice root is a plant that is consumed widely, especially in the east of Turkey. Licorice originates from the Glycyrrhiza glabra root, which has an herbal component called glycyrrhizic acid, and has a mineralocorticoid-like effect. Chronic liquorice consumption causes a condition similar to the one observed in primary hyperaldosteronism. Biochemical experiments show that 11-hydroxysteroid dehydrogenase, the enzyme responsible for inactivating cortisol, is inhibited by glycyrrhizinates. Consequently, excessive intake of licorice can cause a syndrome similar to hypermineralocorticoidism, characterized by sodium and water retention, hypertension, hypokalemia, metabolic alkalosis, low-renin activity, and hypoaldosteronism. In this article, we present a case of muscle weakness, hypokalemia, rhabdomyolysis, and hypertension due to excessive licorice consumption.

Keywords: Hypokalemia; licorice root; rhabdomyolysis

Licorice is a frequently consumed plant, especially in eastern Turkey during the hot seasons. This is a medicinal herb, which has been used for centuries for health benefits. We present a case of muscle fatigue, hypopotassemia, rhabdomyolysis and secondary hypertension due to excessive intake of licorice, which has been treated with potassium replacement.

CASE REPORT

An 80-year-old male patient applied to the hospital with weakness of the extremities for two weeks. The patient stated that he had been drinking one glass of licorice root extract for ten days two weeks ago, and his complaints started after the licorice root consumption progressing over time.

He had a history of hypertension and coronary artery disease for twenty-three years. In 1996, he was operated for coronary artery disease. He has been treated with 10 mg perindopril, 10 mg amlodipine and 100 mg acetylsalicylic acid daily.

At admission, his body temperature was 36.0°C, blood pressure was 181/70 mmHg, and pulse rate was 91 beats/min. Physical examination revealed right arm and right leg muscle strength as level II. There was no specific finding except muscle weakness. Metabolic alkalosis was present in the patient's arterial blood gas analysis. Hemoglobin was 15.3 g/dL. Serum creatinine level was found to be 1.4 mg/dL (range 0.7-1.2 mg/dL). Serum creatine kinase >42,670 U/L (range: 30-200 U/L), myoglobin > 1,200 ng/mL (range: 0-154.9 ng/mL), creatine kinase-MB 35.5 ng/mL (range: 0-5.2 ng/mL), and troponin I 104.7 pg/mL (range: 0-34.2 pg/mL) were measured. ALT was 311 U/L (range: 0-55 U/L), AST was 870 U/L (range: 5-34 U/L) and LDH >1,995 U/L (range: 125/220 U/L). Thyroid function tests were within the reference ranges. Magnesium level was found to be 1.7 mg/dL (range: 1.6-2.6 mg/dL). In addition, serum potassium level was measured as 1.7 mmol/L (range: 3.5-5.1 mmol/L). The electrocardiographic changes at presentation were consistent with hypopotasemia. After the blood results were evaluated, potassium

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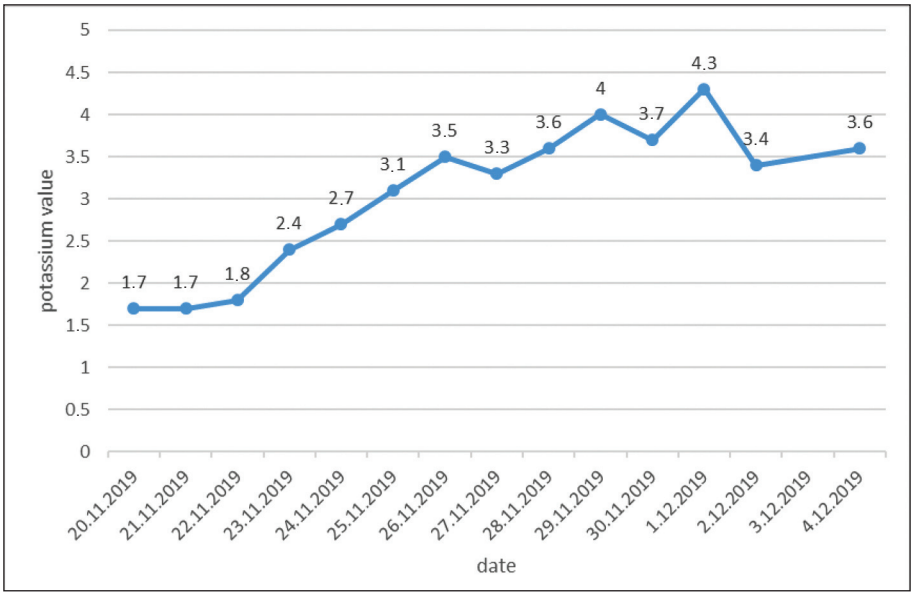

FIGURE 1: Potassium value change by date.

TABLE 1: The biochemical levels at admission and after treatment.

Biochemical parameters	Admission	After treatment	Range
Creatinine (mg/dL)	1.4	0.8	0.7-1.2
Potassium (mmol/L)	1.7	4	3.5-5.1
Magnesium (mg/dL)	1.7	1.7	1.6-2.6
Calcium (mg/dL)	7.7	8.8	8.4-10.6
ALT (U/L)	311	39	0-55
AST (U/L)	870	21	5-34
LDH (U/L)	>1,995	245	125/220
Creatine kinase (U/L)	>42,670	192	30-200
Creatine kinase-MB (ng/mL)	35.5	21.5	0-5.2
Troponin I (pg/mL)	104.7	18.8	0-34.2
Myoglobin (ng/mL)	>1,200	85	0-154.9

chloride (KCl) infusion (10 mmol/h) and spironolactone (100 mg/day) were started. Two litres of 0.9% sodium chloride (NaCl) was were given intravenously per day. After treatment, the patient's quadriparesis entirely healed within 4 days. KCl infusion was terminated and potassium citrate tablet (once daily) was started. After approximately one week of therapy, serum potassium levels and blood pressure returned to normal (Figure 1). Serum creatinine level decreased to 0.8 mg/dL. The biochemical parameters at admission and after treatment are shown in Table 1. Then the treatment was completed. Electromyographic analysis was normal after treatment. The patient was hospitalized for a total of 15 days, including 10 days in the intensive care unit.

Written consent was obtained from the patient for publishing case report.

DISCUSSION

Liquorice is a very ancient plant widely used in the East for millennia.[1] It is also widely used in the East Region of Turkey. Licorice is the root of *Glycyrrhiza glabra*. Glycyrrhizic acid is one of the primary active ingredients in licorice and has some cardioprotective features.[2] In addition, licorice has been known to have therapeutic effects. For example, licorice is useful to relieve cough, phlegm, dyspnea, spasms, and pain.[3]

Hypertension and hypokalemic secondary conditions are the main side effects of licorice and glycyrrhizic acid.[4]

Glycyrrhizic acid is hydrolyzed into glycyrrheteneic acid, in this way 11-β-hydroxysteroid dehydrogenase that converts cortisol to cortisone is inhibited. As a result, cortisol activates the renal mineralocorticoid receptors which cause excess production of mineralocorticoids.[5,6] This clinical condition typically occurs after 3-10 days of consumption.[7] No

drinking of more than 60-70 grams of licorice a day is recommended.[8]

This emerging situation resembles primary hyperaldosteronism and leads to hypertension and hypokalemia, by retention of sodium and increasing excretion of potassium. Hypokalemia associated with low plasma-level renin activity has been reported to result in death due to metabolic alkolosis and ventricular fibrillation.[9,10] An article presented by Kılınç et al. showed us that licorice root intake should be questioned in patients under investigation for secondary hypertension.[11]

Symptoms and findings similar to licorice intake can be observed in some genetic disorders such as Liddle, Bartter, Gittelman syndrome and hypokalemic periodic paralysis. But our patient did not have a previous history of similar symptoms, nor was there a family history. In addition, these genetic abnormalities were not considered based on the patient's age.

Licorice stimulates mineralocorticoid secretion reversibly and this stimulation usually heal within days, but can last for several weeks depending on the amount taken and individual susceptibility.[5]

At the time of admission, no licorice history was given by our patient. There were no other causes of hypopotasemia, such as vomiting, diarrhea, diuretic use, alcohol, herbal remedies and laxatives. Then, when the patient was asked again about the use of any drug or substance, he said that he used a glass of licorice extract for 10 days, about two weeks before admission, thinking it would be a remedy for kidney stone.

Our patient had weakness of the extremities. In a case report, an asymptomatic patient who has been drinking licorice for 18 months despite severe hypokalemia is presented.[12]

In a case presented by Celik et al., licorice was seen to have caused thrombocytopenia, sodium and water retention, edema, and hypokalemia, although the blood pressure raise was not observed.[13] In our patient, the platelet value was normal and the patient was hypertensive.

It is known that consumption of licorice may lead to cardiac arrhythmias. In a case presented, atrial fibrillation as provoked by low potassium levels resulting from consumption of licorice root syrup has been considered.[14] In another case report, it has been specified that licorice may cause pulmonary edema.[15] Atrial fibrillation and pulmonary edema were not observed in our patient.

In the first line of treatment, intake of licorice should be discontinued and replaced with potassium. Spironolactone, a potassium-sparing diuretic, and dexamethasone, which suppresses the development of endogenous cortisol, have to be used for further medical care.[5,10]

In the treatment of our case, we provided intravenous KCl replacement (10 mmol/h), spironolactone tablet (100 mg/d), and continued potassium replacement as potassium citrate tablets after KCl infusion was stopped.

Licorice is widely consumed in our country. However, we have little knowledge about its side effects such as muscle weakness, hypertension and rhabdomyolysis. We should raise awareness and take a detailed patient history.

Source of Finance

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Doğan Nasır Binici****; Design:*** ***C****anan Birdal, Hakan Alaca;* ***Control/Supervision:*** *Doğan Nasır Binici;* ***Data Collection and/or Processing:*** *Yücel Alaylar, Hakan Alaca;* ***Analysis and/or Interpretation:*** *Doğan Nasır Binici, Canan Birdal;* ***Literature Review:*** *Yücel Alaylar, Hakan Alaca;* ***Writing the Article:*** *Canan Birdal, Doğan Nasır Binici;* ***Critical Review:*** *Doğan Nasır Binici.*

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