INTERNAL MEDICINE

□ CASE REPORT □

Thyrotoxic Periodic Paralysis Induced by Pulse Methylprednisolone

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Abstract

We present a young Thai man who developed acute flaccid paralysis after receiving pulse methylprednisolone for chronic inflammatory demyelinating polyneuropathy. Hypokalemia from intracellular shift was confirmed by calculation of transtubular potassium gradient (TTKG). His muscle strength and serum potassium fully recovered with a small amount of potassium replacement. Graves' disease was subsequently diagnosed and treated with radioactive iodine. We suggest that acute paralysis after the use of steroids should raise a suspicion of thyrotoxic periodic paralysis (TPP). The potential mechanisms of steroid-induced TPP are discussed.

Key words: hypokalemia, thyroid periodic paralysis, steroid

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Introduction

Thyrotoxic periodic paralysis (TPP) is a disease characterized by acute and reversible episodes of muscle weakness due to a massive shift of potassium into cells in the presence of high levels of thyroid hormone (1). Despite the woman predominance of hyperthyroidism, TPP occurs more commonly in men at a ratio of 20:1 and 90% of patients are of Asian descent (2). Although the major cause of TPP-associated hyperthyroidism is Graves' disease, other causes have been reported (1). Attacks are precipitated by ingestion of carbohydrate-rich meals, alcohols, or strenuous exercise. In this report, we describe a 23-year-old Thai man suffering from a TPP attack after receiving high-dose methylprednisolone. The potential mechanisms of glucocorticoid-induced TPP are discussed.

Case Report

A 23-year-old Thai man was admitted for the second dose of pulse methylprednisolone for chronic inflammatory demyelinating polyneuropathy (CIDP). This was diagnosed 5 years prior due to onset of progressive weakness of both hands and legs without impaired sensation. Pulse methylprednisolone was added in his regimen, as well as intravenous immunoglobulin (IVIG) and azathioprine, in at effort to control his symptoms. His family history was unremarkable. Four hours after 1 G of pulse methylprednisolone infusion, he developed myalgia and fatigue which progressed to paralysis predominantly of both legs. A similar weakness episode and spontaneous resolution also occurred after the first dose of steroids but serum potassium and thyroid function tests were not done. On examination, the patient appeared thin and alert. His vital signs were as follows: temperature 36.9℃, blood pressure 110/70 mmHg, pulse rate 90 beats/min, and respiratory rate 17 breaths/min. There was slight diffuse enlargement of the thyroid gland. No exophthalmos, lid or stare was noted. Neurological examination revealed flaccid paralysis in both lower extremities in addition to pre-existing mild atrophy of intrinsic hand and foot muscles due to CIDP. Deep tendon reflexes were absent in all extremities. Laboratory data revealed a serum potassium of 2.1 mEq/l (3.5-5.1), hypophosphatemia (1.0 mg/dl, 2.7-4.5), and normal serum creatine kinase (59 U/l, 24-195). Transtubular potassium gradient (TTKG) index was low at 1.47. The patient did not have prior hypokalemia, polyuria, diarrhea or excessive perspiration. Other laboratory findings are shown in Table 1. Electrocardiogram showed flat T wave, right bundle branch block, and a prolonged QTc interval, 0.538 sec. His muscle strength and serum potassium (K^+ 3.9 mEq/l) were fully restored within 12 hours after ad-

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Table 1. **Laboratory Data on Admission**

Hematology		**Arterial blood gas**	
White blood cells	9,200/mm^3	pH	7.39
Red blood cells	522x10^4/mm^3	pO_2	92.5 mmHg
Hemoglobin	14.1 g/dl	pCO_2	36.7 mmHg
Hematocrit	42.5%	HCO_3^-	22.0 mEq/l
Platelets	25.4x10^4/mm^3	Base excess	-3.0 mEq/l
Blood Chemistry		**Hormonal Analysis**	
Glucose	132 mg/dl	FT_4	3.75 ng/dl
Blood urea nitrogen	29 mg/dl	FT_3	10.77 pg/ml
Creatinine	0.8 mg/dl	TSH	<0.005 μU/ml
Sodium	141 mEq/l		
Potassium	2.1 mEq/l		
Chloride	103 mEq/l		
Calcium	9.2 mg/dl		
Phosphate	1.0 mg/dl		
Albumin	3.7 g/dl		
Total protein	6.9 g/dl		
CPK	59 U/l		

ministration of 45 mEq of oral liquid potassium. Graves' disease was confirmed with elevated free thyroxine (3.75 ng/dl, 0.8-1.8), free triiodothyronine (10.77 pg/ml, 1.6-4.0), low TSH (<0.005 μU/ml, 0.3-4.1), and high radioactive iodine uptake, 82%. Methimazole and propanolol were administered. After discharge, I-131 therapy was persued and the patient remained in euthyroid state.

Discussion

Glucocorticoid therapy is frequently used in hyperthyroidism-associated conditions such as thyroid crisis or severe ophthalmopathy. However, hypokalemia is rarely reported. We reported an unusual presentation of TPP due to a high dose of glucocorticoids. The Naranjo probability scale indicated a possible relation between the patient's episode of TPP and his exposure to pulse methylprednisolone (3). Our database search identified only two cases with possible casual relation between steroid therapy and TPP attack (4, 5).

The principle biochemical abnormality during a TPP attack is hypokalemia (1). Pathophysiologic details of this transcellular potassium shift into the cells are, however, not well understood. It is believed to be related to increased Na^+/K^+-ATPase pump activity in skeletal muscle due to direct stimulation by thyroid hormone, β-adrenergic hormones and insulin. Glucocorticoids may induce hypokalemia from a transcellular potassium shift caused by several mechanisms such as an increased Na^+/K^+-ATPase pool in skeletal muscle (6) and steroid-induced hyperinsulinemia and hyperglycemia (7). Steroids can also cause muscle weakness from renal potassium loss (8) and myopathy (9). The present patient developed hypokalemia and weakness soon after glucocorticoid administration; hence the attack maybe explained by TPP and/or glucocorticoid effects. The low TTKG level in our patient indicated that renal potassium loss was not the primary cause of hypokalemia. Other losses from GI tract and sweat glands were not likely based on the patient's history.

The definitive treatment of TPP is to control the hyperthyroid state. Some authors recommend ablative thyroid treatment for susceptible patients. Hypokalemia will eventually correct itself by shifting out of the intracellular compartment. Potassium replacement is used to hasten recovery and prevent cardiac arrhythmias. During replacement, the patient needs to be carefully monitored due to a possibility of rebound hyperkalemia (1, 2). A nonselective β-blocker, propranolol, is considered to be a first-line agent in the treatment of acute TPP and in preventing attacks (10).

Conclusion

We reported an unusual case of TPP precipitated by the use of high-dose steroid. Acute paralysis, after the use of steroids, should raise a suspicion for TPP, especially in an Asian patient.

Conflict of Interest

The authors have no competing financial or personal interests.

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