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CASE REPORT

Thyrotoxic hypokalemic periodic paralysis as the initial manifestation of graves' disease

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ABSTRACT

Thyrotoxic periodic paralysis (TPP) is a rare, potentially life-threatening condition characterized by acute, symmetrical paralysis of proximal muscles coupled with severe hypokalemia, typically arising in the context of thyrotoxicosis, often associated with Graves' disease. We present a case of a 41-year-old male who exhibited sudden-onset quadriplegia following a week of muscle cramps. Initial assessments revealed profound hypokalemia (1.4 mEq/L) and electrocardiographic abnormalities consistent with arrhythmias. Diagnosis was confirmed through positive thyrotropin receptor antibodies and ultrasound findings indicating Graves' disease. The patient was treated with methimazole and propranolol, along with immediate potassium replacement. Remarkably, his motor function improved dramatically post-treatment, with normalization of ECG findings before discharge, highlighting the prompt responsiveness to management and the need for timely diagnosis of this condition. Given the serious implications of untreated hypokalemic periodic paralysis, including respiratory failure and cardiac complications, clinicians must maintain a high index of suspicion for TPP in patients presenting with acute muscle weakness and hypokalemia.

Keywords: Thyrotoxic periodic paralysis, Graves' disease, hypokalemia, acute muscle weakness, thyrotoxicosis complications.

INTRODUCTION

Thyrotoxic periodic paralysis (TPP) is a rare, life-threatening condition characterized by acute, symmetrical paralysis of proximal muscles associated with severe hypokalemia in patients with either known or undiagnosed thyrotoxicosis [1]. The severity of the disease can range from mild weakness to quadriplegia, with bulbar and ocular muscles generally spared in most cases. Patients may present with significant signs of thyrotoxicosis, such as palpitations, tremors, nervousness, unexplained weight loss, and excessive sweating. However, the presentation can vary, and patients may exhibit only mild symptoms of thyrotoxicosis or none at all (Table 1). Unlike hyperthyroidism, the disease is more frequently observed in males, with an average onset age between 20 and 40 years [2].

Various mechanisms are proposed to contribute to hypokalemia-induced paralysis. The most accepted theories include stimulation of Na-K ATPase activity by excessive thyroid hormones or a hyperadrenergic state, as well as intracellular potassium shift caused by hyperinsulinemia [3]. Certain forms of human leukocyte antigen (HLA) are more common in TPP, suggesting a possible immunological link. This association may indicate a connection between the immune system and the disease; however, it is unclear whether HLA directly causes TPP or merely increases susceptibility to Graves' disease, a known autoimmune condition [4].

Any cause of thyrotoxicosis can lead to hypokalemic periodic paralysis. The most common cause is Graves' disease, followed by toxic multinodular

Table 1. Thyrotoxic Periodic Paralysis Clinical Features

1) Young adult male
2) Sporadic
3) Recurrent acute paralysis episodes with complete recovery
4) Limb > trunk involvement
5) Triggered by excessive carbohydrate load, high-salt diet, alcohol, or exertion
6) Family history of hyperthyroidism
7) Clinical features of hyperthyroidism
8) Hypokalemia and reduced potassium excretion rate
9) Normal acid-base balance
10) Decreased phosphate excretion
11) Low-amplitude compound muscle action potential on EMG, unchanged after epinephrine administration

Table 2. Thyrotoxic Periodic Paralysis Etiology

1) Graves' Disease
2) Toxic Nodular Goiter
3) Solitary Toxic Nodule
4) Iodine-Induced Thyrotoxicosis
5) Excessive Exogenous Thyroxine Use
6) Lymphocytic Thyroiditis
7) TSH-Secreting Pituitary Adenoma
8) Amiodarone-Induced Thyrotoxicosis

goiter, solitary toxic nodules, iodine-induced thyrotoxicosis, excessive exogenous thyroxine use, thyroiditis, TSH-secreting pituitary adenoma, and amiodarone-induced thyrotoxicosis (Table 2) [5-7]. Common triggers of periodic paralysis episodes include consumption of carbohydrate-rich foods, intense physical activity, high salt/sodium intake, surgery, trauma, and medications.

This report aims to discuss the pathogenesis, clinical features, laboratory findings, differential diagnosis, and management of thyrotoxic hypokalemic periodic paralysis secondary to Graves' disease through a case presentation.

CASE REPORT

A 41-year-old male with no history of chronic illness presented to the emergency department with sudden-onset muscle weakness following a week of muscle cramps and numbness in his legs. Neurological examination revealed a nervous demeanor, flaccid quadriplegia, and global areflexia. Laboratory tests showed a dangerously low potassium level (1.4 mEq/L). Electrocardiogram (ECG) findings included arrhythmias, ST depression, QT prolongation, and U waves associated with profound hypokalemia (Figure 1). Advanced investigations for the etiology of hypokalemic periodic paralysis revealed thyrotoxicosis. The patient was diagnosed with Graves' disease based on positive thyrotropin receptor antibody (TRAb) findings and ultrasound evidence of increased thyroid size, vascularity, and hypoechogenicity in the parenchyma.

Treatment with methimazole (5 mg, three times daily) and propranolol (80 mg, three times daily) was initiated. Immediate oral and intravenous potassium replacement was administered to normalize serum potassium levels. Following

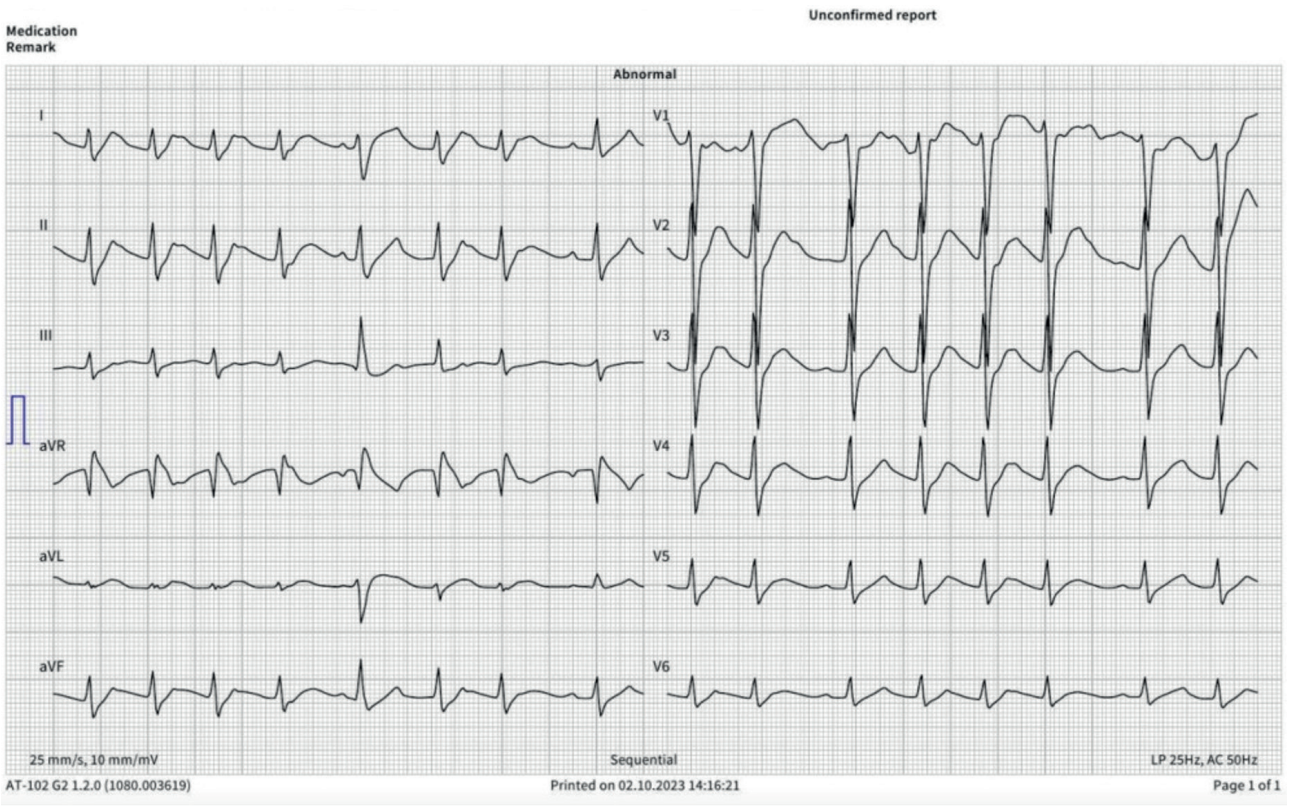

Figure 1. Patient's ECG

potassium normalization, the patient experienced a dramatic improvement in motor function, and ECG abnormalities resolved. The patient was discharged without any residual deficits.

DISCUSSION AND CONCLUSION

Thyrotoxic periodic paralysis (TPP) is defined by the triad of thyrotoxicosis, hypokalemia, and acute muscle weakness. It is most commonly associated with Graves' disease, an autoimmune thyroid disorder. TPP typically affects lower extremity muscles more than upper extremities, with sparing of trunk, ocular, bulbar muscles, and sensory systems. Fatal electrocardiographic findings such as arrhythmias due to hypokalemia may occur. Differential diagnosis should exclude non-thyrotoxic periodic paralysis and familial thyrotoxic periodic paralysis (Table 3) [5].

In the presented case, the rapid resolution of neurological symptoms following potassium replacement and thyrotoxicosis management highlights the treatable nature of the condition. However, untreated hypokalemic periodic paralysis can progress to respiratory failure, arrhythmias, or cardiac arrest, posing a significant risk to life [6]. Prompt diagnosis is therefore critical. Clinicians should thoroughly evaluate laboratory findings in cases of acute paresis and consider hypokalemic periodic paralysis in the differential diagnosis. It is

Table 3. Comparison of Thyrotoxic and Familial

Feature	Thyrotoxic Periodic Paralysis	Familial Hypokalemic Periodic Paralysis
Age (years)	20-40	<20
Gender Distribution	Predominantly male	Equal male-female
Inheritance	Sporadic	Autosomal dominant
Ethnic Background	Asian, American, Hispanic, Caucasian	Caucasian, Asian
Family History	History of hyperthyroidism	History of hypokalemic paralysis
Hyperthyroidism Clinical Signs	Yes	No
Genetic Predisposition	Related to Cav1.1 SNPs (e.g., c.4746G>A, intron mutations)	Cav1.1 mutations (e.g., R528H, R1239H, Na1.4 variants R669H, R672G, K3.4 R83H)

essential to remember that acute-onset tetraparesis may mimic several neurological disorders, with Guillain-Barré syndrome being the most common consideration.

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Conflict of interest

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