v. 5, n. 2, 2025

International Journal of Health Science

Acceptance date: 07/01/2025

THYROTOXIC HYPOKALEMIC PERIODIC PARALYSIS WITH SUPRAVENTRICULAR TACHYCARDIA AND HEMODYNAMIC INSTABILITY

Barbara Vargas Colla
Student of the Medical Residency Program Internal Medicine - Associação Beneficente de Campo Grande - Santa Casa, Campo Grande, Mato Grosso do Sul, Brasil

Milena Gabriela Santana Dalberto
Student of the Medical Residency Program Internal Medicine - Associação Beneficente de Campo Grande - Santa Casa, Campo Grande, Mato Grosso do Sul, Brasil

Thales Aquino Barros
Student of the Medical Residency Program Internal Medicine - Associação Beneficente de Campo Grande - Santa Casa, Campo Grande, Mato Grosso do Sul, Brasil

Eduardo Rafaga Gonçalves Calvoso
Advisor of the Medical Residency Program Internal Medicine - Associação Beneficente de Campo Grande - Santa Casa, Campo Grande, Mato Grosso do Sul

Abstract: Introduction: Thyrotoxic hypokalemic periodic paralysis is a potentially fatal and underdi- agnosed complication of thyrotoxic crisis, which usually occurs after large carbohydrate in- take or after a period of strenuous physical activity. Such conditions generate a stimulus to insulin secretion, affecting the sodium/potassium ATPase pump of musculoskeletal cell membranes, together with the B2-adrenergic release of thyrotoxic crisis, leading to severe hypokalemia and muscle paralysis. **Objective:** To describe a case of thyrotoxic hypokalemic periodic paralysis in a young patient. **Methods:** A 26-year-old black male patient presented with sudden ascending motor deficit associated with diffuse abdominal pain for 48 hours. On admission, supraventricular tachycardia was evidenced, with serum potassium levels of 1.5 mEq/L (3.5-5.5), and evolved with instability, requiring orotracheal intubation and intensive care. After improvement of the critical condition, in the Internal Medicine ward, he com- plained of generalized anxiety and tremors, progressing the clinical investigation he presen- ted FT4: 2.58 ng/dL (0.7-1.48), TSH: less than 0.01 mU/L (0.35-4.94), ANTI TPO: 97.38 U/mL (< 5.61), Thyroglobulin 71.9 ng/mL (1.6 – 59.9), thyroid ultrasound: thyroid with in- creased volume, showing signs of active thyroiditis. Treatment with Tapazol 20 mg and Pro- pranolol 40 mg was initiated every 12 hours, with total clinical improvement. **Final conside- rations:** Thyrotoxic hypokalemic periodic paralysis is considered a rare and potentially fatal condition, which is commonly underdiagnosed, but when diagnosed and managed correctly, avoids unfavorable outcomes.

Keywords: Paralysis; Hyperthyroidism; Hypokalemia; Thyrotoxic.

INTRODUCTION

Hypokalemic periodic paralysis can be primary, due to a genetic defect, or secondary, as a result of thyrotoxic decompensation. This is characterized by the triad of diffuse muscular paralysis, potassium deficit and thyrotoxicosis. During a crisis, fatal arrhythmias and muscle contraction or relaxation disorders may occur, due to dysfunction of the ion channels present in skeletal muscles.[1]

Thyrotoxic hypokalemic periodic paralysis (PPHT) is more common in male patients, aged 20-40 years, of Asian origin. However, in recent years there have been reports of involvement of different ethnicities, such as Afro--descendants, Latin Americans and North Americans, as well as females.[2]

Precipitating factors can be a diet rich in carbohydrates, strenuous exercise, expo- sure to cold, stress, use of medications (insulin, corticosteroids, diuretics), excess alcohol, trauma and surgery.[3]

The pathophysiology is still uncertain and is considered multifactorial, with a genetic and environmental component. The main mechanism described is excess thyroid hormone that sensitizes cells, causing beta-adrenergic stimulation of the sodium-potassium-ATPase (NA-K-ATPase) pump, which can cause its hyperactivation, as well as in situations of hyperinsulinemia. Thus, one of the main manifestations of PPHT, hypokalemia, is justified.1 The main differential diagnoses are Guillain-Barré syndrome, myasthenia gravis, metabolic myopathies, secondary hypokalemia (renal, gastrointestinal or other causes, such as Sjögren's disease), we must also exclude acute myelopathies, tick paralysis and botulism.[4,5]

Acute treatment should be potassium replacement with strict monitoring, the degree of weakness is proportional to the degree of hypokalemia. In addition to stabilizing other possible complications, such as arrhythmias. In refractory cases, the use of intravenous

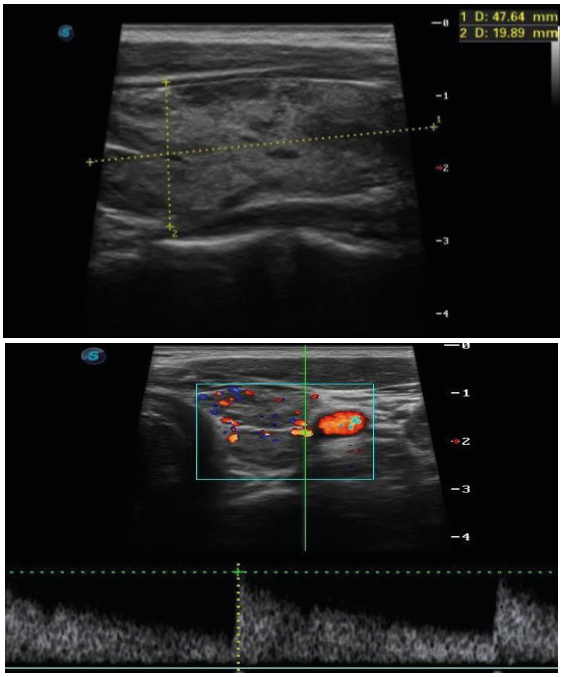
propranolol has been reported to resolve the weakness, as it is a beta adrenergic blocker, possibly inhibiting excessive stimulation of the NA-K-ATPase pump and reducing the level of intracellular potassium.[5]

CASE DESCRIPTION

Patient, A.R.M, male, 26 years old, brown skinned, bricklayer by profession, previously healthy, from Maracaju, Mato Grosso do Sul, was admitted to the emergency department of Santa Casa de Campo Grande due to a sudden, ascending motor deficit, starting in the lower limbs, progressing to the abdomen, chest and upper limbs, sparing the neck and head. Reported onset of the condition upon awakening. Added to the condition was diarrhea of 2 weeks evolution, weight loss of approximately 20 kg in the last 3 months.

Admitted to the critical patient area, where an electrocardiogram was performed showing supraventricular tachycardia, severe hypokalemia (serum potassium 1.5), in addition to worsening neurological deficit, presenting dysphagia and respiratory distress. Orotracheal intubation was chosen due to the lack of airway protection. Clinical stabilization and potassium replacement were performed. The patient was subsequently transferred to the Intensive Care Unit. After 48 hours, the patient was extubated and released to the Internal Medicine ward for investigation of the clinical condition presented.

The patient presented tremors at rest, reported diarrhea and weight loss, in addition to exophthalmos. Due to suspicion of thyrotoxicosis, laboratory tests were requested with the following results: T4L: 2.58 ng/dL (0.7-1.48), TSH: less than 0.01 mU/L (0.35-4.94), ANTI TPO: 97.38 U/mL (<5.61), Thyroglobulin 71.9 ng/mL (1.6 – 59.9). To investigate thyroiditis, a thyroid ultrasound was also performed, showing a topical thyroid gland with increased dimensions, irregular surface, and heterogeneous echotexture on mapping. On Doppler, a diffuse increase in the vascularization of the glandular parenchyma was noted. With the impression of a thyroid with increased volume and signs of active thyroiditis, as shown in the images attached below.



The patient began treatment for hyperthyroidism with propranolol 40 mg every 12 hours and metiamazole 20 mg per day, and was discharged on the tenth day of hospitaliza- tion, with complete remission of symptoms and follow-up in the endocrinology outpatient clinic.

DISCUSSION

PPHT is part of the cannulapathies family and is classified as a neuromuscular disorder that occurs due to changes in muscle ion channels, leading to muscle weakness.[4]

The pathophysiology of this condition has not yet been clearly elucidated. It is known that thyroid hormone increases beta-adrenergic stimulation, leading to greater function of the NA-K-ATPase pump in the skeletal muscle membrane. As a consequence, there is an influx of potassium into the cells, hyperpolariza-

tion of the muscle membrane and reduced excitability of muscle fibers. Thus, excess thyroid hormone further increases the hypokale- mic action of epinephrine and insulin.[5]

Insulin also plays a role in activating the NA-K-ATPase pump and may act synergistically with thyroid hormone. Thus, patients with insulin resistance and compensatory hype- rinsulinemia may trigger crises more easily than patients without this alteration. The same idea applies to understanding a meal rich in carbohydrates and the consequent increase in serum insulin levels as a triggering factor.[5,8]

Some studies suggest that individuals with PPTH may have an ion channel defect that does not manifest itself in cases of euthyroidism, but that in situations of thyrotoxicosis increases the risk of periodic paralysis, such as the expression of the KCNJ2 gene, which encodes Kir 2.6, a type of potassium channel regulated by thyroid hormone. The frequency of these genes varies in different populations, which may explain the higher prevalence in some ethnicities.[5]

Animal studies have shown that testosterone may also play a role in the pathogene- sis, since it also increases the activity of NA-K--ATPase, justifying the predominance of this condition in men.[5]

The manifestations of hypokalemia tend to persist when serum potassium levels are below 3.0 mEq/L, unless the patient has a potentiating factor (such as the use of digitalis to precipitate arrhythmias) or an abrupt drop in the baseline value.[6]

Muscle weakness generally begins with potassium concentrations below 2.5 mEq/L, and has an ascending pattern, with the lower limbs as the starting point, progressing to the trunk and upper limbs.[6]

Weakness of the respiratory muscles may be enough to cause respiratory failure and death. The muscles of the gastrointestinal tract may also be affected, causing paralytic ileus with all its attendant effects, as well as reports of association with intestinal pseudo-obstruction (Olgivie's syndrome).[6]

Severe potassium depletion can lead to cramps, rhabdomyolysis, and myoglobinuria. Cases of rhabdomyolysis may mask the severity of hypokalemia.[6]

Arrhythmias due to hypokalemia are diverse, such as premature atrial complex, premature ventricular beats, sinus bradycardia, paroxysmal or junctional atrial tachycardia, atri- oventricular block, atrial fibrillation, and ventricular tachycardia or fibrillation.[7] In addition, specific changes can be seen on the electrocardiogram, such as ST-segment depression, decreased amplitude of the T wave, and increased amplitude of the U waves that occur at the end of the T wave. Hypokalemia can also prolong the QT interval, and when associated with hypomagnesemia, it increases the development of torsades de pointes, especially in predisposed patients.[6]

Other effects mentioned are renal changes, such as hypokalemic nephropathy and glucose intolerance, through reduced insulin secretion.[7]

The diagnosis of PPTH is based on a set of clinical manifestations, laboratory chan- ges, and adequate response to treatment. That is, a picture with hypokalemia (K < 3.5 mEq/L) and thyrotoxicosis (FT4 0.7 - 1.48/TSH 0.35 - 4.94), in an individual with generalized muscle weakness, which responds to the instituted treatment. The degree of hypokalemia during an attack is variable, being more frequent at levels < 2.1 mmol/L, with the severity of the weakness corresponding to the hypokalemia indices. Other findings include mild hypophosphatemia (< 2.5 mg/dL) and hypomagnesemia (< 1.6 mg/dL).[4,5,13,14]

The goal of acute treatment is to improve potassium levels and treat complications. The initial replacement should bring the values to a safe level, after which continuous repla- cement is necessary over the course of days to

allow plasma and cellular balance.[6, 9, 10] In severe patients, it is ideal for replacement to be initially intravenous; a series of cases sho- wed faster recovery for those who underwent intravenous replacement.[12] Concomitant di- sorders, such as hypomagnesemia, should also be treated, as this can increase urinary potassium losses and reduce its serum concentration.6 In refractory cases, the use of intra- venous propranolol, a beta-adrenergic blocker, has been reported, which possibly inhibits excessive stimulation of the NA-K-ATPase pump and reduces the intracellular potassium level.[5]

As for preventive treatment, it is ideal to restore euthyroidism to eliminate crises.[14] Until this is established, non-selective beta--blockers, such as propranolol, can help reduce the frequency and severity of crises.5 In addition, it is essential educating patients on the subject, advising them to avoid strenuous exercise, intense exposure to cold, high carbohydrate intake, and recognizing episodes of crises.[11]

FINAL CONSIDERATIONS

The case report highlights the importance of early recognition of the disease to avoid unfavorable outcomes. Therefore, in the face of an acute case of flaccid muscle paralysis, it is pertinent to raise the hypothesis of PPTH, especially if associated with hypokalemia. In addition, adequate control of potassium levels and thyrotoxicosis is mandatory to resolve the clinical picture.

METHODOLOGY

STUDY DESIGN

As this is a case report, the study was observational and descriptive.

LOCATION OF RESEARCH

Medical Clinic Sector of the Santa Casa de Campo Grande Hospital/MS, Campo Grande/MS. Rua Eduardo Santos Pereira, 88, Centro, CEP 79002-251.

ETHICAL ASPECTS OF RESEARCH

The case report entitled: HYPOKALEMIC THYROTOXIC PERIODIC PARALYSIS WITH SUPRAVENTRICULAR TACHYCARDIA AND HEMODYNAMIC INSTABILITY, had its data kept confidential, in accordance with the provisions of Resolutions 466/12, 510/16 and 580/18 of the National Health Council, and supported by the General Law for the Protection of Personal Data 13.709/2018. It should be noted that data collection began after the appli- cation of the Informed Consent Form, with the knowledge and signature of the participant of the case report.

RISKS TO THE PARTICIPANT

The risks that may occur are the leakage, loss or incorrect handling of the data by the researcher. However, these risks will be minimized or suppressed by correct storage, which will be the responsibility of the researcher in charge. Furthermore, the data will be kept con- fidential, in accordance with the provisions of Resolution 466/12 and 510/16 of the National Health Council, and supported by the General Law on the Protection of Personal Data 13.709/2018.

BENEFÍTS TO THE PARTICIPANT

The participant was not granted any direct benefit, but the results will serve to improve the work plan and provide more qualified care for future patients who will be treated in this sector, as well as professionals who are not from this sector or even from the institution to learn about this type of condition and diagnose it earlier.

DISCLOSURE OF RESULTS

The results of this case report will initially be presented and disclosed to residents and preceptors of the Residency Program in Internal Medicine at ABCG Santa Casa. In addition, in the form of a scientific article in publications related to the area, oral presentation or banner at medical conferences.

REFERENCES

1. OLIVEIRA, N.F, et.al. Paralisia hipocalemica tireotoxica: revisão de li- teratura. Brazilian Journal of Surgery and Clinical Research. 2020: Vol.31, n1, pp 61- 64, Jun-Agosto.

2. LINLE, JM; PROTO, AL, Reconhecimento da paralisia periódica hipo- calêmica tireotóxica na emergência: relato de caso e revisão da literatura. Rev Soc Bras Clin Med. 2020; 18 (2): 95-9

3. ASSIS, T.J, et. al. Paralisia periódica hipocalêmica tipo 1: envolvimento dos canais de cálcio dependentes de voltagem. Rev Neurociências. 2012:20(4):588-96. doi: http://dx.doi.org/10.4181/RNC.2012.20.750.9p

4. GUTMANN, L; CONWIT, R (2023). Hypokalemic periodic paralysis. In Jeremy M Shefner (Ed.), UpToDate. Retrieved 03/08/2024, from https://www.upto- date.com/contents/hypokalemic-periodic-paralysis?search=paralisia%20perió- dica%20hipocalêmica&source=search_result&selec- tedTitle=1%7E19&usage_type=default&display_rank=1

5. GUTMANN, L; CONWIT, R (2022). Thyrotoxic periodic paralysis. In Je- remy M Shefner (Ed.), UpToDate. Retrieved 03/08/2024, from https://www.upto-date.com/contents/thyrotoxic-periodic-paralysis?search=parali-sia%20peri%C3%B3di-ca%20tireot%C3%B3xica&source=search_result&selec-tedTitle=1%7E14&usage_type=default&display_rank=1#references

6. MOUNT, DB (2024). Clinical manifestations and treatment of hypokale- mia in adults. In Richard H Sterns, Michael Emmett (Ed.); UpToDate. Retrieved 03/08/2024, from https://www.uptodate.com/contents/clinical-manifestations-and-tre-atment-of--hypokalemia-in-adults?search=MANIFESTACOES%20CL%C3%8DNI-CAS%20e%20tratamento%20da%20hipocalemia&-source=search_result&selec-tedTitle=1%7E150&usage_type=default&display_rank=1

7. Krijthe BP, Heeringa J, Kors JA, et al. Serum potassium levels and the risk of atrial fibrillation: the Rotterdam Study. Int J Cardiol 2013; 168:5411.

8. RUBIN, ID (2022). Neurologic manifestations of hyperthiroidism and Graves 'disease. Michael J Aminoff, Douglas S Ross (Ed.), UpToDate. Retrieved 03/08/2024, from https://www.uptodate.com/contents/neurologic-manifestations-of-hyperthyroidism-and-graves-disease?search=mani-festa%C3%A7%C3%B5es%20neurol%C3%B3gicas%20do%20hiperti-reoi-dismo&source=search_result&selectedTitle=3%7E150&usage_type=default&dis- play_rank=3

9. Gennari FJ. Hypokalemia. N Engl J Med 1998; 339:451.

10. Cohn JN, Kowey PR, Whelton PK, Prisant LM. New guidelines for po- tassium replacement in clinical practice: a contemporary review by the National Council on Potassium in Clinical Practice. Arch Intern Med 2000; 160:2429.

11. Cesur M, Bayram F, Temel MA, et al. Thyrotoxic hypokalaemic periodic paralysis in a Turkish population: three new case reports and analysis of the case series. Clin Endocrinol (Oxf) 2008; 68:143.

12. ROSS, DG (2023). Diagnosis of hyperthyroidism. David S Cooper (ED.). UpToDate. Retrieved 03/08/2024, from https://www.uptodate.com/contents/di-agnosis-of-hyperthyroidism?search=diagnosis%20of%20hyperthyroi-dism&source=search_result&selectedTitle=1%7E150&usage_type=default&dis- play_rank=1

13. YANG, L.J. et.al. Thyrotoxic periodic paralysis in the Chinese popula- tion: clinical features in 45 cases. Exp Clin Endocrinol Diabetes. 2010;118(1):22.

14. Chang CC, Cheng CJ, Sung CC, et al. A 10-year analysis of thyrotoxic periodic paralysis in 135 patients: focus on symptomatology and precipitants. Eur J Endocrinol 2013; 169:529.