Hypokalemic Periodic Paralysis and Renal Tubular Acidosis in Patient withHypothyroidism

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Abstract

Hypokalemiaperiodic paralysis (HPP) is a rare disorder characterized by acute muscle paralysis. Based on its etiology, HPP can be classified as primary and secondary types. One of the most common causes of secondary HPP is renal tubular acidosis (RTA) which may be also present in thyroid disease. We observed a case of a 48-year-old female, with complaints of weakness in both lower extremities for two days. Difficulties in walking and weakness in both arms were also present. Patient also experienced nausea, vomiting, and diarrhea 4 days before coming to the hospital. She had a history of thyroidectomy in 2009 and in 2019 was admitted for similar symptoms. Medication consumed by the patient were Euthyrox 100 mg one time daily and KSR 600 mg three times daily. In the last week, Euthyrox was discontinued by the patient due to her diarrhea. The patient's general condition was weak and vital signs were BP 120/80 mmHg, pulse 84 bpm, RR 18 times per minute and temperature was 36.6°C. Motoric strength was 4/4 in both arms and 3/3 in both legs. No pathological neurological reflexes were found during examination. Inverted T wave and prominent U wave were seen on electrocardiogram (ECG) results.Laboratory results showed hypokalemia (2.0 mmol/L), Blood Gas Analysis: Metabolic Acidosis (pH 7.42, pCO2 32 mmHg, HCO3 20.8 mmol/L, BE -3.7 mmol/L) with anion gap of 14.2 meq/L. Urinalysis results were pH 8, urinary anion gap 18.29 mmol/h. Decreased thyroid function was also shown in the endocrine laboratory panel FT4 0.57 ng/dl and TSH 32.097 IU/mL.HPP is a disorder characterized by muscle weakness and may be present in distal type RTA. Clinical symptoms of distal type RTA are hypokalemia, hyperchloremic metabolic acidosis, urinary pH <5.5. Distal type RTA can be caused by endocrine disorder i.e., hypothyroidism. Observation of patient condition and laboratory results lead to the conclusion that the patient is diagnosed with hypokalemic periodic paralysis and renal tubular acidosis based on hypokalemia, metabolic acidosis with normal anion gap, and alkaline urine with positive urinary anion gap.

Keywords: *Hypokalemia Periodic Paralisis, Renal Tubular Acidosis, Hypothyroidism.*

Introduction

Hypokalemia periodic paralysis is an autosomal dominant genetic disease characterized by sporadic muscle weakness that can cause respiratory muscle failure and can lead to death, however it is also marked by a decrease in the value of blood potassium (<3.5 mmol/L)[1,2]. The prevalence of periodic paralysis hypokalemia is 1:100,000. Hypokalemia periodic paralysis can be caused by primary causes, namely autosomal dominant and secondary dominant genetics such as excessive use of diuretic drugs, gastroenteritis, tubular renal acidosis, hyperaldosterone, Barter syndrome and hyperthyroidism.Hypokalemia periodic paralysis can often occur in hyperthyroidism and rarely occurs in cases of hypothyroidism[3]. Renal tubular acidosis(RTA) is a metabolic acidosis caused by failure of the kidneys (renal tubules) to excrete acid (H ions), disturbances in bicarbonate reabsorption, or both.RTA can be induced by primary causes due to gene mutation

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or secondary causes(acquired).RTA is divided into 3 types: distal, proximal and hyperkalemic[4,5].

Case Report

A female patient, 48 years old, came with complaints that both of her lower extremities felt weak since the last 2 days. The patient also complained that it was difficult to walk and that her arms also felt weak. Four days before admission to the hospital, the patient experienced nausea, vomiting and diarrhea. According to past medical history, in 2009 the patient received thyroidectomy and in 2019 the patient was admittedwith complaints of weakness in both lower extremities. Patient consumedEuthyrox 1×100mg and KSR 3×1,then stopped consuming Euthyrox 1 week after experiencing diarrhea.Physical examination showed that the general condition of the patient was weak, BP 120/80mmHg, pulse 84×/m, respiratory rate 18×/m, temperature 36.6°C, motor strength in the upper arm 4/4 and in both legs 3/3. Laboratory test results are shown in Table 1.

Table 1. Laboratory Test Results

Case	Results	Reference Range
Clinical Chemistry		
K (mmol/L)	2.0	3.5-5.1
Na (mmol/L)	141	135-145
Cl (mmol/L)	106	98-105
BUN(mg/dL)	13	7-18
Alb(g/dL)	3.7	3.4-5.0
AST (U/L)	10	15-37
ALT (U/L)	41	12-78
Blood Gas Analysis		
pH	7.42	7.35-7.45
pCO2 (mmHg)	32	35-45
HCO3(mmol/L)	20.8	22.0-26.0
BaseExcess (mmol/L)	-3.7	-2-2.0
Anion Gap (mEq/L)	14.2	8-16
Immunology Analysis		
FT4	0.57	0.89-176
TSH	32.097	2-12: 0.64-6.27 12-18:0.51-4.94 >18: 0.55-4.78
HbsAg	**Non-Reactive**	Non-Reactive
Urinalysis		
pH	8.0	
Potassium (mmol/24jam)	33.79	35-80
Natrium (mmol/24jam)	151.9	30-300
Chloride (mmol/24jam)	167.4	85-170
Phosphate (mgh/24jam)	314.65	300-1000
Calcium (mg/24jam)	141,05	50-400
Coagulation Test		
PPT (s)	9.0	9-12
APTT (s)	21.8	24.9
EKG	**T waveinversionand prominentU wave**	

Table 2. Hematology Results

Case	Results	Reference Range
Hematology		
WBC (×103/µL)	16.11	4.1-11.0
% Neu	67.7	47-80
% Lym	25.3	13-40
% Mono	5.2	2.0-11.4
% Eos	1.4	0.6-5.4
% Baso	0.4	0.3-1.4
RBC×106/µL	4.42	3.69-5.46
Hb (g/dL)	9.8	13.3-16.6
Hct (%)	28.4	41.3-52.1
MCV (fL)	64.3	86.7-102.3
MCH (pg)	22.2	27.1-32.4
MCHC (g/dL)	34.5	29.7-33.1
Platelet	489	150-450

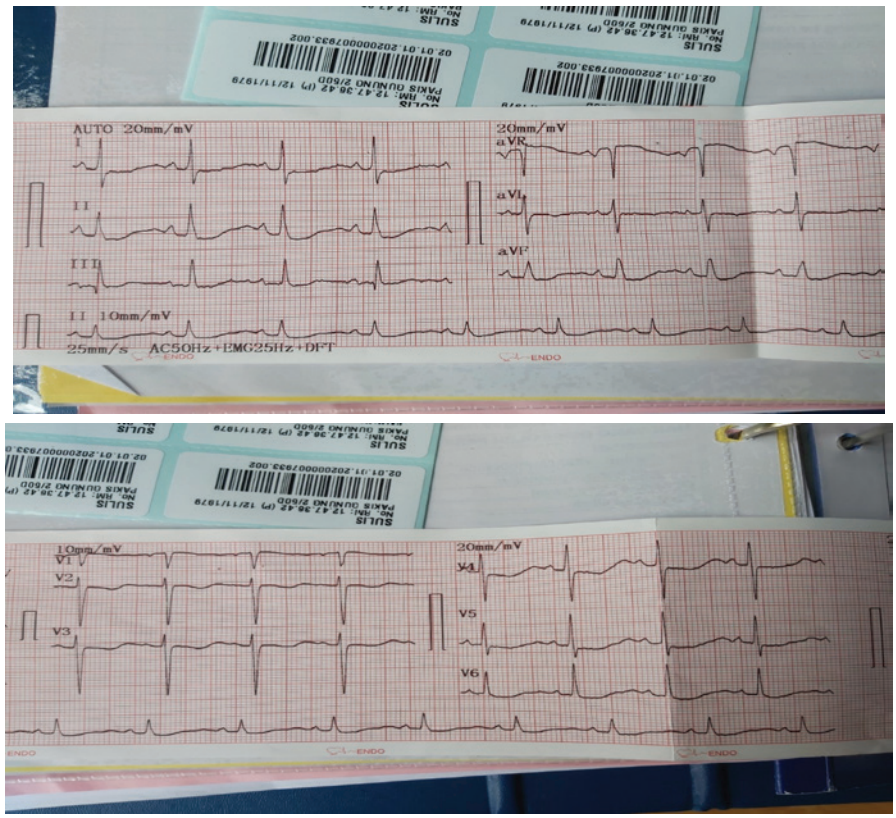

Figure 1. Electrocardiogram: T Wave Inversion and Prominent U Wave.

Discussion

Hypokalemia is defined as a low plasma potassium concentration (<3.5 mmol/L) and is also a common electrolyte disorder.Plasma potassium concentration <2.5 mmol/L can cause symptoms such as paralysis of the extremities also the respiratory and cardiac muscles[6]. Hypokalemia can occur due to deficiency of potassium or displacement of potassium into cells which can cause weakness in both localized and general muscles and can last from several hours to several days[3,7].

Signs of hypokalemia in electrocardiogram results can be seen as ST depression, decreased T waves and the presence of U waves.Renal tubular acidosis (RTA) is caused by failure of the renal tubules to reabsorb bicarbonate or excrete H ions. RTA is accompanied by hyperchloremia and a normal plasma anion gap[4,8]. RTA is divided into three groups (1) type 1 or distal RTA is characterized by failure of distal renal tubules to acidify urine, (2) type 2 or proximal RTA is characterized by failure in bicarbonate filtration, (3) type 4 or a combination of proximal and distal RTA is characterized by acid-base disorders due to aldosterone deficiency or resistance.Distal RTA is the most common type of RTA[5,8].

HPP can be found in distal RTA. Clinical symptoms of distal RTA consist of hypokalemia, hyperchloremic metabolic acidosis, inability to acidify urine (pH> 5.5), nephrocalcinosis and nephrolithiasis.Type 1 RTA or distal RTA can be caused by autoimmune diseases, drugs or can also be caused by infection. One of the endocrine diseases that can cause RTA is hypothyroidism[9].

In distal RTA cases, intercalated cells in the collecting duct fails to reabsorb HCO3-, causing urine to become alkaline. Defect in the collectivus duct leads to the reduction ofNAE which is followed by reduction of NH4 +. Excretion of titrated acid and removal of HCO3- decreases the serum concentration of HCO3- which results in a condition of hyperchloremic metabolic acidosis[10]. According to thepatient's clinical symptoms, the patient suffered from distal RTA. This is because the patient had metabolic acidosis with normal anion gap (hyperchloremic metabolic acidosis), positive urine anion gap and alkaline urine.

There are 3 mechanisms associated withhypothyroid and distal renal tubular: (1) defects in the H+ATPase pump in the collecting tubules, both cortical and medulla, (2) reduced cortical sodium reabsorption, and (3) increased membrane permeability which causes diffusion of the H or bicarbonate ions[11].In this patient's case, there was an increase in TSH, a decrease in FT4 and recurrent hypokalemia.

Conclusion

Clinical symptoms of patient consisted of weakness in all four extremities along with laboratory test results that show hypokalemia, normal metabolic acidosis, positive urine anions and alkaline urine. The patient was diagnosed with HPP and RTA. In addition, the patient suffered from Hypothyroidism which was characterized by the increase of TSH and decrease of FT4 levels.

Conflict of Interest: The author declare that they have no conflict of interest.

Source of Funding: None.

Acknowledgements: We thank Rr. Putri Amaristya Purwono and Arif Nur Muhammad Ansori for editing the manuscript.

Ethical Approval: This study approved by Dr. Soetomo Hospital, Surabaya, Indonesia.

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