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•CASE REPORT•

Hypokalemia Caused by Quetiapine and Risperidone Treatment in Schizophrenia: A Case Report

Qiongwei YANG[1,2], Xiaoyun GUO[1]*, Dengtang LIU[1]*

Summary: Hypokalemia can cause abnormalities in multiple systems. Long term use of antipsychotic medications can lead to electrolyte imbalance, including hypokalemia. We report a 49-year-old female patient with schizophrenia who developed hypokalemia after oral quetiapine and risperidone treatments. Her blood potassium became normal after she switched to another antipsychotic drug (amisulpride). In addition, we discuss the potential mechanism of antipsychotic drugs leading to hypokalemia and clinical cautions.

Key words: Hypokalemia, somatic, quetiapine, risperidone, antipsychotic drugs, schizophrenia

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1. Introduction

The normal value of blood potassium (K+) concentration is between 3.5 and 5.5 mmol/L with an average value of 4.2 mmol/L. Generally, hypokalemia is defined as the value of blood potassium concentration less than 3.5 mmol/L. Acute and severe hypokalemia can cause abnormalities in multiple systems. It is fatal in severe cases. The common symptoms of hypokalemia in the neuromuscular system are myasthenia, paroxysmal soft paralysis, and reduced muscle excitability. Hypokalemia could manifest as mental symptoms such as depression, drowsiness and loss or impairment in memory and orientation. In the cardiovascular system, hypokalemia can reduce myocardial stress. It could also induce arrhythmia and conduction blocks. It is fatal in the most serious cases. Severe hypokalemia in the digestive system can cause paralytic ileus. Long term use of antipsychotic drugs can lead to electrolyte imbalance including hypokelamia. The mechanism of this phenomenon is not clear. We report a 49-year-old female who developed hypokalemia after quetiapine and risperidone treatment.

2. Case history

The patient was replaced in her job by a new colleague in 2011. At that time she was unwilling to do anything at work and thought her boss was bullying her. She felt aggrieved and depressed. On September 16th 2015, she said that her boss had assigned her to work in Canada. She spent most of the time during the day by herself. Three days later, she was found by police officers in Pudong District (a district of Shanghai). According to the patient, she thought someone in the air told her to do this. Then she retired and stayed at home where her mood was fairly stable. She cursed at the air sometimes. Sometimes she said her manager's wife had been spying on her and trying to break up her family. On September 2016, she reported being afraid to eat at her own home. She thought that if she ate at home, her manager's wife would throw dust into her parents' bowls. Occasionally, she talked to herself saying that her manager would ask her to talk with him at midnight. When her mother suggested accompanying her to a doctor's appointment, she said that her manager had cancelled the appointment. This patient was brought to our hospital's

[1] First-episode Schizophrenia and Early Psychosis Program, Division of Psychotic Disorders, Shanghai Mental Health Center, Shanghai Jiao Tong University School of Medicine, Shanghai, China

[2]Minkang Hospital of Ningxia Civil Affairs Department, Ningxia, China

*correspondence: Dengtang Liu & Xiaoyun Guo. Mailing address: 600 South Wanping RD, Shanghai, China. Postcode: 200030. E-Mail: xiaoyunguo@163.com (Xiaoyun Guo); erliu110@126.com (Denglang Liu)

emergency department by her family on August 15th 2017. A quick check for blood potassium showed 2.7 mmol/L, however this improved after potassium supplementation treatment. At the same time, she was given olanzapine 5 mg/d, but the outcome was poor. In addition, her family members felt that it was difficult to take care of her at home. Thus, she was sent to the hospital with a diagnosis of schizophrenia. During the 1 month before hospitalization, the patient had an irregular diet as she only ate once a day. She slept through the daytime but went out or did house chores at night. She had normal urine and stool activities. She did not have obvious weight change. She did not have self-injuring behavior or suicide attempts. Her routine blood, urine and hepatic function test were within normal ranges. Her blood potassium concentration was 3.11 mmol/L. Her chest radiograph and brain MRI were all normal. Electrocardiogram examination's results showed sinus rhythm but changes in T-wave (V4-V6 were low, flat and inverted).

There was no special medical history except for an allergy to penicillin. She had an older brother. There was no reported family history of mental illness. Upon mental examination the patient had a normal level of consciousness. She was cleanly dressed. During the interview she was uncooperative, refusing to answer questions. The patient denied any auditory hallucinations. Her volition was not entirely impaired. She had normal memory, calculating abilities, discretion, knowledge and abstract thinking ability. Yet she lacked insight into her illness. The diagnosis given was schizophrenia.

After being hospitalized, she was given olanzapine 20 mg/d for 14 days. 2 weeks later, her psychotic symptoms relieved. She could eat normally. However, she often got up at night, eating and drinking. She got hungry so easily that she had to eat multiple times during the night. Her blood potassium concentration was within the normal range. Therefore, she was switched to quetiapine 700 mg. 9 days later, her blood potassium concentration was 3.1 mmol/L. Mental status exam showed that the patient was conscious and had average interpersonal interactions. However, she denied having any previous auditory hallucinations or persecutory delusions. She still had fragmented suspicions with a stable mood and a lack of insight. Thus, she was switched to risperidone 5 mg/d. 14 days later, the patient felt feeble. The blood potassium level was 2.89 mmol/L. Since the patient was eating normally, this phenomenon was considered as the result of quetiapine and risperidone consumption. Therefore, she was switched to amisulpride 0.4 g/d with potassium supplementation 1.5 g/d. Blood potassium concentration was 3.85 mmol/L 7 days later. Furthermore, hallucinations, delusions and other psychotic symptoms disappeared.

3. Discussion

The patient ate well after she was admitted into the hospital. She did not experience vomiting or diarrhea during treatment. In addition, she did not have any past medical history of cardiovascular or kidney disease. Therefore, the most probable cause for hypokalemia was quetiapine and risperidone. Previous literature indicates that antipsychotic drugs such as clozapine,[1] olanzapine,[2] risperidone[3] and quetiapine [3] can lead to hypokalemia. However, the mechanism of this phenomenon is still unclear. One possible explanation for this is that antipsychotic drugs induce hypercatecholemia, which could include high blood pressure, hypokalemia, and tachycardia.[4] Catecholamine induces the transfer of potassium ions from the outside to the inside of cells[6] by the increase of insulin level mediated by alpha 2 adrenergic receptors.[5] Another possible explanation is losing potassium ions in the kidney. Antipsychotic drugs may have aldosterone-like effects. Aldosterone is an adrenocortical hormone. It is generated by the adrenocortical globular zone. Aldosterone mainly acts on the distal tubules and collecting tubules of glomerulus. It could increase the activity of Na-K-ATP enzyme in the basement membrane. As the result, it could help to absorb the sodium ions and water from the urine back to the blood and discharge potassium ions in the urine.[1] Thus, high levels of aldosterone will lead to hypokalemia by causing the kidney to discharge more potassium ions.

After she was switched to amisulpride, the patient's blood potassium level returned to normal. Based on the current literature, there was no evidence indicating that amisulpride leads to hypokalemia. The mechanism underlying this is unclear. One possible explanation is that the affinity of amisulpride's receptors is relatively simple. Amisulpride has selective affinity to dopamine D2/D3 receptors but lacks affinity to other neurotransmitter receptors and pharmacologic sites. Therefore, it has relatively fewer adverse side effects. [7]

In conclusion, the mechanism underlying the hypokalemia caused by the antipsychotic drugs quetiapine and risperidone is still unclear. One possible mechanism is the aldosterone effect and the catecholamine effect of antipsychotic drugs. Catecholamine transfers potassium from the outside to the inside of cells. It could also induce the loss of blood potassium in the kidneys. In clinical practice, blood potassium concentration should be monitored to prevent serious accidents. Future basic and clinical studies could focus on the potassium concentration in urine and the total potassium discharged within 24 hours under a controlled diet. In future research, we could effectively explore the biological mechanism of abnormal electrolytes caused by antipsychotic drugs. We could also explore the relationship between abnormal electrolytes and acute psychosis and treatment effects of antipsychotics.

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Conflict of interest statement

The authors declared no conflicts of interest related to this manuscript.

Informed consent

The patient signed informed consent for the present report's publication.

Authors' contributions

Qiongwei Yang wrote up the draft. Xiaoyun Guo and Dengtang Liu made critical revisions. Xiaoyun Guo made the clinical diagnosis and carried out psychiatric evaluations. The manuscript was finalized after all writers reviewed it.

奎硫平合并利培酮治疗精神分裂症导致低血钾 1 例

杨琼玮，郭晓云，刘登堂

概述：低血钾可造成躯体多系统障碍，长期服用某些抗精神病药可能会导致电解质代谢的异常，包括血清钾的异常。我们报告一例 49 岁女性精神分裂症患者，在服用奎硫平和利培酮后出现低血钾，在换用其它抗精神病药（氨磺必利）后，血钾恢复正常。我们还讨论了抗精神病药导致低血钾的可能机制和临床注意事项。

关键词: 低血钾、躯体、奎硫平、利培酮、抗精神病药、精神分裂症

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Qiongwei Yang graduated as a resident psychiatrist and a level three national psychological consultant. She studied in the department of medicine at Havana Medical University in Cuba as an international student sent by the National Education Department. She graduated with a major in clinical medicine from Ningxia Medical University in 2013. She has been working in the Minkang Hospital of the Ningxia Civil Affairs Department since June 2014 with a research interest in pharmacological treatments for schizophrenia and bipolar disorder. She is currently studying and taking advanced training at the Shanghai Mental Health Center.