Severe Hypokalemia Associated with Paralysis after a Large Carbohydrate Intake following Exercise

Andrew S. Davison,[a,b,*] Lucy Devlin,[c] and Janki Panicker[c]

[a]Department of Clinical Biochemistry and Metabolic Medicine, Royal Liverpool University Hospitals NHS Foundation Trust, Liverpool, United Kingdom; [b]Department of Women's & Children's Health, Institute of Life Course and Medical Science, University of Liverpool, United Kingdom; [c]Department of Liverpool Clinical Laboratories and Endocrinology, Royal Liverpool University Hospitals NHS Foundation Trust, Liverpool, United Kingdom.

*Address correspondence to this author at: Department of Clinical Biochemistry, Liverpool Clinical Laboratories, Royal Liverpool University Hospitals NHS Foundation Trust, Liverpool L7 8SP, United Kingdom. Tel 0151 706 4011; Fax 0151 706 4250; E-mail andrew.davison@liverpoolft.nhs.uk.

CASE DESCRIPTION

A 22-year-old male Chinese student presented to the department of emergency medicine after he woke up with numbness in the right arm, felt no power in his legs, and was unable to walk or move his legs. He had been to the gym the night before but had only done upper limb work. Following the gym, he had consumed a large carbohydrate load. He was not on any prescribed or over-the-counter medications/supplements and denied using alcohol or recreational drugs.

On examination he was alert and oriented (Glasgow Coma Score 15/15), with pulse 68 beats per minute, blood pressure 110/70 mmHg, oxygen saturation 98%. His chest was clear and abdomen soft. Assessment of his central nervous system revealed that tone and power were intact in the upper limb. In the lower limb, power was 3/5 bilaterally, knee reflexes were absent, and ankle reflexes were positive on reinforcement.

Routine blood tests and arterial blood gas analysis revealed severe hypokalemia in the presence of normomagnesemia, elevated creatine kinase (CK), and lactic acidosis (Table 1). His electrocardiogram showed a significantly prolonged QTc interval of 577 ms (prolonged QTc defined as >440 ms in men), which was in keeping with the overall biochemical picture.

Following review of the routine biochemistry, the on-call clinical scientist added thyroid function tests to the sample as hyperthyroidism should be considered in the differential diagnosis of hypokalemia in a young Asian male without any obvious cause. Thyroid function tests revealed severe hyperthyroidism (Table 1). Interestingly, upon clinical assessment, the patient displayed no signs or symptoms of hyperthyroidism including no palpable thyroid nodule; no neck or lymph gland swelling; and no reports of palpitations, weight loss, sweating, or tiredness.

QUESTIONS TO CONSIDER	
1.	How should hypokalemia be evaluated in a young adult?
2.	What are the underlying mechanisms that lead to HTPP?
3.	How should hypokalemia be managed in HTPP?
4.	Why does CK increase in HTPP?

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Table 1. Summary of laboratory results for the patient during hospitalization and follow-up.

		Time from admission					
Analyte, units	Reference interval	Admit	8 h	14 h	36 h	48 h	9 d
Potassium, mmol/L[d]	3.5–5.3	2.3	4.5	4.3	4.9	4.4	4.4
Creatinine, μmol/L	59–104	54	56	48	50	47	76[c]
Bicarbonate, mmol/L	22–29	22	21	23	27	–	–
Chloride, mmol/L	95–108	101	111	106	102	–	–
Anion gap	10–20	23	21	16	16	–	–
Inorganic phosphate, mmol/L	0.70–1.50	1.19	–		1.65	–	–
Magnesium, mmol/L	0.70–1.0	0.81			0.91		
Creatine kinase, U/L	40–320	748	–	1929	5516	4090	78
C-reactive protein, mg/L	<5	5	–	9	4	–	–
Thyroid stimulating hormone, mU/L	0.27–4.2	<0.01	–	<0.01	<0.01	–	<0.01
Free tetraiodothyronine, pmol/L	12.0–22.0	74.5	–	72.1	73.8	–	26.7
Free triiodothyronine, pmol/L	3.1–6.8	–	–	–		–	8.3
Thyroid peroxidase antibody, kIU/L	<34	–	–	–	<15	–	–
Thyroid receptor antibody, U/L	<1.8	–	–	–	11	–	–
Ferritin, μg/L	30–400	–	–	614	–	–	–
Transferrin, g/L	2.0–3.6	–	–	1.55	–	–	–
Total iron binding capacity, μmol/L	50–90	–	–	39	–	–	–
pH[b]	7.35–7.45	7.29	7.34	–	–	–	–
Lactate[b]	0.5–2.2	5.7	1.4	–	–	–	–
Potassium[b,e]	3.5–5.3	1.8	4.1	–	–	–	–
Antinuclear antibodies[f]		–	–	–	Positive	–	–
Double-stranded DNA antibodies		–	–	–	Negative	–	–
Extractable nuclear antigen screen[g]		–	–	–	Negative	–	–
Hemoglobin, g/L[a]	140–180	144	125		150	141	135
White blood cells, $\times 10^9$/L[a]	4.0–11.0	9.5	3.6		4.9	3.2	6.2
Neutrophils, $\times 10^9$/L[a]	1.9–8.0	5.6	1.6		2.7	1.4	3.5
Hematocrit, L/L[a]	0.38–0.51	0.43	0.36		0.44	0.41	0.39

All analyses were performed on serum gel samples except for
[a]Hemoglobin, white blood cells, hematocrit (potassium EDTA).
[b]pH, lactate, potassium (arterial whole blood).
[c]Acute Kidney Injury 1 flag.
[d]Measurement by indirect ion selective electrode.
[e]Measurement by direct ion selective electrode.
[f]Homogenous (AC-1), nuclear speckled.
[g]Screen includes: Ro60, Ro52, La, Sm, RNP, Sd70, Jo-1, CENP-B.

Final Publication and Comments

The final published version with discussion and comments from the experts will appear in the April 2024 issue of *Clinical Chemistry*. To view the case and comments online, go to https://academic.oup.com/clinchem/issue/70/4 and follow the link to the Clinical Case Study and Commentaries.

Educational Centers

If you are associated with an educational center and would like to receive the cases and questions 1 month in advance of publication, please email clinchemed@myadlm.org.

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