

Hypokalaemic paralysis associated with renal tubular acidosis

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Introduction

Broadly defined, renal tubular acidosis (RTA) is a group of disorders characterized by hyperchloraemic metabolic acidosis occurring as a consequence of diminished renal tubular hydrogen ion secretion in the absence of renal insufficiency. Hypokalaemia is an accompanying feature in some forms of RTA though few cases have been described that have presented with paralysis. Renal tubular acidosis has been reported in infants from Papua New Guinea (1,2) but not in adults. Here we report a case of distal renal tubular acidosis in a young male Papua New Guinean.

Case Report

A 22-year-old man from the lowlying coastlands of Central Province of Papua New Guinea was seen during a weekend in the emergency department of the Port Moresby General Hospital. He had a four-day history of fever, chills and vomiting and a one-day history of progressive weakness in his lower limbs. His family and past medical history were insignificant and he was not on any previous medications.

On examination, he was mildly dehydrated with flaccid paralysis of his arms and legs. He had no difficulty in swallowing or speaking. No cranial nerve abnormalities were detected and peripheral sensation was intact. There were diminished tendon reflexes in his lower limbs. He had a pulse rate of 60/minute and blood pressure (supine) of 100/70 mmHg. A

provisional diagnosis of malaria with possible hypokalaemic periodic paralysis was made. Guillain-Barré syndrome was also queried. Blood samples were drawn for glucose, electrolytes, urea and haemoglobin analysis. Hypokalaemic periodic paralysis, though initially considered, was subsequently thought to be unlikely in view of the patient's place of origin. The observation of hyperchloraemic acidosis with a normal anion gap is also not typical of hypokalaemic periodic paralysis (3). A spot urinary pH was found to be 6.5 in spite of severe acidosis.

Arterial blood gas analysis and electrocardiography were not done. The peripheral blood film was negative for malaria parasites and cerebrospinal fluid (CSF) analysis was normal. Urine microscopy and culture were normal.

The patient was started on 1.5 g potassium chloride in 4.3% dextrose saline intravenous infusion plus oral potassium chloride 60 mg tid and intramuscular quinine 450 mg every 8 hours. Serum electrolyte results obtained on admission are shown in Table 1. The potassium dose was increased to 1 g/hour 12 hours after admission; the patient improved gradually and regained full muscle power by the end of the third day.

After adequate potassium repletion therapy, an ammonium chloride loading test (4) was performed and a diagnosis of distal renal tubular acidosis made (Table 2). Before discharge a plain abdominal X-ray was taken. No foci of calcification were seen.

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Discussion

A simple RTA classification consists of three subgroups: proximal RTA, hypokalaemic distal RTA (DRTA) and hyperkalaemic distal RTA (Table 3). DRTA is the most common and clinically significant form of RTA. Patients with DRTA are sometimes asymptomatic but frequently present with musculoskeletal disorders such as arthralgia, myalgia, muscle weakness or low back pain. Severe paralysis due to hypokalaemia as seen in our patient is extremely rare.

The diagnosis can be easily confused with hypokalaemic periodic paralysis. In Papua New Guinea, hypokalaemic paralysis has been reported in migrants from the highlands to the coast (5). These patients typically present within 2 months of migrating to the coast and this condition is associated with a decrease in dietary potassium intake and an increase in dietary sodium. However, unlike patients with RTA they are not acidaemic, though plasma

chloride levels may be moderately elevated.

Nephrocalcinosis is a common finding in RTA and is seen in 60% of patients (6). However, there was no evidence of this in our patient. Nephrocalcinosis and nephrolithiasis are a consequence of hypercalciuria which is secondary to calcium release produced by bone buffering of unexcreted acid loads (7). Decreased urinary citrate (8) is almost a universal finding in hypokalaemic distal RTA and this favours precipitation of calcium salts as does the relatively alkaline urine. Though a 24-hour urine collection was attempted in our patient, the sample was not processed as there were indications that the urinary collection was incomplete.

The setting which prompts investigation for possible disordered renal acidification is hyperchloraemic acidosis with a normal anion gap in the absence of gastrointestinal bicarbonate loss and exogenous acid loads (9). The first step in investigating normokalaemic

TABLE 1

SERIAL SERUM ELECTROLYTES, UREA AND ALBUMIN IN THE PATIENT

	Hours after admission						Reference values
	0	12	24	48	72	96	
Sodium (Na)	136	140	144	147	143	140	135-143
Potassium (K)	2.2	1.6	2.4	2.5	3.3	3.7	3.2-4.8
Chloride (Cl)			117	120	117	110	96-105
Bicarbonate			11	14	18	21	24-29
Urea			8.8	9.0	9.0	8.0	3.3-6.4
Creatinine			0.13	0.13			0.07-0.14
Calcium (Ca) (total)			2.54				2.35-2.55
Phosphate (PO ₄)			1.0				0.8-1.5
Albumin (g/l)			41				35-44

All values except for albumin are in mmol/l

or hypokalaemic individuals with a probable diagnosis of RTA after clinical assessment is careful determination of urinary pH, done by collecting a urine sample under oil to prevent carbon dioxide evaporation, and using a pH meter rather than a dipstick. A urinary pH below 5.5 excludes distal RTA but not proximal RTA while a urine pH above 5.6 suggests distal RTA, provided that urinary tract infection has been excluded (since urea-splitting bacteria alkalinize urine).

Proximal RTA can be definitely diagnosed by bicarbonate loading. Another important clue is the serum potassium, which is usually normal in untreated proximal RTA and low in distal RTA. Once proximal RTA is ruled out in an acidaemic patient with an abnormally high

urine pH, a diagnosis of distal RTA should be considered. The patient in this case had severe hypokalaemia, hyperchloraemic acidosis and an alkaline urinary pH in the absence of urinary tract infection.

The definitive test, which was performed in this patient after adequate potassium replacement, is the short ammonium chloride loading test (3). In this setting a urine pH persistently above 5.5 is diagnostic of distal RTA. In the present case the lowest urine pH achieved was 6.5, 8 hours after administration of the ammonium chloride.

The patient made a full recovery and was discharged on oral potassium citrate tablets 5g tid and was to be seen once a month in the

TABLE 2

RESULTS OF THE AMMONIUM CHLORIDE LOADING TEST (0.1 MG/KG) IN THE PATIENT

Time	Na mmol/l	K mmol/l	pH
0 hours	18.0	40.5	6.6
2 hours	21.5	42.8	6.6
4 hours	27.5	48.8	6.5
6 hours	33.5	47.6	6.5
8 hours	31.4	47.7	6.5

TABLE 3

CLASSIFICATION OF RENAL TUBULAR ACIDOSIS (RTA)

	Serum potassium	Urine pH	Urinary citrate	FEHCO ₃ %
Proximal RTA	normal or low	<5.5	normal	≥15
Hypokalaemic distal RTA	low or normal	>5.6	low	≥3
Hyperkalaemic RTA	high	<5.5	unknown	<3-10

FEHCO₃ = fractional excretion of bicarbonate

outpatient clinic. Though several conditions are associated with DRTA, eg, immunological disorders, primary hyperparathyroidism and various drugs, the patient was judged to be a sporadic case of distal RTA as no underlying cause could be determined.

Prognosis

Prognosis is excellent especially when there is no significant underlying disease process. As nephrocalcinosis is the major factor determining morbidity, it is worthwhile considering other forms of treatment (9) in addition to alkali, such as measures that reduce urinary calcium excretion (low calcium diet, cellulose phosphate, thiazide diuretics). A careful follow-up with frequent checks for urinary tract infection and calculus formation or obstruction is important. This can be complemented with periodic electrolyte measurements.

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