CASE REPORT

JIACM 2011; 12(4): 311-3

Distal renal tubular acidosis presenting as periodic paralysis in a young female

Soumya Sarathi Mondal, Subhabrata Gangopadhyay**, Siddhartha Mani**, Debjoy Sau**, Rudrajit Paul**, Ramtanu Bandyopadhyay**

Abstract

A 17-year-old normotensive and non-diabetic female presented with acute onset flaccid paralysis with the history of a similar episode a few months back. Clinical and laboratory evaluation revealed lower motor neuron type of flaccid quadruparesis with hypokalaemia, normal anion gap metabolic acidosis, bicarbonaturia, and transtubular potassium concentration gradient (TTKG) more than 7. Subsequently urine acidification test (by NH4CI challenge test) was done and diagnosis of distal renal tubular acidosis was established. The patient responded to conservative management (Sohl's solution).

Key words: Hypokalaemia, flaccid quadruparesis, urine acidification.

Introduction

Distal-renal tubular acidosis (dRTA) is a non-uraemic syndrome of defective urinary acidification. It is characterised by presence of hypokalaemia, normal blood pressure, and normal anion gap metabolic acidosis, alkaline urine, inability to acidify urine pH < 5.5, nephrocalcinosis, and features of rickets. Primary dRTA can be inherited, but most cases are sporadic. An inherited case may be autosomal dominant or autosomal recessive form. Secondary causes are Sjögrens syndrome, amphotericin B toxicity, chronic active hepatitis, and SLE. The treatment required is alkali administration in the form of Sohl's solution in doses 0.5 to 2 ml/kg in 4 - 6 divided doses per day. We report a case of a 17-year-old female presenting with periodic acute onset flaccid quadruparesis. A diagnosis of d-RTA was established after a series of investigations.

Case report

A 17-year-old girl was admitted with acute onset quadruparesis evolving over a period of 24 hours and reaching upto the extent that she could only sit or stand with adequate support. She had a similar episode two months back which was preceded by diarrhoea and dehydration with hypokalaemia persisting even long after resolution of the diarrhoea. On assessment of the previous records, it revealed to be an episode of hypokalaemia leading to quadruparesis, recovered with oral KCl supplementation and discharged as hypokalaemic periodic paralysis with the advice to take oral KCl. But this time there was no history of diarrhoea. On examination, the only positive finding in the general survey was bradycardia (pulse 52/minute, regular). No features suggestive of thyrotoxicosis were present. Nervous system examination revealed normal higher functions, cranial nerves, sensory system, bladder and bowel, and cerebellar functions. Motor examination revealed normal muscle bulk with hypotonia. Muscle power of upper limb was 4/5 and lower limb was 3/5; deep tendon reflexes were present but diminished, and plantars were bilaterally flexor.

Investigation showed Hb – 11.2 gm%, TLC – 8,700/cmm (neutrophils – 72%, lymphocytes – 22%, eosinophils – 4%), MCH – 28.6 pg/cell, MCHC – 31.4 gm/dl, MCV – 91 fL. FBS was 108 mg/dl, CPK – 383 U/L, Na^+ – 134.8 mmol/l, K^+ – 2.29 mmol/l, Ca^{2+} – 3.8 mg/dl, Mg^{2+} – 2.8 mg/dl (normal – 1.5 to 2.6). ECG – prolonged PR interval, T-wave flattening and U wave. ABG performed: pH – 7.38, pO2 – 102 mmHg, pCO_2 – 20 mmHg, HCO_3 – 11.4 meq/l, Na^+ – 142 meq/l, K^+ – 2.6 meq/l, Ca^{2+} – 120.2 meq/l, anion gap – 10.4, plasma osmolality – 302.5 mOsm/kg. This ABG report showed a combination of metabolic acidosis with hypokalaemia. This condition is usually found in two possible conditions either due to GI loss or RTA. As there was no history or GI loss this time, we were strongly suspecting RTA.

**** Assistant Professor, ** Post-graduate Student, Department of Medicine, Medical College, 88, College Street, Kolkata - 700 073, West Bengal.***

Other investigations included ANA – negative, fT_3 – 3.58 pg/ml, fT_4 – 7.2 mcg/dl, TSH – 1.59 IU/ml. 24 hours urine-total volume – 3,180 ml, K^+ excretion – 73.3 meq/24 hrs., i.e., 23.27 meq/l. Osmolality was 436.7 mOsm/kg and pH 7. Trans-tubular potassium gradient (TTKG) was 6.2. USG did not reveal any nephrocalcinosis. In the meantime, the patient was treated with oral potassium supplementation and patient dramatically improved. To confirm our diagnosis after stabilisation of the patient, we opted for an oral NH_4Cl challenge test. UTI was ruled-out beforehand by urine microscopy and culture. NH_4Cl was given orally at doses of 0.1 gm/kg with fruit juice.

Urine pH was subsequently recorded as follows:-

1st hour – 6.69

2nd hour – 6.19

3rd hour – 6.63

4th hour – 6.1

5th hour – 6.17

ABG – 2nd hour

pH – 7.29

HCO3 – 9.9 meq/l

Base excess – 14.5

Na^+ – 133 meq/l , K^+ – 2.4 meq/l

ABG – 4th hour

pH – 7.31

HCO_3 – 10.8 meg/l

Base excess – 13.7 mmol/l

Na^+ – 139 meq/l, K^+ – 2.4 meq/l, Cl – 118 mmol/l

Therefore, the urine pH did not decrease below 5.5 in spite of plasma HCO_3 being persistently below 20 meq/l. So our diagnosis of dTRA (type 1) was confirmed. Treatment with Sohl's solution (Na-citrate 500 mg, K- citrate 550 mg, and citric acid 334 mg/5 ml) was started. 1 ml of thin solution is equivalent to 1 meq of Na^+, 1 meq of K^+ and 2 meq of HCO_3. It was started at a dose of 1 mmol/kg per day in divided doses. After one week of starting therapy serum K^+ was 4 meq/l, Cl^- – 102 meq/l, pH – 7.4, and HCO_3 – 23.8 meq/l. ECG at discharge was normal. In follow-up, the patient is doing well.

Discussion

Renal tubular acidosis (RTA) is a medical condition that involves an accumulation of acid in the body due to a failure of the kidneys to appropriately acidify the urine either by failure to recover sufficient (alkaline) bicarbonate ions from the filtrate in the early portion of the nephron (proximal tubule) or by insufficient secretion of (acid) hydrogen ions into the latter portions of the nephron (distal tubule)[1].

Distal RTA (dRTA) is the classical form of RTA, characterised by a failure of acid secretion by the alpha intercalated cells of the cortical collecting duct. This leads to an inability to acidify the urine to a pH of less than 5.5. The clinical features of dRTA include[1]: normal anion gap metabolic acidosis/acidaemia, hypokalaemia, urinary stone formation (related to alkaline urine, hypercalciuria, and low urinary citrate)[2], nephrocalcinosis (deposition of calcium in the substance of the kidney) and bone demineralisation (causing rickets in children and osteomalacia in adults)[3]. The diagnosis of dRTA can be made by the observation of a urinary pH of greater than 5.5 in the face of a systemic acidaemia (usually taken to be serum bicarbonate of 20 mmol/l or less). The test usually performed is *the short ammonium chloride test*[4], in which ammonium chloride capsules are used as the acid load. Secondary causes include: Autoimmune disease (e.g., Sjögrens syndrome)[5], mutations of Band 3[6], subunits of the apical proton pump vH^+-ATPase[8], renal transplantation, sickle cell anaemia, toxins – including ifosfamide[10], toluene[11], lithium carbonate[12] and amphotericin B[13]; and chronic active hepatitis[14].

On the other hand, periodic paralysis due to hypokalaemia is often due to hypokalaemic periodic paralysis, an inherited channelopathy[15]. However, because the clinical manifestations of hypokalaemia are mainly muscle weakness, it may be difficult, in some cases, to discriminate between a paralytic attack of hypokalaemic periodic paralysis and an episode of weakness associated with hypokalaemia of another cause (e.g., reduced potassium intake, enhanced renal excretion, or digestive loss) requiring varied investigations.

In our case, all possible causes were excluded by appropriate investigations and ultimate diagnosis of d-RTA was established by ABG, 24-hour urinary potassium excretion, TTKG, NH_4Cl challenge test. Treatment with Sohl's solution was followed by rapid recovery and

patient is asymptomatic since then.

Conclusion

We report this case to focus on the diverse presentations of dRTA. The purpose of this case report is to emphasise that any patient presenting with periodic paralysis from hypokalaemia should not have a diagnostic bias and causes like thyrotoxicosis, , hyperaldosteronism, GI loss, barium poisoning, RTA, etc., should be ruled-out.

References

1. Laing CM, Toye AM, Capasso G, Unwin RJ. Renal tubular acidosis: developments in our understanding of the molecular basis. *Int J Biochem Cell Biol* 2005; 37 (6): 1151-61.
2. Buckalew VM Jr. Nephrolithiasis in renal tubular acidosis. *Journal of Urology* 1989; 141 (3 part 2): 731-7.
3. Walsh SB, Shirley DG, Wrong OM, Unwin RJ. Urinary acidification assessed by simultaneous furosemide and fludrocortisone treatment: an alternative to ammonium chloride. *Kidney Int* 2007; 71 (12): 1310-6.
4. Wrong O, Davies HEF. The Excretion of Acid in Renal Disease. *QJM* 1959; 28: 259-313.
5. Wrong OM, Feest TG, MacIver AG. Immune-related potassium-losing interstitial nephritis: a comparison with distal renal tubular acidosis. *Q J Med* 1993; 86 (8): 513-34. PMID 8210309.
6. Bruce LJ, Cope DL, Jones GK *et al.* Familial distal renal tubular acidosis is associated with mutations in the red cell anion exchanger (Band 3, AE1) gene. *J Clin Invest* 1997; 100 (7): 1693-707. doi:10.1172/JCI119694. PMID 9312167. PMC 508352.
7. Bruce LJ, Wrong O, Toye AM *et al.* Band 3 mutations, renal tubular acidosis and South-East Asian ovalocytosis in Malaysia and Papua New Guinea: loss of up to 95% band 3 transport in red cells. *Biochem J* 2000; 350 Pt 1: 41-51. doi:10.1042/0264-6021:3500041. PMID 10926824. PMC 1221222.
8. Wagner CA. Renal Vacuolar H^+-ATPase. *Physiological Reviews* 2004; 84 (4): 1263-314. doi:10.1152/physrev.00045.2003. PMID 15383652.
9. Karet FE, Finberg KE, Nelson RD *et al.* Mutations in the gene encoding B1 subunit of H+-ATPase cause renal tubular acidosis with sensorineural deafness. *Nat Genet* 1999; 21 (1): 84-90. doi:10.1038/5022. PMID 9916796.
10 Skinner R, Pearson AD, English MW *et al.* Risk factors for ifosfamide nephrotoxicity in children. *Lancet* 1996; 348 (9027): 578-80. doi:10.1016/S0140-6736(96)03480-0. PMID 8774570.
11. Batlle DC, Sabatini S, Kurtzman NA. On the mechanism of toluene-induced renal tubular acidosis. *Nephron* 1988; 49 (3): 210-8. doi:10.1159/000185057. PMID 3135502.
12. Boton R, Gaviria M, Batlle DC. Prevalence, pathogenesis, and treatment of renal dysfunction associated with chronic lithium therapy. *Am J Kidney Dis* 1987; 10 (5): 329-45. PMID 3314489.
13. McCurdy DK, Frederic M, Elkinton JR. Renal tubular acidosis due to amphotericin B. *N Engl J Med* 1968; 278 (3): 124-30. PMID 5634966.
14. PA Koul, SM Saleem. Chronic active hepatitis with renal tubular acidosis presenting as hypokalemic periodic paralysis with respiratory failure. *Acta Pædiatrica* 81 (6-7): 568-9.
15. Christopher M Viscomi, Louis J Ptacek, Donald Dudley. Anesthetic Management of Familial Hypokalemic Periodic Paralysis during Parturition. *Anesth Analg* 1999; 88: 1081-2.