

RENAL TUBULAR ACIDOSIS: A CASE REPORT

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ABSTRACT

This case report describes a 19 years old boy presenting with bilateral lumbar pain, abdominal cramps and generalized bodyaches. Systemic examination was unremarkable. Patient was diagnosed as Type 1 Renal Tubular Acidosis on the basis of alkaline urine, nephrocalcinosis, hypokalemic hyperchloremic metabolic acidosis with normal serum anion gap and positive ammonium chloride challenge test.

Key words: Renal Tubular Acidosis, Normal anion gap, Hypokalemic hyperchloremic metabolic acidosis, Alkaline urine.

INTRODUCTION

Renal tubular acidosis (RTA) is a systemic acidosis due to impaired ability of renal tubules to acidify the urine and there will be little or no overall reduction in the renal functions. RTA is characterized by hyperchloremic metabolic acidosis with a normal serum anion gap¹. Disease can present in different ways depending upon which aspect of renal acid handling has been affected. Defect in HCO_3^- re-absorption in proximal tubule, suppressed ammoniogenesis in distal tubule and inadequate distal tubule proton secretion are the main defects that produce RTA². There are four main types of RTA. Types 1 and 2 may be inherited or acquired. Type 4 is acquired and is associated with either hypoadosteronism or tubu-

lar unresponsiveness to mineralocorticoids. Type 3 was previously labeled as Distal RTA with HCO_3^- wasting in children but this bicarbonaturia settles with age and is not truly a part of pathologic process³. Now a days type 3 RTA is characterized by glomerular insufficiency leading to impaired NH_3 production⁴.

CASE REPORT

A 19- years old thin boy presented with six months history of bilateral lumbar pain, abdominal cramps and generalized body aches .He was also experiencing difficulty in walking along with epigastric pain and occasional vomiting for the last two months. In his past medical history, he was hospitalized for bleeding P/R and put on treatment for ulcerative colitis two years previously

which he took only for one month as the condition improved. One month ago, he was again hospitalized for vomiting and partially responded to anti-emetic and proton pump inhibitor (PPI). On examination, he was a thin boy of average height, afebrile and normotensive. Systemic examination was unremarkable. Gait was normal although he was complaining of pain during walking and on standing from sitting position.

Investigations revealed Hb 13 gram%, WBC count 7500 /mm³ with normal differential count, blood urea 50 mg%, S. Creatinine 1.1mg%, serum amylase 171 U/L and serum calcium 8.5mg%. Urine examination was normal with urinary pH 6.0. Serum electrolytes performed and showed Na⁺ 139meq/L, Cl⁻ 113 meq/L and, K⁺ 3.4 meq/L. Abdominal ultrasound showed bilateral medullary nephrocalcinosis. Arterial blood gases demonstrated pH 7.34, pCO₂ 35.5 mmHg and HCO₃⁻ 18.4 mmol/L. Having diagnosis of RTA in mind, patient underwent ammonium chloride challenge test. After overnight fasting, 0.1 gm/kg body weight NH₄Cl was given orally and urine pH measured hourly for 8 hours. Urine pH does not drop below 5.4. Type 1 RTA was diagnosed on the basis of hypokalemic, hyperchloremic metabolic acidosis, alkaline urine, nephrocalcinosis and positive NH₄Cl challenge test. Patients were started on 1 gram sodium bicarbonate tablets 8 hourly.

DISCUSSION

RTA is impairment of renal acidification out of proportion to reduction in Glomerular filtration rate.^{1,3,4} RTA is characterized by hyperchloremic metabolic acidosis with a normal serum anion gap⁴. There are different types of RTA depending on which aspects of renal acid handling have been affected. The clinical setting, urinary pH, urinary anion gap and serum K⁺ level can differentiate four different types.

Type 1 (Distal) RTA: - It can present at any age. Type 1 RTA is characterized by hypokalemic hyperchloremic metabolic acidosis. Distal nephrons fail to acidify urine normally leading to excess bicarbonate in filtrate and unable to decrease urinary pH below 5.5⁴. The underlying mechanism of Type 1 RTA is either excessive back diffusion of Hydrogen ions from lumen to blood or because of inadequate transport of Hydrogen ions in the collecting ducts².

Urine ammonium excretion is inappropriately low for the level of acidosis. Potassium excretion enhances, as there is less competition from H⁺ in the distal nephron transport system.

Chronic acidosis decreases calcium tubular reabsorption leading to renal hypercalciuria and secondary hyperparathyroidism. The hypercalciuria, alkaline urine, and lowered level of urinary citrate cause calcium phosphate stones and nephrocalcinosis⁵. Growth in children stunted because of rickets. This growth defect responds to correction of acidosis with alkali. In the adult, osteomalacia occurs³.

Type 1 RTA can be familial with autosomal dominant, X-linked and autosomal recessive. Other hereditary diseases that cause type 1 RTA include galactosemia, Ehler Danlos syndrome, Fabry's disease, medullary sponge kidney, Wilson's disease and hereditary elliptocytosis. The majority of type 1 RTA cases are secondary to systemic disorders such as Sjogren's syndrome, hypergamma-globulinemia, chronic active hepatitis or systemic lupus erythematosus.

The diagnosis of type 1 RTA is suggested by a normal anion gap metabolic acidosis with simultaneous urine pH greater than 5.5. Osteomalacia or rickets, calcium phosphate stones or nephrocalcinosis support the diagnosis. Bicarbonaturia is not present which distinguishes type 1 from type 2 RTA⁶.

If acidosis is not severe and urine pH suggestive, the oral ammonium chloride (NH_4Cl) loading test should be carried out. The systemic acidosis worsens but the urine pH does not fall below 5.5. Urinary tract infection must be excluded during this test as the bacteria may possess urease, hydrolyzing urea to ammonia and producing an alkaline urine⁴.

Alkali supplements are the standard therapy for type 1 RTA. Enough alkali should be given to titrate the daily metabolic acid load, usually in the range of 0.5 to 2.0 mmol/Kg body weight/day in 4-6 divided doses⁵. Sodium bicarbonate and Shohl's solution (1mmol Sodium citrate+1 mmol citric acid per ml) are common treatments. The dose of alkali should be raised until acidosis and hypercalciuria are both eliminated and patients should be followed twice yearly by measurements of serum potassium, chloride and CO_2 content. Requirements for alkali usually rise during intercurrent disease but are usually below 4 mmol/ kg body weight per day³.

Type 2 (Proximal) RTA: - It is less common than type 1 RTA. This disorder normally presents as part of a generalized tubular defect together with glycosuria, aminoaciduria and phosphaturia⁷. Bicarbonate reabsorption in the proximal tubule is the main defect². The cardinal features of type 2 RTA are hyperchloremic hypokalemic metabolic acidosis, urine pH below 5.5 and bicarbonaturia despite subnormal plasma bicarbonate¹. Rickets or osteomalacia may occur due to hypophosphatemia and low calcitriol levels. Hypercalciuria occurs but stone formation is unusual because urine citrate levels are normal⁷.

Type 2 RTA may be inherited as autosomal dominant, autosomal recessive or X-linked disorder. It may be acquired in association with other diseases (e.g. Fanconi syndrome) or secondary to drugs inhibiting carbonic anhydrase activity³.

Treatment of type 2 RTA is administration of large amount of alkali, usually 5-15 mmol/Kg body weight/day as bicarbonate is rapidly excreted in urine¹. Potassium supplement is often required. Sometimes thiazide diuretic is required in combination with low salt diet to reduce the bicarbonate dose required³.

Type III RTA: - According to some books the term type 3 RTA is no longer used now³ while others describe it as extremely rare and presents as combination of type 1 and type 2 RTA^{1,4,7}. When the GFR declines to 20-30 ml/min, the ability to generate adequate NH_3 is impaired leading to decreased NH_4Cl excretion. All this results in normokalemic hyperchloremic metabolic acidosis².

Type IV (Hyporeninemic hypoaldosteronism) RTA:- It is the most common type of these disorders and is characterized by hyperkalemic hyperchloremic metabolic acidosis². Type 4 RTA is an acquired disorder and a moderate degree of renal insufficiency is present in majority of patients³. The main defect is aldosterone deficiency or antagonism impairing distal nephron Na^+ reabsorption and K^+ and H^+ excretion². The most common causes of type 4 RTA are diabetic nephropathy, tubulointerstitial renal disease, hypertensive nephrosclerosis and AIDS. Drugs exacerbating hyperkalemia (e.g. ACE inhibitors) and aldosterone receptor blockers (e.g. spironolactone and NSAIDs) must be used with extreme caution in above mentioned diseases⁴.

Treatment of type 4 RTA is to reduce serum potassium. Any offending drug should be stopped and patients should be on low potassium diet³.

Fludrocortisone, sodium bicarbonate, diuretics or ion exchange resins to remove potassium or combinations of these are used as treatment options¹.

TABLE: COMPARISON BETWEEN DIFFERENT TYPES OF RTA*

Renal Tubular Acidosis	Renal Defect	Serum (K ⁺)	Distal H ⁺ Secretion		Urinary Anion Gap	Treatment
			Urinary NH ₄ ⁺ Plus Minimal Urine pH	Titrateable Acid		
I. Classic distal	Distal H ⁺ secretion		>5.5		Positive	NaHCO ₃ (1 – 3 meq/kg/d)
II. Proximal Secretion	Proximal H ⁺		<5.5	Normal	Positive	NaHCO ₃ or KHCO ₃ (10 – 15 meq/kg/d), thiazide
III. Glomerular insufficiency	NH ₃ Production	Normal	<5.5		Positive	NaHCO ₃ (1 – 3 meq/kg/d)
IV. Hyporeninemic hypoaldosteronism	Distal Na ⁺ reabsorption, K ⁺ secretion and H ₂ secretion		<5.5		Positive	Fludrocortisone (0.1-0.5mg/d), dietary K ⁺ restriction frusemide (40 – 160 mg/d), NaHCO ₃ (1-3 meq/kg/d)

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