Case Report

Type 1 Renal Tubular Acidosis with Sensorineural Deafness

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Abstract
We report a case of Type 1 Renal Tubular Acidosis (RTA) in association with sensorineural deafness. Inherited Type 1 RTA is usually autosomal dominant, though there is a rarer recessive form associated with nerve deafness. Simple alkali replacement can correct the systemic metabolic defect, but does not appear to ameliorate hearing loss. ©

INTRODUCTION

Type 1 renal tubular acidosis, due to impaired tubular secretion of hydrogen ion in the distal nephron, leads to the development of metabolic acidosis, frequently accompanied by hypokalemia, nephrocalcinosis, and metabolic bone disease. The condition can be familial, when it is usually inherited as autosomal dominant, though there is a rarer autosomal recessive form associated with nerve deafness. We report a case of Type 1 distal renal tubular acidosis with nerve deafness.

CASE PRESENTATION

A female child aged 11 years was brought for evaluation of growth delay and inability to stand and walk. Mother gave a history of deafness in the child, which was observed at the age of 7 months and later found that she was a deaf mute. The child’s motor milestones were normal up to 2 years. She stood and walked till the age of two, but later developed difficulty in walking with progressive deformities of both knees. The child had history of polyuria and polydipsia. She had normal dentition and no history of fractures. She was born to nonconsanguinous parentage and is the eldest of 3 siblings, others being healthy. There was no family history of similar illness in 1st and 2nd degree relatives. The child was given Vitamin D (Arachitol) injections earlier with partial improvement.

O/E child was deaf mute, could not stand, and had stunted growth - length 92 cm, weight 11kg. There was no dysmorphic facies. She had rickety stigmata (Fig. 1) – genu valgum, widened wrists, rickety rosary, and widely spaced teeth. She had hypotonia, could not get up from the sitting position suggestive of proximal...
muscle weakness. There was no muscle wasting and no signs of tetany. Systemic examination was normal.

Investigations revealed metabolic acidosis, arterial blood pH was 7.29, normal being 7.38-7.44 and serum bicarbonate was 11.6mmol/L (Normal 21-28mmol/L). Serum sodium was 146 mEq/l (Normal 136-145mmol/L), potassium was 2.8 mEq/l (Normal 3.5-5mmol/L), and chloride 122mEq/l (Normal 98-106mmol/L). Anion gap was normal with a value of 15 (normal 7-16 mmol/L). Urine was relatively alkaline with pH of 6.5 (normal range 5-9). Serum phosphorus was 2.1mEq/L with normal range being 3.5-4.5mg/dl. Corrected serum calcium was low -8.5 mg/dl (normal range 9-10.5mg/dl). Serum Alkaline phosphatase was 845U/L, normal being 30-120U/L. All other renal parameters, blood counts and blood glucose were normal.

Radiological findings of X-ray hand and pelvis are shown in Figs. 2a and 2b. An ultrasound abdomen revealed bilateral echogenic renal medullae and some of these contained small hyperechoic foci with faint distal shadowing suggestive of nephrocalcinosis. Audiogram revealed severe bilateral sensorineural hearing loss.

A diagnosis of rickets due to type 1 renal tubular Acidosis associated with sensorineural deafness was made. The diagnosis of distal renal tubular acidosis was made by the findings of systemic acidosis, low bicarbonate, hypokalemia, a normal anion gap and relatively alkaline urine despite the acidemia in the present case. The patient was started on Shohl’s solution (1mmol of sodium citrate and 1 mmol of citric acid) in a dose of 1mmol/kg/day in divided doses and had marked improvement in muscle strength and growth. Serum calcium, potassium and phosphorus were normalised. However, there was no significant improvement in deafmutism.

**DISCUSSION**

To our knowledge, this is the first case report of Type 1 renal tubular acidosis with sensorineural deafness in Indian literature. Type 1 renal tubular acidosis with sensorineural deafness is autosomal recessive in inheritance, also termed as Type –Ib; MIM#267300. The peculiarity of this case is the absence of family history. Autosomal recessive disorders usually give a family history and fresh mutations are rare. Sporadic mutations are known to occur in autosomal dominant disorders and the index case could represent a new mutation. So it is interesting whether this case represents an autosomal dominant variant. The possibility of a mere chance association cannot be ruled out.

The diagnosis of Type 1 RTA was made by the findings of systemic acidosis, low bicarbonate, hypokalemia, a normal anion gap and relatively alkaline urine despite the acidemia in the present case. The ammonium chloride test was not done in the present case in view of overt metabolic acidosis.

Type 1 RTA can be familial with autosomal dominant as the most common mode of inheritance. Autosomal recessive and sporadic cases have been reported. It has been shown that the autosomal dominant form of Type 1 RTA is associated with a defect in the anion exchanger (AE1) of the renal collecting duct intercalated cell. The autosomal recessive form has been associated with mutations in the H+ATPase gene in some families. Patients with recessive Type 1 RTA are severely affected, presenting with either acute illness or growth failure at a young age. In contrast, dominant Type 1 RTA is a milder disease, and sometimes goes undiagnosed until adulthood.2

In addition, among patients with recessive but not dominant Type 1 RTA, a substantial fraction has progressive and irreversible bilateral sensorineural hearing loss (SNHL; Type 1 type 1b). Mutational analysis revealed defects in ATP6B1 gene responsible for recessive Type 1 RTA with sensorineural deafness.3 The coexistence of hearing loss with Type 1 RTA is of note due to the challenges facing pH homeostasis in the inner ear. Endolymph pH is maintained near 7.4 in the cochlea, and is even lower in the endolymphatic sac (pH 6.6), indicating an active acidification process.4 However, the cause and effect relationship between endolymph pH and sensorineural deafness remains speculative.

Simple alkali replacement can correct the systemic metabolic defects, but such treatment does not appear to ameliorate or prevent progression of hearing loss. Alkali administration to neutralize the production of metabolic acids corrects metabolic acidosis. Correction of acidosis reduces urinary potassium and sodium excretion, normalises hypokalemia and sodium depletion. So,
in most patients, potassium supplementation is not necessary. The present case was treated with Shohl’s solution which was well tolerated with significant improvement in growth and metabolic parameters for the one year follow up. There was no progression of hearing loss and a slight subjective improvement in hearing has been observed by the parents.

REFERENCES