Hypokalemic Periodic Paralysis and Distal Renal Tubular Acidosis Associated with Renal Morphological Changes

RATAN GUPTA, KUMAR SAURABH, SHOBHA SHARMA AND RIYANKA GUPTA
From the Department of Pediatrics, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India.

Correspondence to:
Dr Ratan Gupta, Specialist Pediatrician at Department of Pediatrics, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India.
ratangupta100@yahoo.com.
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We report an unusual case of 5-yrs-old girl presenting with recurrent episodic weakness with documented hypokalemia, polyuria and failure to thrive. The child was finally diagnosed as having distal renal tubular acidosis. Imaging studies revealed associated hypoechoic spaces in renal medulla. Long term treatment with alkali and maintenance of normokalemia lead to regression of these morphological changes.

Key words: *Hypoechoeic medullary spaces, Hypokalemic periodic paralysis, Renal tubular acidosis (RTA).*

Hypokalemic periodic paralysis is a rare disorder causing recurrent episodic weakness. Most cases are hereditary due to various channelopathies. Distal renal tubular acidosis (RTA) is an uncommon secondary cause of HPP, more so in children, with only few cases reported till date. We report a case of HPP due to distal RTA who was also found to have renal medullary hypoechoeic changes.

CASE REPORT

A 5 yr old girl presented with weakness of all four limbs and neck without any preceding history of diarrhea or other illness. There was past history of two similar episodes of weakness in last 2 years, all occurring in evening and resolved spontaneously after variable period of time. Parents also gave history of polydipsia, polyuria and craving for salty foods. On examination, limbs were hypotonic with absent reflexes and a motor power of grade one in all limbs. There was no history of dysarthria, diplopia, respiratory difficulty or bladder and bowel involvement. Her weight (10 kg) and height (85cm) were below 3rd percentile for age. She was born of non-consanguineous marriage and was third in birth order.

Her serum sodium was 133 mEq/L (135-148), serum potassium 1.4 mEq/L (3.5-4.5), serum chloride 105 mEq/L (95-105), with ECG changes of hypokalemia. Intravenous therapy followed by oral potassium treatement brought serum potassium to 3.3 mEq/L. Serum calcium profile revealed a value of 8.4 mg/dL, Phosphorus of 3.1 mg/dL and alkaline phosphatase of 461 IU/L. Arterial blood gas analysis showed normal anion gap (14 mEq/L) metabolic acidosis with a pH of 7.28 (7.35-7.45), serum bicarbonate was 14 mEq/L. Blood sugar, renal and liver function tests were within normal limits.

Urine output was about 5 mL/kg/hr, with pH of 7.0, specific gravity of 1.005. Urine electrolytes showed urinary potassium of 25 meq/L and there was gross urinary potassium wasting as 24-hrs urinary potassium was 189 mEq/L (normal: 40-80). Fractional excretion of potassium was 22%. Urinary anion gap was positive (49 mEq/L) indicating decreased ammonium chloride secretion. Urine examination did not show any glucose, proteins or pus cells. Urinary calcium excretion was high as 24-hrs urinary calcium excretion was 193 mg in 24 hrs (> 4 mg/kg/d). Ammonium chloride test was carried out by giving 0.1 mg/kg ammonium chloride orally after obtaining blood pH, serum bicarbonate and urine pH. Six hours monitoring of these parameters revealed lack of acidification of urine in spite of increasing acidosis of blood from 7.40 to 7.25 suggesting distal RTA. Altogether all the tests were consistent with features of distal RTA.

X-ray wrist showed frank rickets with metaphyseal cupping and fraying. USG abdomen showed enlarged kidney with multiple hypoechoeic spaces in renal medulla of variable sizes in both kidneys taking shapes of all renal pyramids but density was not consistent with frank cysts (***Fig.* 1**). Cortcomedullary differentiation was maintained. To further delineate the structure of kidney CECT abdomen was done, which showed medullary prominence with relative thinned out cortex. Child was put on alkali therapy in the form of soda bicarbonate and polycitra solution along with calcium supplementation. After two years of therapy child is now asymptomatic, with serum sodium of 141 mEq/L, potassium of 3.9 mEq/L, chloride of 103 mEq/L, calcium of 10.5 mg/dL, bicarbonate of 24 mEq/L and arterial pH of 7.41. 24 hrs calcium excretion was 48 mg (normal <4 mg/kg/day). Patient has also achieved her weight and height around median for his age and sex. Imaging studies revealed a regression of hypoechoeic medullary spaces with a normal size kidney.

DISCUSSION

RTA is a recognized cause of severe hypokalemia and muscle paralysis in adults [1] but there are only few case reports showing such severe hypokalemia with distal RTA in children. Chang, *et al*. [2] reported 3 Chinese girls with HPP secondary to different types of RTA. In our case, we did not get other possible cause of secondary distal RTA like liver disorder, drug, toxins, urological disorders, rhabdomyolysis, which suggests the possibility of primary (hereditary) or sporadic cause of distal RTA in this patient, although mutational studies were not carried out to confirm this assumption. In literature, distal RTA is associated with renal cysts and medullary sponge kidney (MSK) which is also regarded to have causal association with distal RTA [3-5].

In our patient, imaging studies did not show any renal cyst or MSK, rather we had a very unusual presentation of hypoehoeic regions taking shape of renal pyramids in both kidneys and same was confirmed with CECT abdomen in form of prominent medulla. Ultrasonographic appearance of neonatal kidney is different from childrens and adults, the immature cortex in the neonate is thinner relative to the size of the pyramids so pyramids appear relatively large and hypoechoeic. Hypoechoeic renal pyramids may be a normal finding in neonates and infants but not in childrens [6].

Normally cyst formation is assumed to occur due to enhanced growth and proliferation of epithelial cells lining the cysts [7] as it has been seen that hypokalemia stimulates protein synthesis and cell division under experimental conditions [8,9]. This shows that severe hypokalemia promotes formation of renal cysts. In one study Torres, *et al*. [10] compared patients with aldosteronism and hypokalemia to those with controls with essential hypertension. They conclude that renal cysts formation may be due to severe hypokalemia rather than a simple association as removal of adrenal adenomas lead to regression of cysts which also corresponded to the normalization of serum potassium levels.

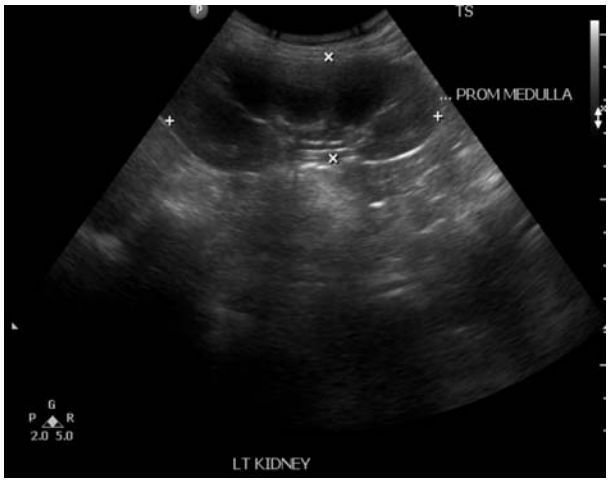

FIG.1 *USG abdomen showing multiple hypoechoic spaces of variable sizes in renal medulla.*

In this case, after two years of treatment and regular follow up there was regression of hypoechoeic spaces of renal medulla on imaging studies. Based on these observations, we postulate that hypoechoeic renal changes may be the initial steps in cyst formation which regressed due to early therapeutic intervention. Furthermore hypokalemia may be the etiological factor for these changes as long term correction of hypokalemia resulted in regression of these lesions.

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