Case report

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방광요관역류 환자에서 일과성 거짓저알도스테론증을 보인 6개월 소아 1 례

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Transient Pseudohypoaldosteronism in an Infant with Vesicoureteral Reflux

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A 6-month-old boy with vesicoureteral reflux exhibited features of transient type 1 pseudohypoaldosteronism (PHA) in the course of urinary tract infection. PHA presents hyponatremia, hyperkalemia, and metabolic acidosis, accompanying with high urinary sodium, low potassium excretion, and high plasma aldosterone concentration. Severe electrolyte disturbance can occur in an infant with vesicoureteral reflux because of secondary PHA. Appropriate treatment of dehydration and sodium supplementation induces rapid improvement of electrolyte imbalance and metabolic acidosis resulting from secondary PHA associated with vesicoureteral reflux.

Key Words: Failure to thrive, Infant, Pseudohypoaldosteronism, Vesicoureteral reflux

Introduction

Secondary forms of pseudohypoaldosteronism (PHA) have been rarely reported, most of which are associated with urinary tract malformation and acute pyelonephritis [1]. PHA is characterized by a state of renal tubular unresponsiveness to aldosterone, especially in infants who have immature renal tubules, and is manifested by hyponatremia, hyperkalemia, and metabolic acidosis [2]. We report a 6-month-old boy with transient PHA who had bilateral vesicoureteral reflux (VUR).

Case report

A 6-month-old male visited our emergency department because of a two-weeks history of mild diarrhea, poor appetite and poor weight gain. Two weeks ago, there was three days of high fever without vomiting, poor activity, cough, or rhinorrhea. He had taken medications for acute gastroenteritis. He was pale, but was not hypotonic and dehydrated. He was admitted because of serum electrolyte imbalance (serum Na^+ 118 mEq/L, K^+ 7.3 mEq/L, Cl^- 92 mEq/L, T-CO_2 10.9 mEq/L).

Delivery had been normal, his birth weight was 3.04 kg, and he had been breast-fed. Vital signs were blood pressure 100/56 mmHg, heart rate 132/minute, respiratory rate 30/minute, and body temperature 36.3℃. He weighed 7.04 kg (10 percentile) and 64.9 cm tall (10 percentile). Phimosis was noted. Initial laboratory findings were: arterial pH 7.346, PO_2 72.6 mmHg, PCO_2 18.7 mmHg, HCO_3^- 10.6 mEq/L, and base excess -13.8 mmol/L, Hgb 10.3 g/dL, WBC 28,980/mm3, platelet count 592,000/mm_3, CRP 2.4 mg/dL, ESR 80 mm/hr, protein 8.3 g/dL, albumin 4.9 g/dL, BUN/cr 31.2/0.6 mg/dL, Uric acid 5.5 mg/dL, T-bilirubin 0.19 mg/dL, GOT/GPT 134/106 IU/L, serum Osmolality 283 mOsm/kg, abnormal urinalysis (specific gravity ≤1.005, pH 6.0, occult blood 2+, protein 1+, nitrite +, leukocyte esterase 3+, RBC 5-10/high power field (HPF), and WBC many/HPF), urine electrolytes (Na+ 4 mEq/l, K^+ 20.2 mEq/L, Cl^- 23 mEq/L, creatinine 10.4 mEq/L, Osmolality 144 mOsm/kg), fractional excretion of sodium 0.2, and peaked T waves on EKG (Fig. 1). Two hours after his visit, the serum electrolytes were Na^+ 112 mEq/L, K^+ 6.7 mEq/L, Cl^- 87 mEq/L, and T-CO_2 10.9 mEq/L. Then he was admitted and the initial diagnosis was urinary tract infection (UTI) with hyponatremic dehydration. The intravenous administration of 45 mL (6 mL/kg) of 3% sodium chloride (NS) for 3 hours was started and then 150 mL infusion of 0.9% NS was done for 2 hours. Thereafter intravenous infusion was maintained with 5% dextrose in 0.9 % NS hydration (52 ml/hour) and was changed with maintenance fluid 15 hours after admission because the results of follow-up serum electrolytes were Na^+ 131 mEq/L, K^+ 3.6 mEq/L, Cl^- 101 mEq/L, and T-CO_2 17 mEq/L. Sodium bicarbonate (8.4%) was injected slowly at admission (7 mEq/L) and then was infused with 10 mEq/L/day. Intravenous ceftriaxone was initiated at admission.

Transient seconday PHA due to UTI was suspected. Transtubular potassium gradient 5.28, plasma rennin activity (PRA) was 96.6 ng/mL/hour (1.31-3.95), serum

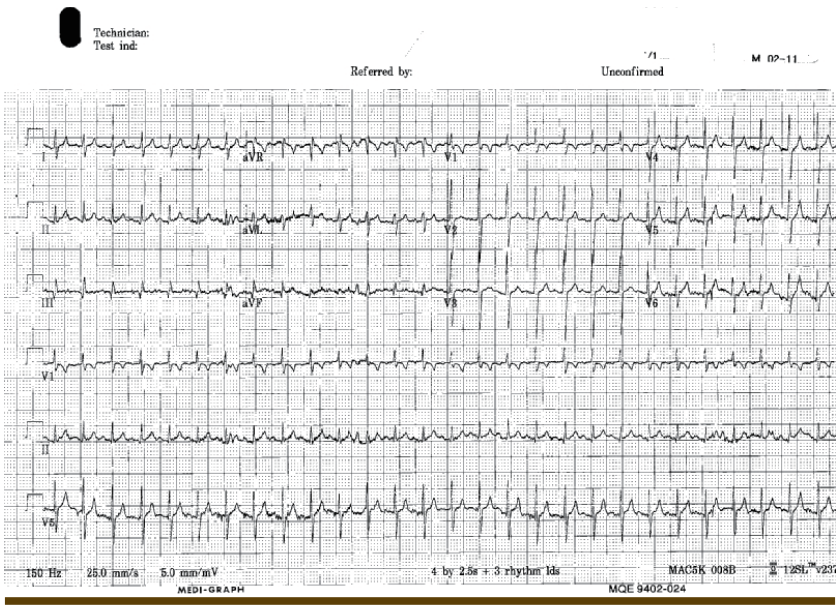

Fig. 1. Peaked T waves on lead V5 and V6.

aldosterone 207 ng/dL (1-16), serum cortisol 11.94 μg/dL (4.3-22.4), 17α-hydroxyprogesterone 1.5 ng/mL (<3.5). Gamma-streptococcus and serratia marcescens were cultured from urine (>10^5 CFU/mL). After genital cleansing with a mild soap, urine specimen was collected in a sterile urine bag. Renal sonogram showed both hydronephrosis (right grade 1 and left grade 2 by Society Fetal for Urology) and right hydroureter (5 mm) (Fig. 2a). ^{99m}Tc-dimercaptosuccinic acid (DMSA) renal scan showed multiple cortical defects in both kidneys (relative renal uptake of 24% in right kidney) (Fig. 2b). Voiding cystourethrogram (VCUG) showed bilateral vesicoureteral reflux (VUR) (right grade IV, left grade III) (Fig. 2c). Five days after admission, BUN, serum creatinine, and GOT/GPT were normalized with no significant symptom, and he was discharged. Thirteen days after admission, he visited our outpatient department with his weight of 8.1 kg (25-50 percentile).

Then, one month later ureteroneocystostomy was done according to the 2010 AUA guideline on management of primary VUR in children [3]. Four months after the operation, he weighed 10.2 kg (50-75 percentile) with normal level of serum electrolytes, PRA, and aldosterone (Na^+ 140 mEq/L, K^+ 4.8 mEq/L, Cl^- 105 mEq/L T-CO_2 26.1 mEq/L, PRA 2.7 ng/mL/hr, and aldosterone 4.9 ng/dL).

Discussion

Infancy, UTI, and urinary tract anomalies are contributing factors for the development of secondary PHA [4]. Aldosterone resistance occurring alongside urinary tract malformations with or without UTI has been recognized in infants with obstructive uropathy although urinary tract malformation is not a prerequisite for the development of electrolyte disturbance [1, 5]. Its natural history was not familiar to many pediatricians, but failure to thrive, weight loss, polyuria, dehydration, and hyponatremia with UTI were the presenting features in many of previously reported cases with secondary PHA.

In this case, there is lack of evidence for the diagnosis of UTI because it is possible that the urine culture of

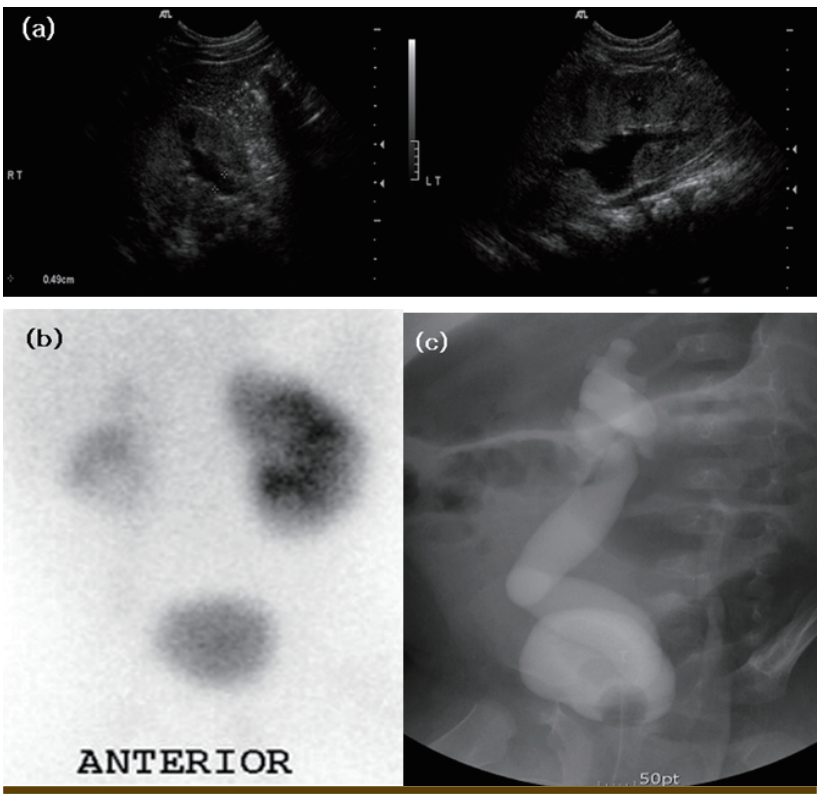

Fig. 2. (a) Bilateral hydronephrosis on renal sonogram; (b) multiple cortical defects on dimercaptosuccinic acid renal scan; (c) vesicoureteral reflux on voiding cystourethrogram.

which result was the growth of two separate organisms in urine collected by sterile urine bag was contaminated and the result of DMSA scan was a congenital atrophic renal scar rather than an acquired renal scar. He appeared not so dehydrated or hypotonic even though the hyponatremia and hyperkalemia was severe and the urinary excretion of sodium was low. Those findings imply a slow progression of electrolyte imbalance, and volume depletion that overrides aldosterone effect for tubular reabsorption of sodium. The reason for the overcorrection of hyponatremia by insufficient sodium supply might be that the depressed effects of aldosterone were overshot to some extent as volume repletion made tubular function begin to recover. Moreover, initial hydration and sodium supplementation made rapid improvement of electrolyte imbalance to near normal though it took 3 days till hyponatremia and metabolic acidosis were normalized completely.

Electrolyte disturbances cause non-specific clinical signs, such as vomiting, failure to thrive and dehydration, which may result in the development of life threatening complications such as cardiac dysrhythmias due to delayed diagnosis [6]. Moreover, PHA should be differentiated from congenital adrenal hyperplasia in salt wasting patients because each management is completely different. Thies et al. [7] reported on an infant with transient PHA, who was initially misdiagnosed as having CAH, leading to ventricular flutter. Treatment of secondary PHA includes volume resuscitation, treatment of UTI, and supplying sodium and bicarbonate and correction may be obtained within 24 hours [7-9].

In summary, severe electrolyte disturbance can occur in an infant with vesicoureteral reflux because of secondary PHA. Appropriate treatment of dehydration and sodium supplementation makes rapid improvement of electrolyte imbalance and metabolic acidosis resulted from secondary PHA in an infant with vesicoureteral reflux.

한글 요약

요로감염환자에서 이차성 거짓저알도스테론증이 발생할 수 있다는 보고들이 흔하지 않게 보고되고 있다. 많은 경우들에서는 요로계통의 기형을 동반하였으나, 요로계기형이 없는 급성 신우신염 환자들에서도 거짓저알도스테론증의 발생이 보고되었다. 대부분의 경우들은 영아에서 발생하였다. 거짓저알도스테론증은 저나트륨혈증, 고칼륨혈증, 그리고 대사성 산증을 특징으로 심할 경우 치명적인 결과를 초래할 수 있다. 더군다나, 본 증례에서와 같이 전해질 불균형에 의한 증세가 식욕부진, 성장장애(failure to thrive) 등으로 미미할 경우 이차성 거짓저알도스테론증의 조기 진단이 어려울 수 있다. 세뇨관 기능이 아직 미숙하고, 요로감염의 발병율이 높은 영아에서는 요로감염으로 진단시 저나트륨혈증, 고칼륨혈증 등의 전해질 불균형의 동반 가능성을 염두에 두어야 할 것으로 사려된다.

References

1) Maruyama K, Watanabe H, Onigata K. Reversible secondary pseudohypoaldosteronism due to pyelonephritits. Pediatr Nephrol 2002;17:1069-70.
2) Geller DS. Mineralocorticoid resistance. Clin Endocrinol 2005;62:513-20.
3) Peters CA, Skoog SJ, Arant BS Jr, Copp HL, Elder JS, Hudson RG, Khoury AE, Lorenzo AJ, Pohl HG, Shapiro E, Snodgrass WT, Diaz M. Summary of the AUA guideline on management of primary vesicoureteral reflux in children. J Urol 2010;184:1134-44.
4) Watanabe T. Reversible secondary pseudohypoaldosteronism. Pediatr Nephrol 2003;18:486.
5) Rodriguez-soriano J, Vallo A, Oliveros R, Castillo G. Transient pseudohypoaldosteronism secondary to obstructive uropathy in infancy. J Pediatr 1983;103:375-80.
6) Fujinaga S, Ohtomo Y, Someya T, Shimizu T, Yamashiro Y. Transient pseudohypoaldosteronism complicating acute renal failure in an infant with vesico-ureteral reflux and pyelonephritis. Pediatr Int 2009;51:744-6.
7) Thies KC, Boos K, Muller-Deile K, Ohrdorf W, Beushausen T, Townsend P. Ventricular flutter in a neonate: Severe electrolyte imbalance caused by urinary tract infection in the presence of urinary tract malformation. J Emerg Med 2000; 18:47-50.
8) Melzi ML, Guez S, Sersale G, Terzi F, Secco E, Marra G, Tirelli AS Assael BM. Acute pyelonephritis as a cause of hyponatremia/hyperkalemia in young infants with urinary tract malformations. Pediatr Infect Dis J 1995;14:56-9.
9) Mastrandrea LD, Martin DJ, Springate JE. Clinical and biochemical similarities between reflux/obstructive uropathy and salt-wasting congenital adrenal hyperplasia. Clini Pediatr (Phila) 2005;44:809-12.