Journal of Vessels and Circulation
Qom University of Medical Sciences

Spring 2024. Volume 5. Number 2

Case Report

A Case of Secondary Pseudohypoaldosteronism Presented With Severe Dehydration and Tachycardia and Hypotension

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Please cite this article as Farasat E, Modarresi Mosalla Z, Habibi Najafi N. A Case of Secondary Pseudohypoaldosteronism Presented With Severe Dehydration and Tachycardia and Hypotension. J Vessel Circ. 2024; 5(2):67-74. http://dx.doi.org/10.32598/JVC.5.2.168.2

http://dx.doi.org/10.32598/JVC.5.2.168.2

Article info:
Received: 12 Nov 2024
Accepted: 04 Feb 2025
Publish: 01 Apr 2024

Keywords:
Pseudohypoaldosteronism (PHA), Dehydration, Hypotension

ABSTRACT

Background and Aim: Secondary pseudohypoaldosteronism (S-PHA) is a rare condition characterized by resistance to aldosterone, leading to disturbances in electrolyte balance, particularly hyperkalemia and hyponatremia. It can arise from various underlying issues, including renal tubular immaturity and urinary tract anomalies. In this study, we report a case of S-PHA presenting with severe dehydration, tachycardia, and hypotension.

Case Presentation: A 27-day-old male infant presented with dehydration, hyponatremia, hyperkalemia, and metabolic acidosis. Investigations revealed elevated aldosterone and cortisol levels, a urinary tract infection (UTI), and severe bilateral vesicoureteral reflux (VUR) with hydronephrosis. He was treated with fluids, electrolytes, antibiotics, and steroids. At 6 months, he was doing well on steroid replacement and UTI prophylaxis, awaiting surgery for VUR. The case suggests S-PHA, likely secondary to the severe UTI and VUR.

Conclusion: In newborns and infants, secondary PHA can result in hyponatremia and hyperkalemia, conditions diagnosed using imaging techniques. The condition is linked to underdeveloped kidneys, urinary tract malformations (UTMs), and infections, but its precise mechanisms and etiology require further investigation.

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Introduction

Pseudohypoaldosteronism (PHA) occurs when the kidneys fail to respond to aldosterone. The primary forms, types 1 and 2, are inherited conditions, whereas PHA type 3, also referred to as secondary PHA (S-PHA), is a rare, temporary condition typically seen in children and often associated with urinary tract infections (UTIs) and or congenital abnormalities of the kidney and urinary tract (CAKUT) [1]. S-PHA is listed in Orphanet under the ORPHAcode 93164, and its pathogenesis has not been clearly defined. Since 1983, over 130 cases have been documented. Individuals with S-PHA exhibit vague symptoms like decreased appetite, nausea, or dehydration [2]. Although PHA is considered to have a good prognosis if treated early and appropriately, some cases show dangerous presentations, such as cardiac arrhythmia [3]. We reported a case of secondary PHA presenting with hyponatremia, severe dehydration, tachycardia, and UTI.

Case Report

A 27-day-old boy infant was presented with symptoms of poor feeding, lethargy, and severe dehydration. Physical examination revealed an unwell infant exhibiting pallor, poor feeding, and sunken eyes. The infant was born at full term with a birth weight of 2900 g to consanguineous parents; the pregnancy was uncomplicated. Genitalia was normal without hyperpigmentation. Laboratory investigations revealed hyponatremia (Na^+=120 mEq/L), hyperkalemia (K^+=6.9 mEq/L), metabolic acidosis (HCO_3^-=14 mmol/L), elevated serum aldosterone (>1000 pg/mL), and elevated cortisol (>63 µg/dL) (Table 1).

He required two normal saline boluses, oxygen, $NaHCO_3$, and hydrocortisone. In the urine analysis, WBC was 10-25, RBC was many and protein was 3+. The sample was taken with a urine catheter. The urine culture had grown non-hemolytic *Streptococcus* at 100,000 CFU/mL, while the blood culture had grown *Staphylococcus* (gram-negative). Cerebrospinal fluid (CSF) analysis and culture were normal. He was treated with ampicillin, cefotaxime, and vancomycin. After 1 day, the electrolytes were normal; after 7 days, the blood and urine cultures were negative, and he was discharged from the hospital after 11 days. Kidney sonography showed that the right kidney had severe hydronephrosis, and the left kidney had moderate hydronephrosis. In the dimercaptosuccinic acid (DMSA) scan, the right kidney exhibited moderate to severe hydronephrosis and globally impaired cortical function, with evidence of cortical distortion, particularly in the upper pole. The left kidney showed mild hydronephrosis and acceptable cortical function. A voiding cystourethrogram (VCUG) showed grade 5 reflux on both sides (Figures 1 , 2 and 3).

He was discharged with hydrocortisone and fludrocortisone. After 6 months of follow-up, he had no adrenal crises or electrolyte abnormalities, and amoxicillin was administered for him for prophylaxis of UTI, and he was referred for operation of VUR. The patient has been off hydrocortisone and fludrocortisone since 8 months of age and is currently taking 5 mL of amoxicillin 125 every night. He has not had surgery yet and is under the care of a kidney specialist, weighing 9.5 kg.

Discussion

Diagnosing such cases in infants is particularly important due to their rarity and clinical complexity. In this instance, the occurrence of adrenal insufficiency secondary to hyperaldosteronism and electrolyte imbalance, particularly hyperkalemia and hyponatremia, can lead to serious complications and potentially life-threatening situations. Additionally, the presence of hyperaldosteronism coupled with urinary anomalies such as grade 5 reflux increases the risk of UTIs, which may further complicate the clinical picture. This condition not only requires prompt and accurate diagnosis but also necessitates effective treatment and regular follow-up to prevent adrenal crises and minimize long-term complications. Thus, recognizing these disorders in infancy and managing them appropriately can significantly impact the quality of life for the patient and help prevent severe consequences in the future. In infants under one year old, a secondary form of PHA is frequently associated with UTIs and urinary tract malformations (UTMs). This condition is characterized by reduced aldosterone receptor function due to inflammation and pressure damage related to immature kidney distal tubules. Urinary toxins and aldosterone hypersecretion are thought to contribute to this aldosterone receptor downregulation [4, 5], but the pathogenic mechanisms are unclear. Infants with S-PHA present with nonspecific symptoms mirroring congenital adrenal hyperplasia (CAH), including poor feeding, poor weight gain, vomiting, diarrhea, and dehydration, both causing hyponatremia. Distinguishing them requires hormonal analysis: secondary PHA shows elevated renin and aldosterone with normal ACTH and cortisol, unlike CAH. Urinalysis and urinary tract imaging help identify the underlying UTI or UTM responsible for secondary PHA, differentiating it from CAH [4, 6].

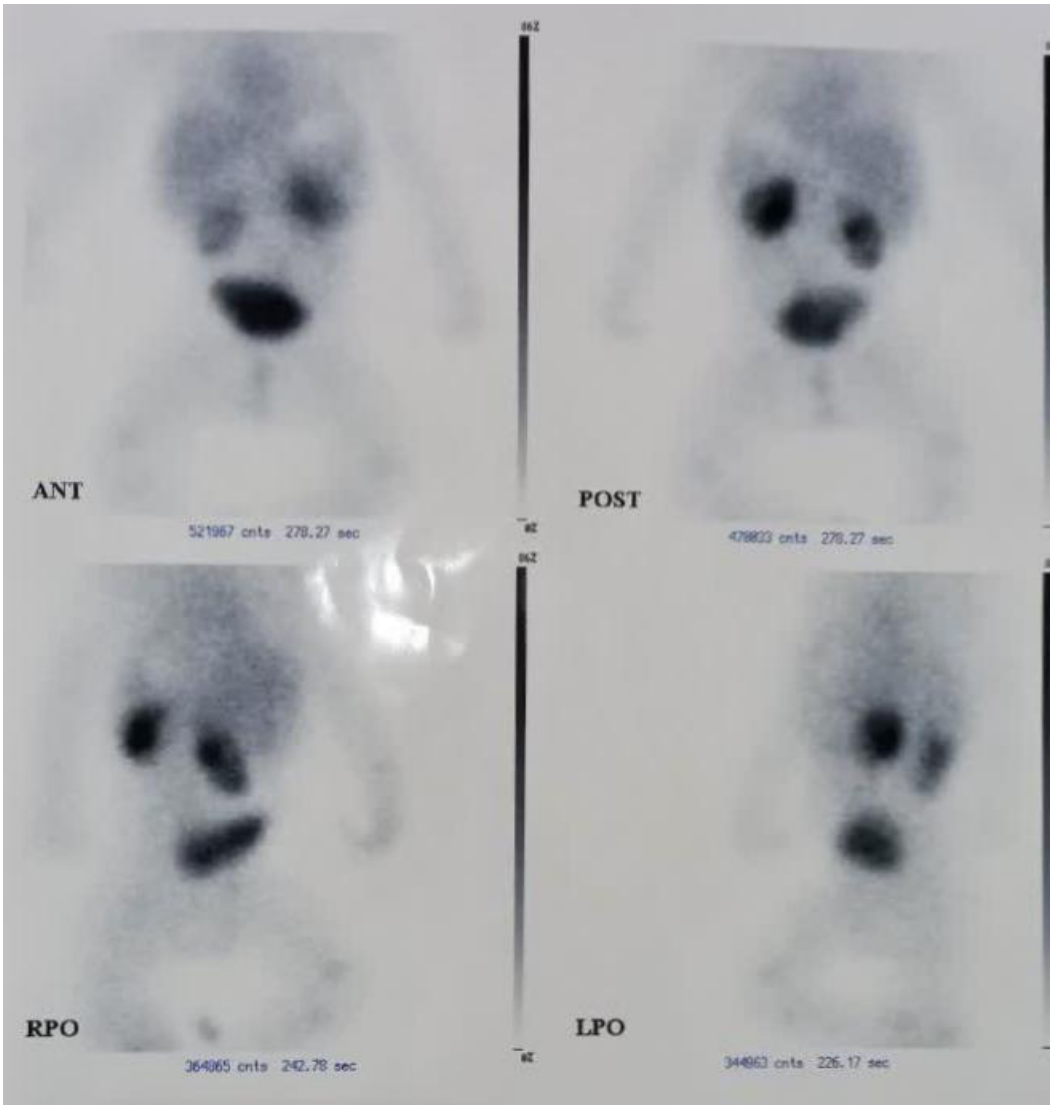

Figure 1. DMSA scan of right kidney

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Note: In DMSA, the right kidney has moderate to severe hydronephrotic and globally impaired cortical function with evidence of cortical distortion, particularly in the upper pole.

In our case, the absence of strong physical findings suggestive of CAH, coupled with improved vitality after fluid replacement and ultrasound confirmation of a UTM, led to the administration of glucocorticoids. Specific reports suggest that patients should receive glucocorticoid treatment until the results of endocrine tests are obtained [7, 8]. Since Moll et al. first reported secondary PHA in 1982, more than 100 cases have been documented globally. Around 90% of secondary PHA cases occur within the first three months of life. After this period, its occurrence becomes less common and seldom results in electrolyte imbalances [9]. The serum sodium level in our case was 120 mEq/L, urea was 319 mg/dL, and creatinine was 1.69 mg/dL. While secondary PHA is generally associated with a favorable prognosis, some reported cases of infants experienced severe complications, such as seizures and altered consciousness due to hyponatremia, life-threatening arrhythmias caused by hyperkalemia, as well as circulatory failure and shock [2].

Therefore, early diagnosis is essential [6]. Elevated intrarenal pressure decreases aldosterone receptors in infants suffering from UTM or vesicoureteral reflux (VUR). Furthermore, the presence of immature kidney tubules and UTM in children triggers an increase in the production of various cytokines in the kidneys, including tumor necrosis factor-β1 and tumor necrosis factor-α, which might inhibit the effect of aldosterone [10]. Secondary PHA in infants under one year presents a diag-

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Table 1. Analysis of serial laboratory results

Variables	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12
BS (mg/dL)	84	96	112	146	112	98	117	123				
Urea (mg/dL)	329	226	197	142	110	69	34	34	28	20		
Cr (mg/dL)	1.67	1.5	1.45	1.25	1.1	1	1.1	0.9	0.9	0.8		
Na (mmol/L)	120	124	124	136	137	145	139	137	144	142	140	142
K (mmol/L)	6.9	5.8	4.5	4	3.6	4.4	4.8	4.9	5.3	4.7	5.1	4.7
Ca (mg/dL)	9.5											
Lactate (mmol/L)	15.4											
Mg (mg/dL)	2.1											
P (mg/dL)	7.11	7.10	7.20	7.23	7.23	7.34	7.28	7.17	7.35	7.38		
PCO_2 (mmHg)	14.2	19.5	11.7	10	16.8	16.5	24.4	32.3	25.9	27.3		
HCO_3 (mmol/L)	4.4	5.9	4.5	4.4	6.8	8.8	11.2	10.2	13.5	16		
CRP (mg/L)	1	6										
S/E	NL											
S/C	-											
WBC (10^3/µL)	16.7	14.6	15.82									
Hb (g/dL)	14	10.7	9.4									
Plt (10^3/µL)	657000	697000	644000									
TSH (mIU/L)	9.9	1.9										
T4 (µg/dL)	5.6	9.2										
Testosterone (ng/dL)	0.4											
Androstenedione (ng/mL)	5.2											
ACTH (pg/mL)	8.4											
Cortisol (µg/dL)	>63.44											
Aldosterone (pg/mL)	>1000											
17-OH progesterone (ng/mL)	14.4											
DHEA-S (µg/dL)	1.54											
Cl (mmol/L)	116											

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Abbreviations: S/E: Stool exam; s/c: Stool culture; BS: Blood sugar; T4: Thyroxine; TSH: Thyroid-stimulating hormone; Plt: Platelets; Hb: Hemoglobin; WBC: White blood cells; CRP: C-reactive protein; ACTH: Adrenocorticotropic hormone; DHEA-S: Dehydroepiandrosterone sulfate.

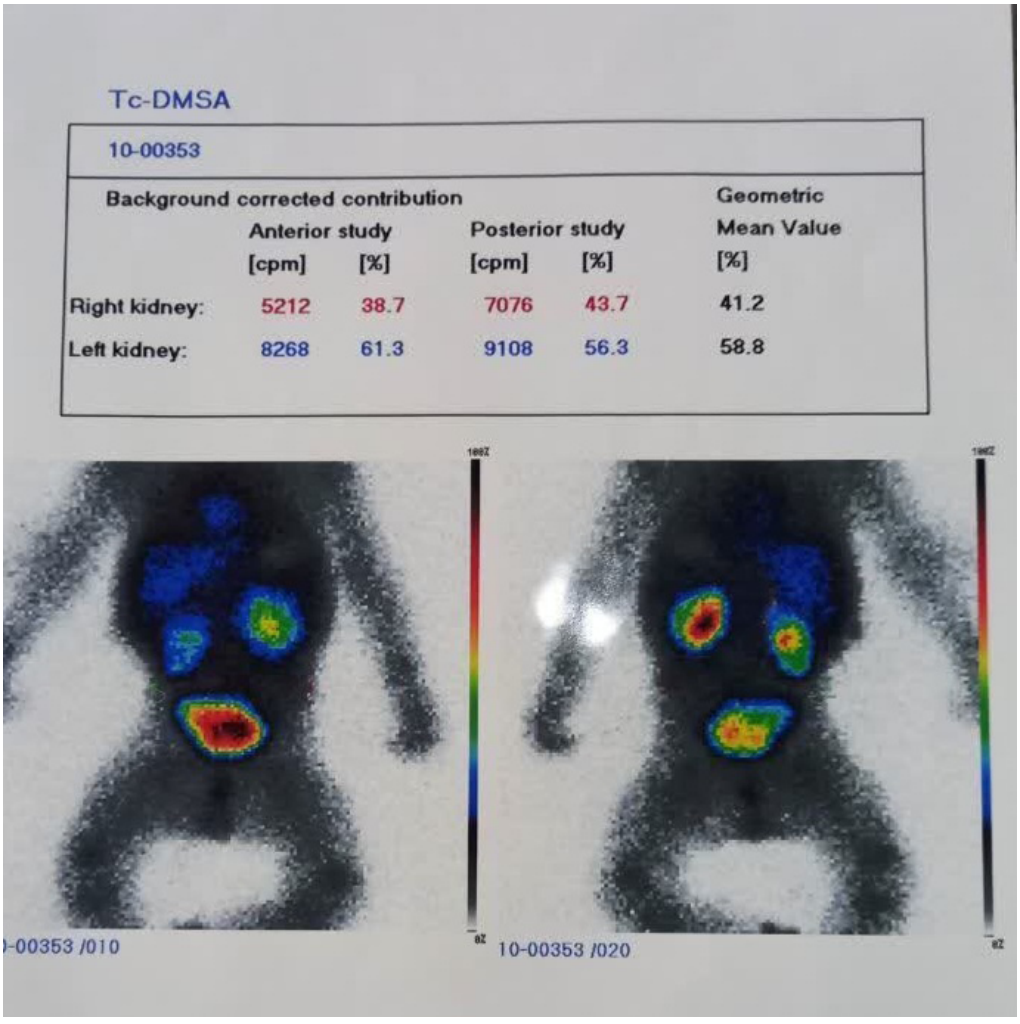

Figure 2. DMSA scan

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nostic and management challenge due to its nonspecific symptoms, often mimicking CAH. Accurate diagnosis requires measuring serum renin and aldosterone levels. Management involves a multidisciplinary approach, including fluid resuscitation, electrolyte monitoring, and potentially glucocorticoids. UTMs or UTIs complicate the condition. Serious complications like dehydration, electrolyte imbalances (hyponatremia, hyperkalemia), seizures, arrhythmias, and circulatory failure necessitate vigilant monitoring and caregiver education. While prognosis is generally good, outcome variability highlights the need for further research into pathophysiology and improved treatment strategies.

Conclusion

Secondary PHA should be considered one of the causes of hyponatremia and hyperkalemia in infants and newborns, and it can be diagnosed through imaging. This condition has been associated with the immaturity of renal tubules, UTM and UTI. However, its pathophysiology and primary causes remain unknown. Further progress in elucidating the pathology, including basic research, is necessary for the future.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Qom University of Medical Sciences, Qom, Iran (Code: IR.MUQ.REC.1403.107).

Funding

This research did not receive any grant from funding agencies in the public, commercial, or non-profit sectors.

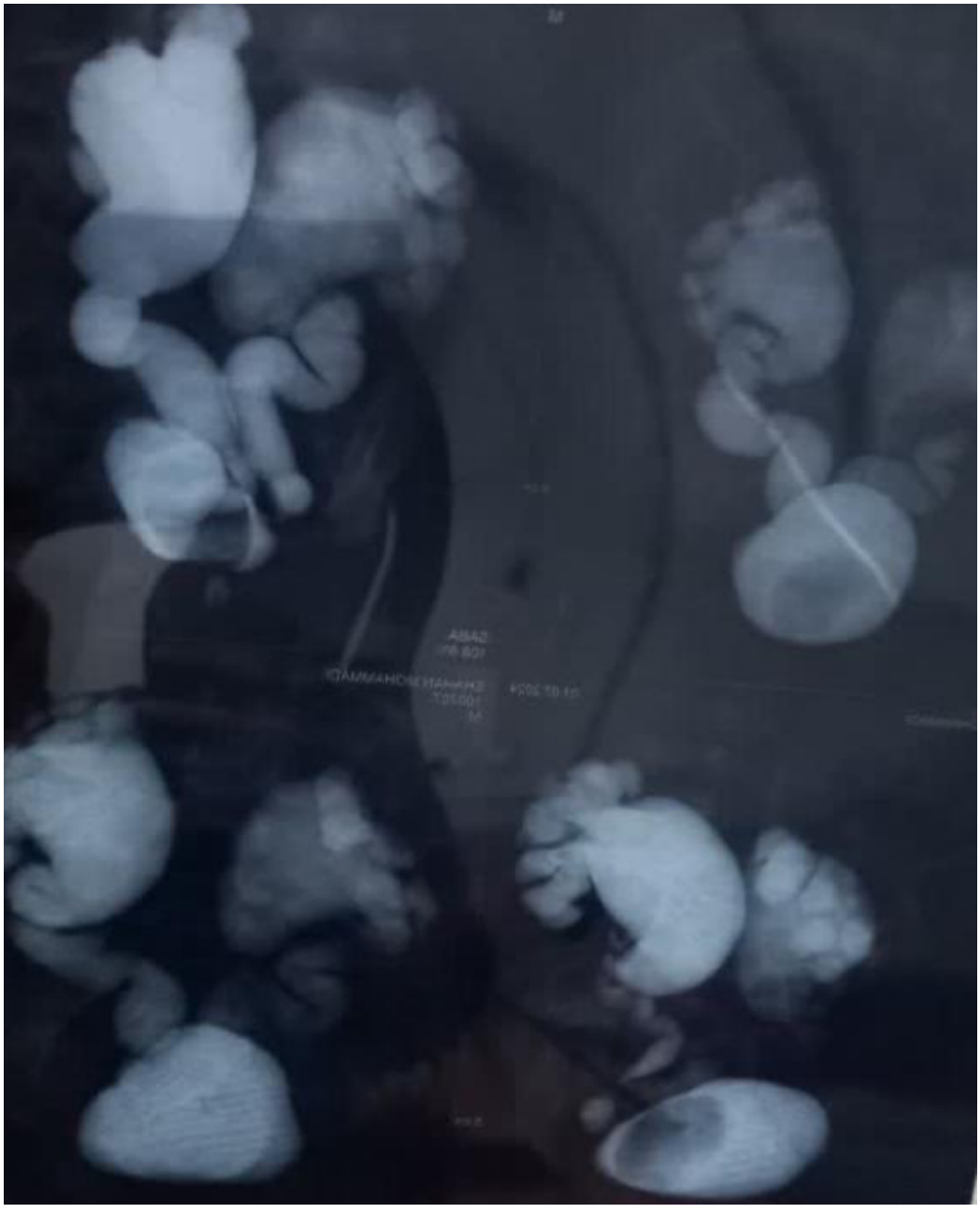

Figure 3. The VCUG reflux grade 5 on both sides

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Authors' contributions

All authors equally contributed to this study.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

The authors want to express their deepest gratitude to all those who supported them in publishing this article.

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