

World Journal of *Clinical Cases*

World J Clin Cases 2022 March 26; 10(9): 2660-2975



Contents

Thrice Monthly Volume 10 Number 9 March 26, 2022

REVIEW

- 2660 Role of metabolites derived from gut microbiota in inflammatory bowel disease
Zheng L, Wen XL, Duan SL

MINIREVIEWS

- 2678 Roles of Wnt/ β -catenin signaling pathway related microRNAs in esophageal cancer
Chu CY, Wang R, Liu XL
- 2687 Animal models applied to acute-on-chronic liver failure: Are new models required to understand the human condition?
Gama JFG, Cardoso LMDF, Lagrota-Candido JM, Alves LA

ORIGINAL ARTICLE

Case Control Study

- 2700 Associations between coagulation factor XII, coagulation factor XI, and stability of venous thromboembolism: A case-control study
Meng Y, Li Y, Ye YJ, Ma Q, Zhang JB, Qin H, Deng YY, Tian HY

Retrospective Cohort Study

- 2710 Nomogram to predict the risk of endoscopic removal failure with forceps/baskets for treating submandibular stones
Huang Y, Liang PS, Yang YC, Cai WX, Tao Q
- 2721 Association between anesthesia technique and complications after hip surgery in the elderly population
Guo LS, Wang LN, Xiao JB, Zhong M, Zhao GF

Retrospective Study

- 2733 Perforating and nonperforating indications in repeated surgeries for Crohn's disease
Shen WS, Huang XH, Liu RQ, Li CY, Li Y, Zhu WM
- 2743 Treatment of *Pneumocystis jirovecii* pneumonia in non-human immunodeficiency virus-infected patients using a combination of trimethoprim-sulfamethoxazole and caspofungin
Wu HH, Fang SY, Chen YX, Feng LF
- 2751 Acute kidney injury in traumatic brain injury intensive care unit patients
Huang ZY, Liu Y, Huang HF, Huang SH, Wang JX, Tian JF, Zeng WX, Lv RG, Jiang S, Gao JL, Gao Y, Yu XX
- 2764 Enucleation combined with guided bone regeneration in small and medium-sized odontogenic jaw cysts
Cao YT, Gu QH, Wang YW, Jiang Q

Clinical Trials Study

- 2773 Determination of the ED₉₅ of intranasal sufentanil combined with intranasal dexmedetomidine for moderate sedation during endoscopic ultrasonography

Zou Y, Li N, Shao LJZ, Liu FK, Xue FS, Tao X

Observational Study

- 2783 Overexpression of Ubiquilin4 is associated with poor prognosis in patients with cervical cancer

Wang LN, Huang KJ, Wang L, Cheng HY

Randomized Clinical Trial

- 2792 Peplau's interpersonal relationship theory combined with bladder function training on patients with prostate cancer

Yang XH, Wu LF, Yan XY, Zhou Y, Liu X

SYSTEMATIC REVIEWS

- 2801 Efficacy of bone grafts in jaw cystic lesions: A systematic review

Wang J, Yao QY, Zhu HY

CASE REPORT

- 2811 Short stature associated with a novel mutation in the aggrecan gene: A case report and literature review

Yin LP, Zheng HX, Zhu H

- 2818 Treatment with sorafenib plus camrelizumab after splenectomy for primary splenic angiosarcoma with liver metastasis: A case report and literature review

Pan D, Li TP, Xiong JH, Wang SB, Chen YX, Li JF, Xiao Q

- 2829 Sarcomatoid intrahepatic cholangiocarcinoma with good patient prognosis after treatment with Huaier granules following hepatectomy: A case report

Feng JY, Li XP, Wu ZY, Ying LP, Xin C, Dai ZZ, Shen Y, Wu YF

- 2836 Sequential occurrence of T790M mutation and small cell lung cancer transformation in EGFR-positive lung adenocarcinoma: A case report

Hong E, Chen XE, Mao J, Zhou JJ, Chen L, Xu JY, Tao W

- 2844 Early diagnosis of Gitelman syndrome in a young child: A case report

Wu CY, Tsai MH, Chen CC, Kao CH

- 2851 Congenital intestinal malrotation with gastric wall defects causing extensive gut necrosis and short gut syndrome: A case report

Wang Y, Gu Y, Ma D, Guo WX, Zhang YF

- 2858 Delusional parasitosis as premotor symptom of parkinson's disease: A case report

Oh M, Kim JW, Lee SM

- 2864** Laninamivir-induced ischemic enterocolitis: A case report
Suzuki C, Kenzaka T
- 2871** Intramural pregnancy after *in vitro* fertilization and embryo transfer: A case report
Xie QJ, Li X, Ni DY, Ji H, Zhao C, Ling XF
- 2878** Bilateral ureteral reimplantation in a patient with an intraperitoneal ectopic bipenis: A case report
Jia YT, Shi BL, Zhang J, Li YY, Zhu J
- 2883** Lumbar disc sequestration mimicking a tumor: Report of four cases and a literature review
Li ST, Zhang T, Shi XW, Liu H, Yang CW, Zhen P, Li SK
- 2895** Parasitic leiomyoma in the trocar site after laparoscopic myomectomy: A case report
Roh CK, Kwon HJ, Jung MJ
- 2901** Giant nontraumatic myositis ossificans in a child: A case report
Xia AN, Wang JS
- 2908** Paradoxical carbon dioxide embolism during laparoscopic hepatectomy without intracardiac shunt: A case report
Jeon S, Hong JM, Lee HJ, Kim Y, Kang H, Hwang BY, Lee D, Jung YH
- 2916** Local hyperthermia combined with chemotherapy for the treatment of multiple recurrences of *undifferentiated pleomorphic sarcoma*: A case report
Zhou YT, Wang RY, Zhang Y, Li DY, Yu J
- 2923** Acute coronary artery stent thrombosis caused by a spasm: A case report
Meng LP, Wang P, Peng F
- 2931** Turner syndrome with primary myelofibrosis, cirrhosis and ovarian cystic mass: A case report
Xu LW, Su YZ, Tao HF
- 2938** Esophageal myoepithelial carcinoma: Four case reports
Lu H, Zhao HP, Liu YY, Yu J, Wang R, Gao JB
- 2948** Ipsilateral hemifacial microsomia with dextrocardia and pulmonary hypoplasia: A case report
Guo R, Chang SH, Wang BQ, Zhang QG
- 2954** Upper gastrointestinal bleeding from a Mallory-Weiss tear associated with transesophageal echocardiography during successful cardiopulmonary resuscitation: A case report
Tang MM, Fang DF, Liu B
- 2961** Malignant struma ovarii with papillary carcinoma combined with retroperitoneal lymph node metastasis: A case report
Xiao W, Zhou JR, Chen D

- 2969** Occult colon cancer with sepsis as the primary manifestation identified by bone marrow puncture: A case report

Wang HJ, Zhou CJ

ABOUT COVER

Editorial Board Member of *World Journal of Clinical Cases*, Arunchai Chang, MD, Assistant Professor, Lecturer, Staff Physician, Division of Gastroenterology, Department of Internal Medicine, Hatyai Hospital, Hatyai 90110, Songkhla, Thailand. busmdcu58@gmail.com

AIMS AND SCOPE

The primary aim of *World Journal of Clinical Cases* (WJCC, *World J Clin Cases*) is to provide scholars and readers from various fields of clinical medicine with a platform to publish high-quality clinical research articles and communicate their research findings online.

WJCC mainly publishes articles reporting research results and findings obtained in the field of clinical medicine and covering a wide range of topics, including case control studies, retrospective cohort studies, retrospective studies, clinical trials studies, observational studies, prospective studies, randomized controlled trials, randomized clinical trials, systematic reviews, meta-analysis, and case reports.

INDEXING/ABSTRACTING

The WJCC is now indexed in Science Citation Index Expanded (also known as SciSearch®), Journal Citation Reports/Science Edition, Scopus, PubMed, and PubMed Central. The 2021 Edition of Journal Citation Reports® cites the 2020 impact factor (IF) for WJCC as 1.337; IF without journal self cites: 1.301; 5-year IF: 1.742; Journal Citation Indicator: 0.33; Ranking: 119 among 169 journals in medicine, general and internal; and Quartile category: Q3. The WJCC's CiteScore for 2020 is 0.8 and Scopus CiteScore rank 2020: General Medicine is 493/793.

RESPONSIBLE EDITORS FOR THIS ISSUE

Production Editor: *Ying-Yi Yuan*, Production Department Director: *Xiang Li*, Editorial Office Director: *Jin-Lei Wang*.

NAME OF JOURNAL

World Journal of Clinical Cases

ISSN

ISSN 2307-8960 (online)

LAUNCH DATE

April 16, 2013

FREQUENCY

Thrice Monthly

EDITORS-IN-CHIEF

Bao-Gan Peng, Jerzy Tadeusz Chudek, George Kontogeorgos, Maurizio Serati, Ja Hyeon Ku

EDITORIAL BOARD MEMBERS

<https://www.wjgnet.com/2307-8960/editorialboard.htm>

PUBLICATION DATE

March 26, 2022

COPYRIGHT

© 2022 Baishideng Publishing Group Inc

INSTRUCTIONS TO AUTHORS

<https://www.wjgnet.com/bpg/gerinfo/204>

GUIDELINES FOR ETHICS DOCUMENTS

<https://www.wjgnet.com/bpg/GerInfo/287>

GUIDELINES FOR NON-NATIVE SPEAKERS OF ENGLISH

<https://www.wjgnet.com/bpg/gerinfo/240>

PUBLICATION ETHICS

<https://www.wjgnet.com/bpg/GerInfo/288>

PUBLICATION MISCONDUCT

<https://www.wjgnet.com/bpg/gerinfo/208>

ARTICLE PROCESSING CHARGE

<https://www.wjgnet.com/bpg/gerinfo/242>

STEPS FOR SUBMITTING MANUSCRIPTS

<https://www.wjgnet.com/bpg/GerInfo/239>

ONLINE SUBMISSION

<https://www.f6publishing.com>



Early diagnosis of Gitelman syndrome in a young child: A case report

Chun-Yen Wu, Ming-Hsein Tsai, Chia-Chun Chen, Chuan-Hong Kao

Specialty type: Pediatrics

Provenance and peer review:

Unsolicited article; Externally peer-reviewed.

Peer-review model: Single-blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0

Grade B (Very good): 0

Grade C (Good): C, C

Grade D (Fair): D, D

Grade E (Poor): 0

P-Reviewer: Mogahed EA, Navarrete Arellano M, Rodrigues AT, Wierzbicka A

Received: August 23, 2021

Peer-review started: August 23, 2021

First decision: November 17, 2021

Revised: December 11, 2021

Accepted: February 19, 2022

Article in press: February 19, 2022

Published online: March 26, 2022



Chun-Yen Wu, Chia-Chun Chen, Chuan-Hong Kao, Department of Pediatrics, Far Eastern Memorial Hospital, New Taipei City 220, Taiwan

Ming-Hsein Tsai, Department of Internal Medicine, Shin-Kong Wu Ho-Su Memorial Hospital, Taipei 111, Taiwan

Corresponding author: Chuan-Hong Kao, MD, MS, Attending Doctor, Department of Pediatrics, Far Eastern Memorial Hospital, No. 21 Sec. 2, Nanya S. Road, Banciao District, New Taipei City 220, Taiwan. kche4324@gmail.com

Abstract

BACKGROUND

Gitelman syndrome (GS) is an autosomal recessive renal tubular disorder characterized by renal wasting hypokalemia, metabolic alkalosis, hypomagnesemia, and hypocalciuria. It is usually caused by mutations in the gene *SLC12A3*, which encodes the thiazide-sensitive Na-Cl cotransporter. GS is not usually diagnosed until late childhood or adulthood.

CASE SUMMARY

Here, we report the case of a one-year-old girl who was brought to the emergency department due to persistent vomiting for two days. On admission to our hospital, generalized weakness was observed, and laboratory investigations revealed severe hypokalemia (1.9 mmol/L). However, persistent hypokalemia was observed during outpatient follow-up. Suspicion of the GS phenotype was assessed *via* the patient's clinical presentation, family history, and biochemical analysis of blood and urine. Further genetic analysis was performed for her and her family by exon-wide sequencing analysis of the gene *SLC12A3*. The genetic diagnosis of GS was established in the Taiwanese family with three affected individuals, two of whom were children (7 years/17 years) without obvious symptoms, with the youngest being only one year old (patient in our case).

CONCLUSION

We successfully demonstrated the early diagnosis of GS using family genetic analysis. Any instances of hypokalemia should not be neglected, as early detection of GS with suitable treatment can prevent patients from potentially life-threatening complications.

Key Words: Children; Hypokalemia; Hypomagnesemia; *SLC12A3*; Gitelman syndrome;

Case report

©The Author(s) 2022. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: In this study, the genetic diagnosis of Gitelman syndrome (GS) was established in a Taiwanese family with three affected individuals, two of them being young children without obvious symptoms, with the youngest child being only one year old. We further describe the case of the one-year-old girl brought to the emergency department due to persistent vomiting for two days. We believe that our report makes a significant contribution to the literature because we successfully demonstrated the early diagnosis of a case of GS using family genetic analysis. The early diagnosis and treatment of this condition can help prevent potentially life-threatening conditions.

Citation: Wu CY, Tsai MH, Chen CC, Kao CH. Early diagnosis of Gitelman syndrome in a young child: A case report. *World J Clin Cases* 2022; 10(9): 2844-2850

URL: <https://www.wjgnet.com/2307-8960/full/v10/i9/2844.htm>

DOI: <https://dx.doi.org/10.12998/wjcc.v10.i9.2844>

INTRODUCTION

Hypokalemia is defined as a serum potassium level of less than 3.5 mmol/L and may develop into life-threatening complications in some patients[1]. It can be caused either by inadequate potassium intake, increased potassium excretion in the urine, or increased potassium excretion through the gastrointestinal tract. Gastrointestinal losses of potassium are the most common, secondary to conditions such as prolonged diarrhea, vomiting, diuretic use, or infections[2]. However, genetic causes of hypokalemia, such as the inherited renal tubular disorders, Bartter (BS) and Gitelman (GS) syndromes, are relatively rare; and their diagnosis is challenging especially in children[3]. Most cases of BS are noted in neonates due to polyuria or maternal polyhydramnios; in contrast, the symptoms of GS are milder and it is commonly diagnosed during adulthood[4].

GS is an inherited renal tubular disorder characterized by hypokalemia, metabolic alkalosis, hypomagnesemia, and hypocalciuria. It is recessively inherited and caused by mutations in the gene *SLC12A3*, which encodes for the thiazide-sensitive Na-Cl cotransporter. The estimated GS prevalence is 1:40000. More than 180 different mutations in the gene *SLC12A3* have been identified[5].

GS is often diagnosed in adults with muscle weakness and cramps associated with frequent fatigue or reduction in daily activity. Patients with GS do not show symptoms throughout infancy and preschool years, and they are often discovered incidentally[4,6]. Although GS is described as an asymptomatic or benign disorder, it may develop life-threatening complications, such as ventricular arrhythmia, in some cases[7]. Early detection with suitable treatment may prevent potentially dangerous complications. In this study, we successfully demonstrated an early diagnosis of GS using family genetic analysis.

CASE PRESENTATION

Chief complaints

A one-year-and-10-month-old Taiwanese girl was admitted to our hospital because of acute gastroenteritis with severe vomiting and diarrhea for two days.

History of present illness

The index patient was referred to our genetic clinic because of unusually severe hypokalemia. She had been recently admitted to our hospital because of acute gastroenteritis with severe vomiting and diarrhea for 2 d. On admission, we noted generalized weakness. Laboratory investigations showed severe hypokalemia (1.9 mmol/L) (Table 1). The patient was treated with intravenous potassium supplementation (potassium chloride, 0.15 mEq/kg of body weight per hour) under the diagnosis of hypokalemia related to acute gastroenteritis. The patient's symptoms gradually improved after treatment. Therefore, the patient was discharged, and post-discharge follow-up was suggested.

History of past illness

Based on the birth history, the girl was previously healthy and denied any systemic diseases.

Table 1 Summary of laboratory values

	ED	Admission	OPD	Unit (normal range)	
Blood					
Cr	0.18		0.12	mg/ dL	0.5-0.9
Na	136	138	131	mmol/L	136-146
K	1.9	3.1	2.9	mmol/L	3.5-5.1
Ca	9.1	9.7		mg/ dL	8.6-10.3
Cl	94		91	mmol/L	101-109
Mg	1.9		1.9	mg/ dL	1.9-2.7
Osmolarity			271	mOsmol/Kg	280-305
TSH		4.0		μIU/ mL	0.27-4.2
Free T4		1.94		ng/ dL	0.8-2.0
ACTH			12.65	pg/ mL	10-60
Cortisol (8AM)			8.77	μg/ dL	5-25
Aldosterone			6.1	ng/ dL	0.75-15
Renin			168.0	pg/ mL	
VBG					
pH	7.558	7.442	7.545		7.31-7.41
PCO2	31.2	41.4	28.3	mmHg	41-57
HCO3-	27.2	27.6	23.9	mmol/ L	23-30
Spot urine					
Na		74	81	mmol/ L	
K		23	39	mmol/ L	25-120
Cl			64	mmol/ L	110-250
Cr			28.17	mg/ dL	
Osmolarity			412	mOsmol/ Kg	200-1200
K/Cr ratio			15.6	mmol/ mmol	
TTKG			8.9		
24 Hrs Urine					
Total Volume			210	ml	
Na (Sodium) urine			95	mmol/ L	
K(Potassium) urine			34	mmol/ L	25-120
Cl (Chloride) Urine			442	mmol/ L	110-250
Ca (Calcium) Urine			0.4	mg/ dL	6.8-21.3
Ca/Cr ratio			0.01		

We can see the changes of laboratory values of the index patient from emergency department, admission, and at out-patient follow-up. ED: Emergency department; OPD: Ordinary patient department; Cr: Creatinine; TSH: Thyroid stimulating hormone; ACTH: Adrenocorticotrophic hormone; VBG: Venous blood gas; TTKG: Trans-tubular potassium gradient.

Personal and family history

During a consultation held at our hospital, the patient's mother said that her 7-year-old daughter was also diagnosed with hypokalemia at another hospital, but no further investigations were performed. In addition, her 17-year-old daughter had been experiencing muscle cramps and muscle pain associated with a severe reduction in daily activities for several years.

Physical examination

No history of salt-craving, tetany, motor developmental delay, arthralgia, or arthritis was observed. Her growth parameters and blood pressure were also within the normal range.

Laboratory examinations

During outpatient follow-up, recurrent severe hypokalemia (2.6 mmol/L) was observed. Subsequent laboratory investigations, including blood analysis, showed metabolic alkalosis with hypokalemia (2.9 mmol/L) and borderline hypomagnesemia (1.9 mg/dL). Normal thyroid, adrenal function, plasma renin, and aldosterone levels were noted. Urinalysis revealed renal potassium wasting (urine potassium 39 mmol/L, urine potassium-creatinine ratio 15.6 mmol/mmol, transtubular potassium gradient (TTKG) 8.9), increased level of urine chloride (64 mmol/day), and hypocalciuria (0.4 mg/dL, urine calcium to creatinine ratio 0.01). Based on the above laboratory findings, a renal tubular disorder was highly suspected. Further, family history revealed that the hypokalemia might have been due to genetic processes.

Laboratory investigations showed that potassium levels were as follows: eldest daughter, 1.9 mmol/L; second eldest daughter, 4.1 mmol/L; third eldest daughter, 2.1 mmol/L; and index patient, 2.4 mmol/L. In addition, the potassium levels of the mother and father were 4.5 mmol/L and 4.2 mmol/L, respectively. To date, some autosomal recessive tubular disorders presenting with hypokalemia, metabolic alkalosis, and hypocalciuria have been established in the family.

Venous blood samples were obtained from the three affected individuals with severe hypokalemia and their parents after detailed informed consent. Blood samples were sent to the DNA diagnostics laboratory (SOFIVA GENOMICS). According to their established protocols, the laboratory performed an exon-wide sequencing analysis of the gene *SLC12A3*. Genetic analysis of the gene *SLC12A3* in the three affected individuals with severe hypokalemia revealed compound heterozygous mutations of the gene *SLC12A3*: c.179C>T in exon1 and c.965-1_976delinsACCGAAAATTTT in exon8, respectively. These two mutations are known to be associated with GS (Figure 1A). Both parents were heterozygous carriers of GS-associated mutations found in their daughters. The mother was the carrier of c.179C>T, and the father was the carrier of c.965-1_976delinsACCGAAAATTTT (see Figure 1B).

FINAL DIAGNOSIS

GS, with compound heterozygous mutations of the gene *SLC12A3*: c.179C>T in exon1 and c.965-1_976delinsACCGAAAATTTT in exon8.

TREATMENT

In this study, GS was diagnosed genetically in a Taiwanese family with three affected individuals presenting with severe hypokalemia (less than 2.5 mmol/L), two of whom were young children without obvious symptoms, with the youngest being a one-year-old female toddler. These three girls started treatment of oral potassium supplementation (potassium gluconate) and nonsteroidal anti-inflammatory drugs (NSAIDs) (indomethacin, daily dose of 1 mg/kg/day). Due to gastrointestinal side effects being common (especially diarrhea) and serum magnesium level above 1.6 mg/dL, magnesium supplementation was withheld. Because of the side effects of NSAIDs and their stable condition, oral medications were shifted to potassium-sparing diuretics (spironolactone) 2 years later.

OUTCOME AND FOLLOW-UP

These patients were followed up in the outpatient department for regular monitoring of their serum potassium/ magnesium levels.

DISCUSSION

Hypokalemia is a common clinical problem, especially in hospitalized patients. Blood and urine tests, such as venous blood gas, serum concentrations of sodium, chloride, magnesium, aldosterone, renin, and urine concentrations of calcium, should be obtained to determine the etiology, such as decreased intake, increased intracellular uptake, gastrointestinal loss, or increased urinary loss[8,9].

Genetic tubular disorders are a source of hypokalemia caused by increased urinary potassium loss. Because of mutations in genes encoding tubular transport proteins involved in sodium reabsorption, patients' sodium absorption is disrupted, leading to increased distal delivery of sodium, which results

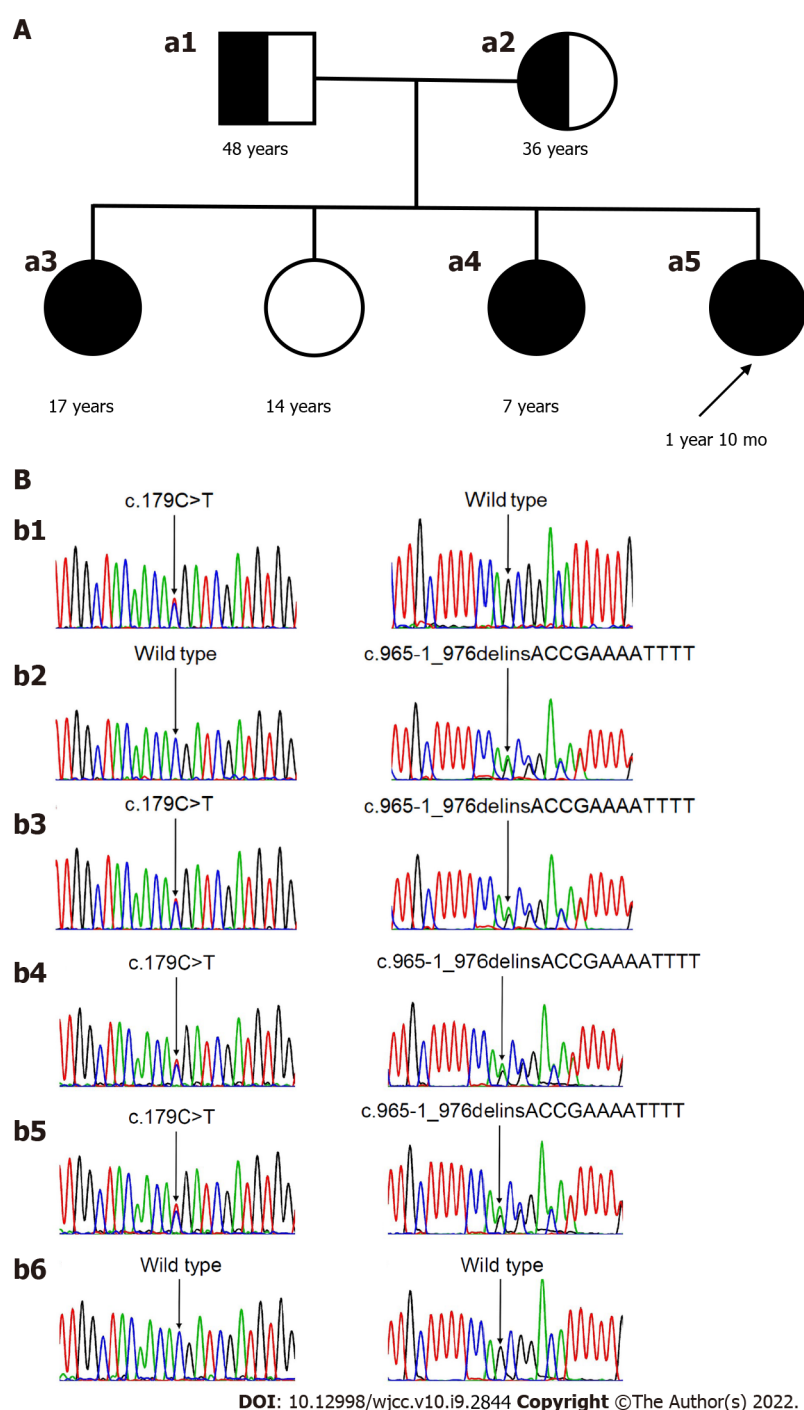


Figure 1 Genetic research of the family. A: Patient's family tree; B: Genetic analysis of SLC12A3 in patient's family. a1 and b1: Father, a carrier of GS-associated mutations, SLC12A3: c.179C>T in exon1; a2 and b2: Mother, a carrier of GS-associated mutations, c.965-1_976delinsACCGAAAATTTT in exon8; a3 and b3: The eldest daughter; a4 and b4: The third eldest daughter; a5 and b5: Index patient; a3-a5 and b3-b5: Revealed compound heterozygous mutations of the gene SLC12A3: c.179C>T in exon1 and c.965-1_976delinsACCGAAAATTTT in exon8; b6: Gene analysis of Wild type.

in metabolic alkalosis and hypokalemia. These disorders, known as BS or GS, are autosomal recessive diseases involved in sodium-chloride reabsorption in the loop of Henle or the distal tubule, respectively. However, both conditions are rare. The prevalence of GS and BS is estimated to be 1 in 40,000 and 1 in one million, respectively[10]. The heterozygous carrier rate is approximately 1 in 100 patients[11]. In contrast to the typical prenatal or neonatal clinical presentation of many patients with BS, GS is usually not diagnosed until late childhood or adulthood, although presentation in infancy has been described in some cases[12].

The diagnosis of BS or GS has primarily been based on clinical presentations and biochemical analysis of blood and urine. Measurement of urinary calcium excretion can help differentiate between BS and GS. Urine calcium excretion is high or elevated in BS and below normal in GS[13]. Hyperreninemia and hyperaldosteronism may present in BS and GS. However, metabolic alkalosis and renin-angiotensin

system activation are not obvious in GS, unlike BS. Genetic analysis for many of the suspected gene mutations is possible and available commercially; for example, screening for recurrent hot spot *SLC12A3* mutations may provide an early diagnosis of GS[14].

In this report, we describe the case of a female toddler who initially presented with acute gastrointestinal symptoms. Acute gastroenteritis in toddlers is a common epidemic disease in which patients frequently experience abdominal pain, vomiting, or diarrhea. If these symptoms are persistent or progressive for a few days, dehydration will occur, and IV treatment is needed. However, unusual, persistent, and severe hypokalemia (1.9 mmol/L) was noted in our case, and a genetic tubular disorder was suspected due to the hypokalemia. After a review of the patient's family history, detailed examinations, including blood and urine tests, and genetic analysis were performed for her family. Finally, this female toddler (one year) and two of her elder sisters (7 years/17 years) were diagnosed with GS due to mutations in the *SLC12A3* gene. GS is traditionally considered a benign disease that is usually not diagnosed until late childhood or adulthood. The average age at onset and diagnosis of GS is 20.0 ± 8.4 years and 23.6 ± 10.4 years, respectively[5]. In this study, the index patient and her third eldest sister were diagnosed with GS earlier than the average age. The two eldest sisters presented without obvious symptoms and were not diagnosed with GS until genetic analysis was performed. Therefore, the prevalence of GS in young children may be underestimated.

CONCLUSION

GS requires aggressive correction of the associated electrolyte imbalance to avoid the development of chronic kidney disease, abnormal glucose metabolism, or even life-threatening complications such as ventricular arrhythmia. With the advancement of genetic testing technology, it is possible to effectively and quickly diagnose inherited renal tubular disorders, such as GS, in children.

ACKNOWLEDGEMENTS

We thank our patients for contributing to the clinical data in this report.

FOOTNOTES

Author contributions: Wu CY and Tsai MH analyzed the data and wrote the manuscript; Kao CH and Chen CC designed the research study; all authors have read and approved the final manuscript.

Informed consent statement: All study participants, or their legal guardian, provided informed written consent for publication of this report and any accompanying images.

Conflict-of-interest statement: The authors declare that they have no conflict of interest.

CARE Checklist (2016) statement: This case report conforms to the CARE Checklist (2016) statement. Upload documents to attachments.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

Country/Territory of origin: Taiwan

ORCID number: Chun-Yen Wu 0000-0001-6622-8436; Ming-Hsein Tsai 0000-0003-3561-4689; Chia-Chun Chen 0000-0002-1824-4420; Chuan-Hong Kao 0000-0002-9368-1401.

S-Editor: Ma YJ

L-Editor: A

P-Editor: Ma YJ

REFERENCES

- 1 Cummings BM, Macklin EA, Yager PH, Sharma A, Noviski N. Potassium abnormalities in a pediatric intensive care unit:

- frequency and severity. *J Intensive Care Med* 2014; **29**: 269-274 [PMID: [23753253](#) DOI: [10.1177/0885066613491708](#)]
- 2 **Molla AM**, Rahman M, Sarker SA, Sack DA, Molla A. Stool electrolyte content and purging rates in diarrhea caused by rotavirus, enterotoxigenic *E. coli*, and *V. cholerae* in children. *J Pediatr* 1981; **98**: 835-838 [PMID: [6262471](#) DOI: [10.1016/s0022-3476\(81\)80863-3](#)]
- 3 **Kurtz I**. Molecular pathogenesis of Bartter's and Gitelman's syndromes. *Kidney Int* 1998; **54**: 1396-1410 [PMID: [9767561](#) DOI: [10.1046/j.1523-1755.1998.00124.x](#)]
- 4 **Chen H**, Ma R, Du H, Liu J, Jin L. Early onset children's Gitelman syndrome with severe hypokalaemia: a case report. *BMC Pediatr* 2020; **20**: 366 [PMID: [32758191](#) DOI: [10.1186/s12887-020-02265-9](#)]
- 5 **Tseng MH**, Yang SS, Hsu YJ, Fang YW, Wu CJ, Tsai JD, Hwang DY, Lin SH. Genotype, phenotype, and follow-up in Taiwanese patients with salt-losing tubulopathy associated with SLC12A3 mutation. *J Clin Endocrinol Metab* 2012; **97**: E1478-E1482 [PMID: [22679066](#) DOI: [10.1210/jc.2012-1707](#)]
- 6 **Fujimura J**, Nozu K, Yamamura T, Minamikawa S, Nakanishi K, Horinouchi T, Nagano C, Sakakibara N, Shima Y, Miyako K, Nozu Y, Morisada N, Nagase H, Ninchoji T, Kaito H, Iijima K. Clinical and Genetic Characteristics in Patients With Gitelman Syndrome. *Kidney Int Rep* 2019; **4**: 119-125 [PMID: [30596175](#) DOI: [10.1016/j.ekir.2018.09.015](#)]
- 7 **Pachulski RT**, Lopez F, Sharaf R. Gitelman's not-so-benign syndrome. *N Engl J Med* 2005; **353**: 850-851 [PMID: [16120871](#) DOI: [10.1056/NEJMc051040](#)]
- 8 **Huang YC**, Tsai MH, Fang YW, Tu ML. Normotensive hypokalemic primary hyperaldosteronism mimicking clinical features of anorexia nervosa in a young patient: A case report. *Medicine (Baltimore)* 2020; **99**: e20826 [PMID: [32702825](#) DOI: [10.1097/MD.00000000000020826](#)]
- 9 **Tu ML**, Fang YW, Leu JG, Tsai MH. An atypical presentation of high potassium renal secretion rate in a patient with thyrotoxic periodic paralysis: a case report. *BMC Nephrol* 2018; **19**: 160 [PMID: [29973184](#) DOI: [10.1186/s12882-018-0971-9](#)]
- 10 **Blanchard A**, Bockenhauer D, Bolignano D, Calò LA, Cosyns E, Devuyst O, Ellison DH, Karet Frankl FE, Knoers NV, Konrad M, Lin SH, Vargas-Poussou R. Gitelman syndrome: consensus and guidance from a Kidney Disease: Improving Global Outcomes (KDIGO) Controversies Conference. *Kidney Int* 2017; **91**: 24-33 [PMID: [28003083](#) DOI: [10.1016/j.kint.2016.09.046](#)]
- 11 **Hsu YJ**, Yang SS, Chu NF, Sytwu HK, Cheng CJ, Lin SH. Heterozygous mutations of the sodium chloride cotransporter in Chinese children: prevalence and association with blood pressure. *Nephrol Dial Transplant* 2009; **24**: 1170-1175 [PMID: [19033254](#) DOI: [10.1093/ndt/gfn619](#)]
- 12 **Tammaro F**, Bettinelli A, Cattarelli D, Cavazza A, Colombo C, Syrén ML, Tedeschi S, Bianchetti MG. Early appearance of hypokalemia in Gitelman syndrome. *Pediatr Nephrol* 2010; **25**: 2179-2182 [PMID: [20552229](#) DOI: [10.1007/s00467-010-1575-1](#)]
- 13 **Bettinelli A**, Bianchetti MG, Girardin E, Caringella A, Cecconi M, Appiani AC, Pavanello L, Gastaldi R, Isimbaldi C, Lama G. Use of calcium excretion values to distinguish two forms of primary renal tubular hypokalemic alkalosis: Bartter and Gitelman syndromes. *J Pediatr* 1992; **120**: 38-43 [PMID: [1731022](#) DOI: [10.1016/s0022-3476\(05\)80594-3](#)]
- 14 **Al Shibli A**, Narchi H. Bartter and Gitelman syndromes: Spectrum of clinical manifestations caused by different mutations. *World J Methodol* 2015; **5**: 55-61 [PMID: [26140272](#) DOI: [10.5662/wjm.v5.i2.55](#)]



Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA

Telephone: +1-925-3991568

E-mail: bpgoffice@wjgnet.com

Help Desk: <https://www.f6publishing.com/helpdesk>

<https://www.wjgnet.com>

