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Familial Renal Glucosuria in a Child with Normoglycemia: A Case Report

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Abstract: ***Familial renal glucosuria (FRG) is an inherited renal tubular disorder characterized by persistent urinary glucose excretion despite normal blood glucose, with preservation of most other proximal tubular functions. We report a female child evaluated for persistent glucosuria first documented in 2023. Repeated urine testing demonstrated glucosuria in the absence of hyperglycemia, and the child had a family history of similar glucosuria in her father. On subsequent evaluation, random plasma glucose was 67 mg/dL and glycated hemoglobin was 5.4%, effectively excluding diabetes mellitus as the explanation for the glucosuria. Urinalysis showed +++ glucose and +++ ketones, with no proteinuria, hematuria, pyuria, or casts. Serum bicarbonate and phosphate were preserved, while serum creatinine was low for the laboratory reference range, consistent with the child's age/body size rather than renal impairment. There was no evidence of generalized proximal tubular dysfunction and concluded that the presentation was consistent with familial renal glucosuria. No pharmacological treatment was prescribed; reassurance and pediatric nephrology follow-up were advised. This case highlights the importance of recognizing renal glucosuria as a distinct cause of glucosuria in a normoglycemic child and of distinguishing it from diabetes mellitus and generalized proximal tubulopathies such as Fanconi syndrome.***

Keywords: familial renal glucosuria; SLC5A2; SGLT2; child; normoglycemia

1. Introduction

Familial renal glucosuria (FRG) is a rare inherited defect of renal glucose reabsorption characterized by persistent glucosuria despite normal plasma glucose concentrations and otherwise preserved renal tubular function. The condition is primarily associated with variants in SLC5A2, which encodes the sodium-glucose cotransporter 2 (SGLT2) in the proximal tubule. SGLT2 accounts for the majority of filtered glucose reabsorption, with the remainder handled predominantly by SGLT1 in more distal proximal tubular segments. [1–3]

FRG is frequently discovered incidentally during urinalysis. The differential diagnosis of glucosuria in children includes diabetes mellitus and generalized proximal tubular disorders such as Fanconi syndrome. Assessment of plasma glucose, glycated hemoglobin, electrolytes, bicarbonate, phosphate, urinalysis, and- when indicated- other tubular solutes is therefore important. Recent pediatric series emphasize that most children with genetically confirmed FRG have normal growth and renal function, although variable glucosuria and occasional abnormalities such as hypercalciuria or aminoaciduria may occur. [2, 4]

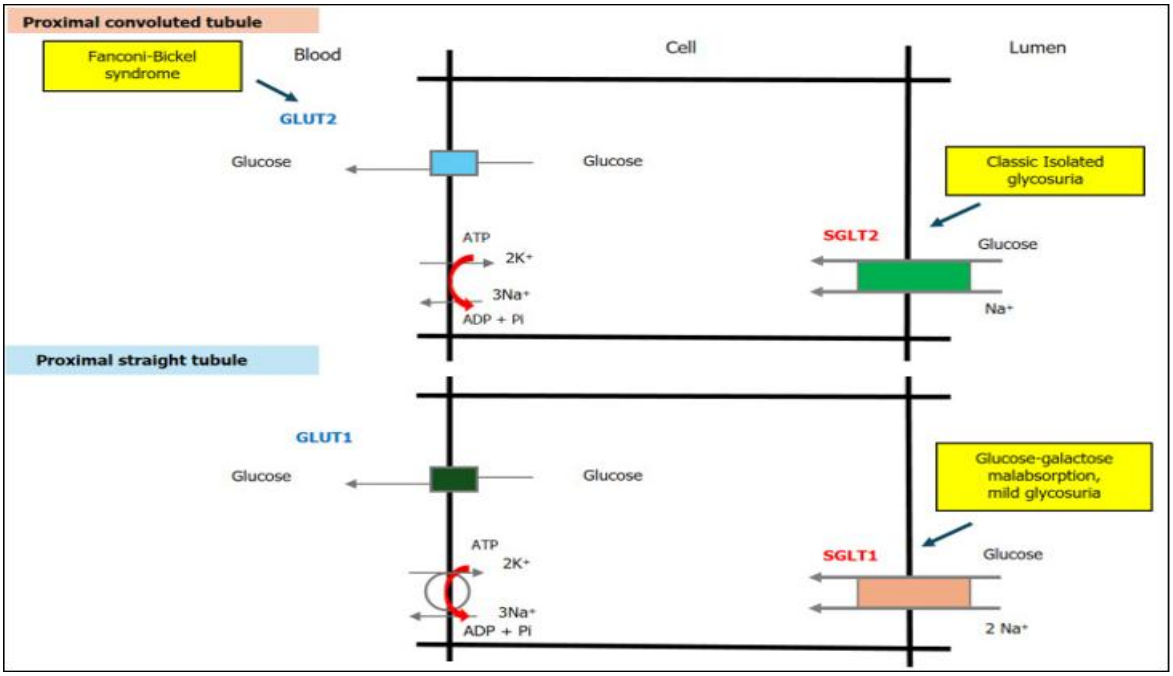

Figure 1: Proximal tubular glucose transport showing SGLT2-mediated glucose reabsorption in the early proximal tubule, SGLT1-mediated reabsorption distally, and the role of the basolateral Na^+/K^+-ATPase
Source: image reproduced from Perry and Shulman (2020).

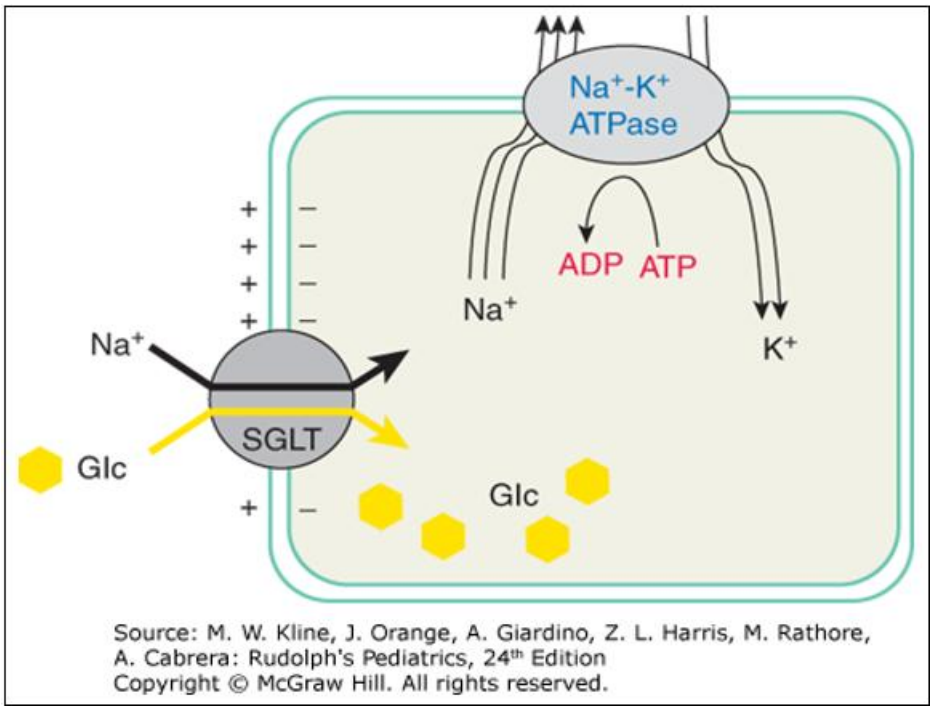

Figure 2: Schematic of sodium-dependent glucose transport and the basolateral Na^+/K^+-ATPase that maintains the sodium gradient driving secondary active glucose transport

Source: Rudolph's Pediatrics, 24th ed., McGraw Hill (2025)

We describe a child with persistent glucosuria, normoglycemia, preserved renal tubular indices, and a paternal history of glucosuria, supporting a clinical diagnosis of familial renal glucosuria.

2. Case Presentation

A female child was evaluated for glucosuria. The available outpatient record documents a history of glucose detected in the urine for approximately three months before the September 2022 visit, with consultation at a nearby hospital. There was no reported polyuria, weight loss, fever, or loose stools.

Past history was otherwise unremarkable. Antenatal period shows no history of gestational diabetes, hypertension, hypothyroidism, or oligohydramnios. The child was reportedly born at term by vaginal delivery, with no neonatal intensive care admission. Immunizations were largely up to date. Development was recorded as normal, with age-appropriate social interaction and feeding.

Anthropometric assessment recorded a height of 79 cm, weight of 9.3 kg, and head circumference of 44.5 cm, all documented as being below expected centiles for age.

Family History

A three-generation-style pedigree showed a history of glucosuria in the father. No other relevant familial disorder was recorded. This paternal history provides additional clinical support for an inherited renal glucose-reabsorption defect.

Clinical Examination

The child was clinically well and developmentally appropriate. There were no edema or other findings suggestive of generalized renal disease. No specific renal or metabolic physical abnormality was attributed to the glucosuria.

Clinical Timeline

Time	Clinical event
2022	Glucosuria and urine glucose positivity reported for approximately 3 months; no polyuria or weight loss. Initial evaluation at another hospital.
2023	Persistent glucosuria documented. Urine glucose remained positive despite normal blood glucose. Differential considerations included familial renal glucosuria, Fanconi syndrome, renal tubular acidosis, and a transporter defect.
2023	Clinical assessment documented renal glucosuria without hyperglycemia. Subsequent nephrology review considered familial renal glucosuria; paternal glucosuria was noted.
13 Dec 2025	Repeat laboratory evaluation: random plasma glucose 67 mg/dL; HbA1c 5.4%; urine glucose +++; urine ketones +++; no protein, blood, leukocytes, nitrites, or casts. Serum bicarbonate 21 mEq/L, phosphorus 5.3 mg/dL, calcium 10.1 mg/dL, creatinine 0.3 mg/dL.
Follow-up	Reassurance was provided; no drug therapy was prescribed. Pediatric nephrology follow-up was advised. Genetic testing was not documented as performed.

Investigations

Available investigations demonstrated persistent glucosuria in the setting of normoglycemia and a normal glycated hemoglobin. The absence of proteinuria and the preservation of bicarbonate and phosphate argue against a generalized proximal tubular disorder. The laboratory report also showed no urinary evidence of infection.

Investigation	Result	Interpretation / note
Random plasma glucose	67 mg/dL	Normal
HbA1c	5.4%	Non-diabetic range
Urine glucose	+ + +	Positive; rechecked
Urine ketones	+ + +	Positive; rechecked
Urine protein	Negative	No proteinuria
Urine blood	Negative	No hematuria by dipstick
Urine leukocytes / nitrite	Negative / Negative	No evidence of UTI
Urine specific gravity	1.027	Concentrated
Urine pH	5.0	Within laboratory range
Urine microscopy	WBC 1/hpf; RBC 1/hpf; epithelial cells 1/hpf	No significant sediment abnormality
Serum sodium	132 mEq/L	Mildly low
Serum potassium	3.6 mEq/L	Within laboratory range
Serum chloride	102 mEq/L	Within laboratory range
Serum bicarbonate	21 mEq/L	Within laboratory range
Serum calcium	10.1 mg/dL	Within laboratory range
Serum phosphorus	5.3 mg/dL	Within laboratory range
Serum magnesium	2.1 mg/dL	Within laboratory range
Serum creatinine	0.3 mg/dL	Low against laboratory adult-style reference range; no evidence of renal impairment in the clinical note
Serum urea	39 mg/dL	Borderline high against laboratory range
ALT/SGPT	30 IU/L	Within laboratory range
Lipase	26 IU/L	Within laboratory range

Diagnostic Reasoning

The key diagnostic finding was persistent urinary glucose excretion in the absence of hyperglycemia. Diabetes mellitus was unlikely because plasma glucose values were not elevated and HbA1c was 5.4%. Generalized proximal tubular disorders such as Fanconi syndrome were also not supported: there was no proteinuria, bicarbonate was preserved, phosphate was not reduced. The combination of isolated/predominant glucosuria, normal glycemic indices, preserved renal function, and paternal glucosuria was therefore considered most consistent with familial renal glucosuria.

Management and Follow-up

No specific pharmacological therapy was prescribed. Ongoing clinical surveillance should focus on hydration status, growth, blood pressure, renal function, electrolytes, and persistence/severity of glucosuria, with further tubular evaluation or molecular testing if clinically indicated.

3. Discussion

FRG results from impaired renal glucose reabsorption, most commonly due to loss-of-function variants in SLC5A2, the gene encoding SGLT2. Under normal conditions, SGLT2 in the early proximal tubule reabsorbs the majority of filtered glucose, while SGLT1 accounts for most of the remainder. [1], [3] Loss of SGLT2 activity therefore lowers the renal threshold for glucose and produces glucosuria despite normal systemic glucose concentrations. Figure 1 illustrates the proximal tubular transport pathway, while Figure 2 highlights the sodium gradient maintained by the basolateral Na^+/K^+-ATPase that drives secondary active glucose transport.

The present case illustrates several practical features of FRG. First, the child's repeated glucosuria was discordant with glycemic status: HbA1c was 5.4% and random plasma glucose was 67 mg/dL at the later evaluation. Second, urinalysis showed no proteinuria, hematuria, pyuria, or casts, and serum bicarbonate and phosphate were preserved. These findings help distinguish isolated renal glucosuria from generalized proximal tubular dysfunction. Third, a history of glucosuria in the father strengthens the clinical suspicion of a familial disorder. Familial transmission of FRG can show variable penetrance, and both heterozygous and biallelic SLC5A2 variants have been reported with differing glucosuria severity. [4],[5]

The child had markedly low recorded height and weight for the age. Pediatric FRG is generally considered benign, and many affected children have normal growth and development; however, recent reviews note that lower body weight or height can occur in some individuals. [2], [6]

Current literature supports a predominantly conservative approach to uncomplicated FRG. There is no established disease-specific treatment for isolated familial renal glucosuria; management is directed toward confirming the diagnosis, excluding diabetes and generalized tubular disorders, assessing hydration and associated tubular abnormalities, and providing reassurance. [2], [6] Genetic testing can confirm SLC5A2-related disease and may be particularly useful when the phenotype is atypical, when family counselling is required, or when diagnostic uncertainty remains.

Strengths and Limitations

The main strengths of this case are the longitudinal documentation of glucosuria, objective demonstration of

normoglycemia and normal HbA1c, assessment of multiple renal tubular indices, and the presence of a positive paternal history. The principal limitations are the absence of quantified 24-hour urinary glucose excretion, lack of fractional excretion studies, absence of molecular confirmation.

4. Conclusion

Familial renal glucosuria should be considered in a child with persistent glucosuria and normal glycemic indices. Careful exclusion of diabetes mellitus and generalized proximal tubular disorders, together with assessment of family history, can establish a strong clinical diagnosis. In this child, persistent glucosuria, normoglycemia, preserved tubular indices, and paternal glucosuria support clinically diagnosed familial renal glucosuria. Genetic confirmation was not documented, and the condition was managed conservatively with reassurance and nephrology follow-up.

5. Learning Points

- Persistent glucosuria does not necessarily indicate diabetes mellitus; renal glucosuria should be considered when blood glucose and HbA1c are normal.
- Urinalysis and serum bicarbonate, phosphate, electrolytes, and renal function help distinguish isolated renal glucosuria from generalized proximal tubular disorders such as Fanconi syndrome.
- A family history of isolated glucosuria is an important clue to familial renal glucosuria.
- SLC5A2 genetic testing can provide molecular confirmation, although a clinical diagnosis may be strongly supported by phenotype and family history.

Patient Consent and Ethics
Written informed consent for publication of the case was obtained from the child's parent/legal guardian before submission.

Declarations

Funding: No funding received for this work.

Conflicts of interest: No conflict-of-interest statement was available in the source records.

Data availability: The clinical information is derived from the patient's medical record.

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