Prevalence and Risk Factors for Microalbuminuria in Children with Sickle Cell Disease at King Abdulaziz University Hospital: A Retrospective Cross-sectional Study

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Research note

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Abstract

Objectives Previous studies have not addressed microalbuminuria in pediatric patients with sickle cell disease (SCD) in Jeddah, Saudi Arabia. This study aimed to determine the prevalence of microalbuminuria and identify associated risk factors in children with SCD at King Abdulaziz University Hospital.Results Overall, 42.5% of the patients enrolled were Saudi Arabian and 51% were male. The patients' mean age was 12.4 years, and the highest percentage (40%) was in the age group of 15–18 years. The prevalence of microalbuminuria was 9.6%, and hematuria was present in 8% of cases. The percentage of patients with hematuria was significantly higher in the microalbuminuria group (22.6%) than in the non-microalbuminuria group (6.5%; P=.007). The percentage of patients with acute chest syndrome was also higher in the microalbuminuria group (26%) than in the non-microalbuminuria group (8%; P=0.005). The percentage of patients with gallbladder stones was higher in the microalbuminuria group (13%) than in the non-microalbuminuria group (2.4%; P=.014). However, the mean number of blood transfusions was higher in the non-microalbuminuria group than in the microalbuminuria group (P=.002). Sickle cell nephropathy manifests as microalbuminuria, begins at an early age, occurs in all types of SCD, and is associated with disease severity.

Introduction

Sickle cell disease (SCD) is one of the most important autosomal recessive diseases. In the Kingdom of Saudi Arabia (KSA), the prevalence of the sickle-cell trait ranges from 2 to 27%, and up to 2.6% of affected individuals develop SCD.[1] SCD is characterized by vaso-occlusive events, hemolytic crises, and organ damage.[2]

Renal impairment is a chronic complication of SCD and a major factor associated with mortality.[3,4] This association with mortality is stronger than that observed with an episode of acute stroke, a febrile episode with positive blood culture, acute chest syndrome, or severe acute anemia.[5] Chronic renal complications occur in 5–18% of SCD cases, and >9% of deaths in young adults are due to renal involvement.[4–6]

In SCD, microalbuminuria is one of the most common clinical manifestations of sickle cell nephropathy (SCN),[7,8] which appears to be associated with a more rapid deterioration in renal function.[9] The reported incidence of microalbuminuria in children with SCD ranges from 18.4% to 46%.[16–18] The identification of microalbuminuria in a patient with SCD is a predictor of end-organ disease, including renal damage.[10,11] Children with SCD experience hyperfiltration and hyperperfusion, which are associated with renal damage.[12,13] Therefore, the early detection of microalbuminuria may represent an important early sign of renal disease.[14]

A prolonged period of microalbuminuria precedes persistent proteinuria, which is followed by renal failure in SCD patients.[15] Therefore, the identification of risk factors for microalbuminuria may allow earlier intervention to prevent renal complications.[16] The KSA faces a high burden of SCD, with a prevalence rate of 2.6% in newborns[1] in a population of >24 million, and children with SCD are prone to developing

microalbuminuria and chronic renal failure with advancing age. However, previous research in the KSA has not addressed this problem. Therefore, this study aimed to determine the prevalence of microalbuminuria in children with SCD and identify the risk factors associated with microalbuminuria in children with SCD at King Abdulaziz University Hospital (KAUH).

Patients And Methods

The study was approved by the Institutional Review Board of the KAUH. This cross-sectional prevalence study retrospectively reviewed all medical records of children aged 2–18 years who were diagnosed with SCD and visited the KAUH Pediatric Sickle Cell Clinic between June 2010 and April 2019. We excluded all patients without urinalysis testing.

The following data were obtained from recent outpatient follow-up visits: sex, age, nationality, weight, height, ABO blood group type, sickle cell genotype, number of hospitalizations, blood transfusion (BT) status, and number of transfusions . Additionally, the frequencies of vaso-occlusive events and SCD complications were collected.

From the urinalysis results, microalbuminuria was defined as a protein level of >1+. Hematuria was defined as a red blood cell (RBC) count >5.

Statistical analysis

Descriptive statistics were used to assess the study participants' demographic characteristics. Means ± standard deviations and median values are used to describe continuous variables, while frequencies with proportions are used to report categorical variables. Numerical variables were compared between groups using the independent *t*-test, whereas categorical variables were compared using the chi-square and Fisher's exact tests. Statistical significance was set at a *P* value <.05. All statistical analyses were performed using IBM SPSS statistics, version 23 (IBM, Armonk, NY, USA).

Results

The prevalence of microalbuminuria and its associated factors were assessed in 322 pediatric patients with SCD. The patients' characteristics are presented in Table 1.

The characteristics of the non-microalbuminuria (291 patients) and microalbuminuria group (31 patients) and comparisons of different variables between the groups are shown in Table 2. The prevalence of hematuria differed significantly between the groups, and was higher in the microalbuminuria group than in the non-microalbuminuria group (*P*=.007). However, a significant difference was observed in the distribution of blood groups (*P*=.022). The percentage of acute chest syndrome was significantly higher in the microalbuminuria group than in the non-microalbuminuria group (*P*=.005). The percentage of gallbladder stones was significantly higher in the microalbuminuria group than in the non-microalbuminuria group (*P*=.014). The mean number of BTs was higher in the non-microalbuminuria group

than in the microalbuminuria group (P=0.002). No other variables differed significantly between the groups.

Discussion

Secondary renal failure affects 5-–20% of adult patients with SCD, and the progression of renal disorder begins in childhood.[19] Microalbuminuria is one of the earliest manifestations of SCN. Hence, many studies have aimed to determine the prevalence of microalbuminuria among SCD patients as an indicator of the severity of the condition.[20,21] In this study, we determined a prevalence of microalbuminuria of 9.6% among pediatric patients with a mean age of 12.4 years. This condition emerged at a very young age (2 years) and increased continuously to the highest percentage among young adults (15–18 years), who exhibited a prevalence of 51.6%. The mean age and average prevalence of microalbuminuria among older patients in our study were consistent with the prevalence rates of 46% as reported by Dharnidharka et al[20] and of 39–43% in adults with SCD as reported by McBurney et al.[16] However, the overall prevalence of microalbuminuria among all patients (9.6%) was lower than the average prevalence reported by those previous studies. Additionally, Alkhunaizi et al[22] determined that the prevalence of microalbuminuria among adult Saudi Arabian patients (>18 years) was 25%, which was very similar to our findings in the same age group.

Dharnidharka et al[20] and McBurney et al[16] reported that no microalbuminuria was detected in children <7 years old. Conversely, 9.7% of microalbuminuria patients in our study were aged 2–5 years. Our findings were supported by those of Aloni et al,[23] who confirmed the presence of microalbuminuria in patients aged <7 years. This early deterioration of glomerular function could be explained by the presence of certain factors, including a genetic predisposition, the fetal hemoglobin (HbF) level, environmental factors, the efficacy of medical care, and lifestyle factors associated with developing countries.[24] However, the small sample size in our study may also reasonably explain these contradictory results. Still, the studies by Dharnidharka et al[20] and by McBurney et al,[16] enrolled 104 and 151 patients, respectively. Interestingly, when we compared the microalbuminuria and non- microalbuminuria groups, we observed no statistical difference in terms of age (*P*=.432), indicating that this was not a defining variable in either group. However, age was a defining variable in the progression of microalbuminuria in the affected group.

Previous publications have reported a female predominance of microalbuminuria. Jones et al reported a microalbuminuria prevalence of 9.7% among female patients and 6.1% among male patients,[8] while Okpere et al[25] also reported results consistent with female predominance (45.3% vs. 20.4% of males). However, we did not observe a significant difference in sex between the microalbuminuria and non-microalbuminuria groups in our study, consistent with the findings of McBurney et al[16] and Dharnidharka et al.[20] Consequently, additional research evidence is needed to clarify these contrasting results.

Our findings demonstrated that microalbuminuria occurs in association with most hemoglobin genotypes. The highest percentage was observed with the Hb-ss genotype (74.2%) in the microalbuminuria group, similar to the results of a previous study conducted by Wigfall et al.[26] However, no microalbuminuria was

detected in the HB-Sβ0 (Beta-Zero) thalassemia sub-group. Most previous studies included few patients with Sβ-thalassemia, and only a few studies have published mixed results regarding this patient group. Becton et al[21] reported that only one patient with Sβ-thalassemia had microalbuminuria.

We further examined the frequencies of several clinical complications that may be associated with microalbuminuria (Table 3). We compared the microalbuminuria and non-microalbuminuria groups to identify definitive variables that varied significantly between the groups. Interestingly, we found that most patients in the microalbuminuria group experienced acute chest syndrome, gallbladder stones, osteomyelitis, pneumonia, and spleen sequestration, whereas none reported priapism, avascular necrosis, aplasia, stroke, acute coronary syndrome (ACS), or dactylitis. These findings were consistent with those reported by Dharnidharka et al[20] and McBurney et al,[16] who observed no significant correlation between microalbuminuria and stroke, and McBurney et al[16] and Kalpathi et al,[21] who reported no significant correlation with ACS. Our observation of a significant association between acute chest syndrome and microalbuminuria (*P*=.005) was consistent with the findings reported by Alvarez et al.[27] In contrast, Bodas et al[28] reported that the glomerular filtration rate was not correlated with episodes of either stroke or acute chest syndrome, suggesting that the etiologies of these complications may differ from the etiologies underlying the development of SCN. However, that study included only 48 patients, and the relatively small sample size likely influenced the significant correlation between the two conditions.

We further identified found a significant correlation between microalbuminuria and the development of gallbladder stones (*P*=.014%). Our findings were consistent with those of Alexander-Reindorf et al[29] and Bond et al,[30] who reported significantly higher morbidity and more hospital admissions among SCD patients with gallbladder stones. Additionally, the mean age in our microalbuminuria group was 13.74 years, consistent with a study by Martins et al[31] with age 11- and 29-year-old, with a higher prevalence of cholelithiasis and gallbladder stones.

In our study, the number of BTs was significantly and negatively associated with microalbuminuria, suggests that BTs are a renoprotective process in the management of SCD. Alvarez et al[27] reported similar results and indicated that the early initiation of transfusion could protect the kidney and hinders deterioration of the SCN. However, the side effects of transfusion, such as iron overload, must be considered before starting this process. In contrast, Aloni et al[23] reported that BT is not a significant factor with respect to microalbuminuria.

Kalpathi et al[21] stated that 36% of SCD patients presented with hematuria. However, the authors reported no significant difference in the frequency of hematuria between the microalbuminuria and non-microalbuminuria groups. In contrast, we observed a statistically significant difference in the frequency of hematuria between patients with and without microalbuminuria (*P*=.007). Our results were consistent with the findings of Sesso et al,[34] who reported higher frequencies of hematuria in the Hb-ss and Hb-as groups. The authors stated that hematuria is caused by the increased sickling of RBCs in the renal medulla, resulting in extravasation and ischemia. We further determined that most patients with SCD had O RhD+ blood, and that this variable differed significantly between the two groups (P=.022). This result was

consistent with the findings of Alagwu et al,[35] who reported a an O blood group frequency of 63% among Hb-ss patients. This finding could be explained by the fact that the O Rh+ blood group is the most prevalent group in humans.

In conclusion, our findings highlight the importance of early investigations (e.g., urinalysis) for the assessment of microalbuminuria and hematuria, as well as the determination of the degree of SCN. The observation that the average number of BTs was significantly higher in the non-microalbuminuria group than in the microalbuminuria group could suggest a protective role of transfusion against the development of microalbuminuria. However, further investigations are needed to confirm our results. We additionally reported significantly higher rates of acute chest syndrome and gallbladder stones in patients with microalbuminuria patients. These factors must be considered, and special care should be provided to affected patients. We recommend the routine screening of SCD patients for microalbuminuria and hematuria.

Limitations

We have identified two potential sources of bias that may serve as limitations. First, patients who visit the pediatric hematology clinic with a diagnosis of SCD do not routinely undergo urinalysis testing. Second, the study data were collected solely from the registration records.

List Of Abbreviations

SCD, sickle cell disease; KSA, Kingdom of Saudi Arabia; KAUH, King Abdulaziz University Hospital; ACS, acute coronary syndrome; RBC, red blood cell; MCV, mean corpuscular volume; HbF, fetal hemoglobin; BT, blood transfusion; SCN, sickle cell nephropathy;

Declarations

Ethics approval and consent to participate

The study was approved by the Institutional Review Board of the King Abdul-Aziz University Hospital (reference number: 186-19).

Consent for publication

Not applicable.

Availability of data and materials

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Yahya AA, the first author, contributed to the conception and design of the study, analysis and interpretation of data, and final approval of the version of the manuscript to be published.

Yara AA made substantial contributions to the acquisition of data and drafting of the article.

OYS contributed to the conception and design of the study and the critical revision of the article for important intellectual content.

MAA made substantial contributions to the acquisition of data and drafting of the article.

MMA made substantial contributions to the conception and design of the study and drafting of the article.

HMA made substantial contributions to the acquisition of data and drafting of the article.

JEA made substantial contributions to the acquisition of data and critical revision of the article for important intellectual content.

KMA made substantial contributions to the conception and design of the study and drafting of the article.

FSA contributed to the conception and design of the study, critical revision of the article for important intellectual content, and final approval of the version of the manuscript to be published.

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References

1. Jastaniah W. Epidemiology of sickle cell disease in Saudi Arabia. Ann Saudi Med. 2011;31:289-93.
2. Quinn CT. Sickle cell disease in childhood: from newborn screening through transition to adult medical care. Pediatr Clin. 2013;60:1363-81.
3. Powars DR, Chan LS, Hiti A, Ramicone E, Johnson C. Outcome of sickle cell anemia: a 4-decade observational study of 1056 patients. Medicine (Baltimore). 2005;84:363-76.
4. Powars DR, Elliott-Mills DD, Chan L, Niland J, Hiti AL, Opas LM, et al. Chronic renal failure in sickle cell disease: risk factors, clinical course, and mortality. Ann Intern Med. 1991;115:614-20.
5. Platt OS, Brambilla DJ, Rosse WF, Milner PF, Castro O, Steinberg MH, et al. Mortality in sickle cell disease–life expectancy and risk factors for early death. N Engl J Med. 1994;330:1639-44.
6. Guasch A, Navarrete J, Nass K, Zayas CF. Glomerular involvement in adults with sickle cell hemoglobinopathies: prevalence and clinical correlates of progressive renal failure. J Am Soc Nephrol. 2006;17:2228-35.

7. Embury SH, Hebbel RP, Mohandas N, Steinberg MH. Sickle cell disease: basic principles and clinical practice. New York: Raven Press; 1994.
8. Eke CB, Okafor HU, Ibe BC. Prevalence and correlates of microalbuminuria in children with sickle cell anaemia: Experience in a tertiary health facility in Enugu, Nigeria. Int J Nephrol. 2012;2012:240173.
9. Pham PT, Pham PC, Wilkinson AH, Lew SQ. Renal abnormalities in sickle cell disease. Kidney Int. 2000;57:1-8.
10. Motala AA. Micro-albuminuria in diabetes mellitus--significance and screening. S Afr Med J. 1998;88:365-6.
11. Mogensen CE. Microalbuminuria as a predictor of clinical diabetic nephropathy. Kidney Int. 1987;31:673-89.
12. Guasch A, Cua M, Mitch WE. Early detection and the course of glomerular injury in patients with sickle cell anemia. Kidney Int. 1996;49:786-91.
13. Etteldorf JN, Tuttle AH, Clayton GW. Renal function studies in pediatrics: I. Renal hemodynamics in children with sickle cell anemia. AMA Am J Dis Child. 1952;83:185-91.
14. Aoki RY, Saad ST. Microalbuminuria in sickle cell disease. Braz J Med Biol Res. 1990;23:1103-6.
15. Foucan L, Bourhis V, Etienne-Julan M, Salmi RL. A randomized trial of captopril for microalbuminuria in normotensive adults with sickle cell anemia. Am J Med. 1998;104:339-42.
16. McBurney PG, Hanevold CD, Hernandez CM, Waller JL, McKie KM. Risk factors for microalbuminuria in children with sickle cell anemia. J Pediatr Hematol Oncol. 2002;24:473-7.
17. King L, MooSang M, Miller M, Reid M. Prevalence and predictors of microalbuminuria in Jamaican children with sickle cell disease. Arch Dis Child. 2011;96:1135-9.
18. Ochigbo SO, Jacob UJ, Nlemadim AC, Kudirat OO. Comparative efficacy of serum ceatinine and microalbuminuria in detecting early renal injury in asphyxiated babies in Calabar, Nigeria. Int J Child Heal Nutr. 2016;5:147-51.
19. McKie KT, Hanevold CD, Hernandez C, Waller JL, Ortiz L, McKie KM. Prevalence, prevention, and treatment of microalbuminuria and proteinuria in children with sickle cell disease. J Pediatr Hematol Oncol. 2007;29:140-4.
20. Dharnidharka VR, Dabbagh S, Atiyeh B, Simpson P, Sarnaik S. Prevalence of microalbuminuria in children with sickle cell disease. Pediatr Nephrol. 1998;12:475-8.
21. Becton LJ, Kalpatthi RV, Rackoff E, Disco D, Orak JK, Jackson SM, et al. Prevalence and clinical correlates of microalbuminuria in children with sickle cell disease. 2010;25:1505-11.
22. Alkhunaizi AM, Al-Khatti AA, Alkhunaizi MA. Prevalence of microalbuminuria in adult patients with sickle cell disease in Eastern Saudi Arabia. Int J Nephrol. 2018;2018:5015764.
23. Aloni MN, Mabidi JL, Ngiyulu M, Ekulu PM, Mbutiwi FI, Makulo JR, et al. Prevalence and determinants of microalbuminuria in children suffering from sickle cell anemia in steady state. 2017;10:479-86.
24. Hay SI, Gupta S, Weatherall DJ, Williams TN. Global burden of sickle cell anaemia in children under five, 2010 – 2050: Modelling based on demographics, excess mortality, and interventions. PLoS Med. 2013;10:e1001484.

25. Okpere AN, Anochie IC, Eke FU. Prevalence of microalbuminuria among secondary school children. Afr Health Sci. 2012;12:140-7.
26. Delbert RW, Ware RE, Burchinal MR, Kinney TR, Foreman JW. Prevalence and clinical correlates of glomerulopathy children with sickle cell disease. 2000;136:749-53.
27. Alvarez O, Montane B, Lopez G, Wilkinson J, Miller T. Early blood transfusions protect against microalbuminuria in children with sickle cell disease. 2006;47:71-6.
28. Bodas P, Huang A, Riordan MAO, Sedor JR, Dell KM. The prevalence of hypertension and abnormal kidney function in children with sickle cell disease – a cross sectional review. BMC Nephrol. 2013;14:237.
29. Alexander-Reindorf C, Nwaneri RU, Worrell RG, Ogbonna A, Uzoma C. The significance of gallstones in children with sickle cell anemia. J Natl Med Assoc. 1990;82:645-50.
30. Bond LR, Hatty SR, Horn MEC, Dick M, Meire HB, Bellingham AJ. Gall stones in sickle cell disease in the United Kingdom. Br Med J (Clin Res Ed). 1987;295:234-6.
31. Martins RA, Soares RS, Vito FB, Barbosa VF, Silva SS, Moraes-Souza H, et al. Cholelithiasis and its complications in sickle cell disease in a university hospital. Rev Bras Hematol Hemoter. 2017;39:28-31.
32. Sesso R, Almeida MA, Figueiredo MS, Bordin JO. Renal dysfunction in patients with sickle cell anemia or sickle cell trait. Braz J Med Biol Res. 1998;31:1257-62.
33. Alagwu EA, Akukwu D, Uloneme GC. ABO/Rhesus blood group and correlation with sickle cell disease and type-ii diabetes mellitus in South East and South-South of Nigeria. UK Journal of Pharmaceutical and Biosciences. 2016;4:78-82.

Tables

Table 1: Descriptive statistics of all patients enrolled in the study (N=322)

Variable	n	Percentage
Nationality		
Non-Saudi Arabian	185	57.5
Saudi Arabian	137	42.5
Sex		
Female	157	48.8
Male	165	51.2
Age group		
2 to 5 years	30	9.3
6 to 10 years	87	27.0
11 to 14 years	77	23.9
15 to 18 years	128	39.8
Sickle cell genotype		
Hemoglobin SB 0 (Beta-zero) thalassemia	4	1.2
Hemoglobin SB+ (beta) thalassemia	41	12.7
Hemoglobin SS disease (sickle cell disease)	233	72.4
Sickle cell trait (hemoglobin S disease)	44	13.7
Microalbuminuria		
No	291	90.4
Yes	31	9.6
Hematuria		
No	296	91.9
Yes	26	8.1
Blood type		
A RhD negative (A-)	3	0.9
A RhD positive (A+)	84	26.1
AB RhD positive (AB+)	15	4.7
B RhD negative (B-)	3	0.9
B RhD positive (B+)	32	9.9
O RhD negative (O-)	9	2.8
O RhD positive (O+)	176	54.7
Blood transfusions		
No	143	44.4
Yes	179	55.6
Frequency of:		
Pneumonia	30	9.3
Priapism	3	0.9
Avascular necrosis	3	0.9
Acute chest syndrome	31	9.6
Aplasia	2	0.6
Stroke	14	4.3
Acute coronary syndrome	10	3.1
Dactylitis	3	0.9
Spleen sequestration	24	7.5
Gallbladder stones	11	3.4
Osteomyelitis	23	7.1

	Mean	SD	Median
Age (years)	12.43	4.64	13.00
Number of hospitalizations	16.14	35.56	5.00

Number of blood transfusions	8.67	26.71	1.00

SD, standard deviation

Table 2: Comparison of different variables between non-microalbuminuria and microalbuminuria patients

	Without microalbuminuria (n=291)		With microalbuminuria (n=31)		*P*-value
	n	%	n	%	
Nationality					
Non-Saudi Arabian	167	57.4	18	58.1	0.942
Saudi Arabian	124	42.6	13	41.9	
Sex					
Female	144	49.5	13	41.9	0.424
Male	147	50.5	18	58.1	
Age group					
2–5 years	27	9.3	3	9.7	0.432
6–10 years	82	28.2	5	16.1	
11–14 years	70	24.1	7	22.6	
15–18 years	112	38.5	16	51.6	
Sickle cell genotype					
Hemoglobin SB 0 (Beta-zero) thalassemia	4	1.4	0	0.0	0.928
Hemoglobin SB+ (beta) thalassemia	37	12.7	4	12.9	
Hemoglobin SS disease (sickle cell disease)	210	72.2	23	74.2	
Sickle cell trait (Hemoglobin S disease)	40	13.7	4	12.9	
Hematuria					
No	272	93.5	24	77.4	0.007*
Yes	19	6.5	7	22.6	
Blood type					
A RhD negative (A-)	2	0.7	1	3.2	0.022*
A RhD positive (A+)	75	25.8	9	29.0	
AB RhD positive (AB+)	10	3.4	5	16.1	
B RhD negative (B-)	3	1.0	0	0.0	
B RhD positive (B+)	31	10.7	1	3.2	
O RhD negative (O-)	9	3.1	0	0.0	
O RhD positive (O+)	161	55.3	15	48.4	
Blood transfusions					
No	131	45.0	12	38.7	0.502
Yes	160	55.0	19	61.3	
Frequency of:					
Pneumonia	28	9.6	2	6.5	0.752
Priapism	3	1.0	0	0.0	1
Avascular necrosis	3	1.0	0	0.0	1
Acute chest syndrome	23	7.9	8	25.8	0.005*
Aplasia	2	0.7	0	0.0	1
Stroke	14	4.8	0	0.0	0.377
Acute coronary syndrome	10	3.4	0	0.0	0.607
Dactylitis	3	1.0	0	0.0	1
Spleen sequestration	22	7.6	2	6.5	1
Gallbladder stones	7	2.4	4	12.9	0.014*
Osteomyelitis	20	6.9	3	9.7	0.474

	Without microalbuminuria			With microalbuminuria			*P*-value
	Mean	SD	Median	Mean	SD	Median	
Age	12.29	4.62	12.00	13.74	4.68	15.00	0.098
Number of hospitalizations	16.76	37.05	4.00	10.39	14.91	8.00	0.068
Number of transfusions	9.26	27.97	1.00	3.13	5.60	1.00	0.002*

SD, standard deviation; *, Significant *P*-value