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Prevalence and Correlation of Autosplenectomy and Renal Impairment in Sickle Cell Disease: Insights from a Nigerian Tertiary Hospital

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Abstract

Background: Sickle Cell Disease (SCD) is a multisystemic genetic disorder characterized by chronic haemolysis and recurrent vaso-occlusion, leading to progressive organ dysfunction. The spleen and kidneys are among the most commonly affected organs. Evaluating both radiological and functional markers of organ damage can aid early detection and guide clinical management.
Objective: To determine the prevalence of autosplenectomy and markers of renal damage in SCD patients using abdominal ultrasonography and estimated glomerular filtration rate (eGFR), and to explore associations with urinalysis findings in a tertiary hospital setting in Nigeria.
Methods: A cross-sectional study was conducted at Ahmadu Bello University Teaching Hospital (ABUTH), Zaria. Consecutive patients with confirmed SCD in their steady state were recruited from paediatric and adult haematology clinics. Clinical data were obtained using interviewer-administered questionnaires. Abdominal ultrasonography was used to assess spleen and kidney morphology. Serum creatinine was analysed to calculate eGFR using the CKD-EPI and Schwartz formulas. Urinalysis was performed to detect proteinuria and haematuria. Data were analysed using SPSS version 25. Statistical significance was set at $p < 0.05$ with a 95% confidence interval.
Results: A total of 175 participants were enrolled for this study. The median age was 15 years (IQR: 8–24). Autosplenectomy was detected in 39.4% of all participants and in 59.5% of adults. Shrunken kidneys were observed in 3.2% of subjects. A positive correlation was found between splenic size and average kidney size ($r = 0.617$, $p < 0.001$). However, spleen and kidney sizes showed weak, non-significant correlations with eGFR ($r = 0.086$ and $r = 0.059$, respectively). Urinalysis revealed proteinuria in 16.0% and haematuria in 5.1% of participants. No statistically significant associations were observed between autosplenectomy and either renal shrinkage ($p = 0.298$), reduced eGFR ($p = 0.258$), proteinuria ($p = 0.212$), or haematuria ($p = 0.309$).
Conclusion: Autosplenectomy and early renal structural and functional changes are prevalent among patients with SCD, especially adults. There was a positive correlation between splenic size and average kidney size.
Keywords: Autosplenectomy; eGFR; Kidney atrophy; Nigeria; Proteinuria; Sickle Cell Disease; Ultrasonography.

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Introduction

Sickle Cell Disease (SCD) is a chronic, inherited haemoglobinopathy characterised by the presence of haemoglobin S, which leads to red blood cell sickling, chronic haemolysis, and recurrent vaso-occlusion. These pathophysiological processes contribute to a wide range of systemic complications, including end-organ damage involving the spleen and kidneys. Over 75% of global SCD cases occur in sub-Saharan Africa, with Nigeria bearing the largest burden worldwide.[1]

The spleen is one of the earliest organs affected in SCD. Repeated microvascular occlusions lead to progressive fibrosis, atrophy, and eventual autosplenectomy, which predisposes patients to increased risk of infections, particularly from encapsulated organisms.[2,3] Although autosplenectomy is a well-recognised feature of SCD, its prevalence and implications in different age groups, particularly in African populations, require further elucidation.
Renal involvement in SCD—collectively referred to as sickle cell nephropathy—is another serious and often underdiagnosed complication. It

may manifest as hyposthenuria, proteinuria, or progressive chronic kidney disease (CKD), potentially leading to end-stage renal disease (ESRD).[4] The underlying mechanisms include glomerular hyperfiltration, ischaemic injury from vaso-occlusion, and chronic haemolysis.[5]

Early identification of structural and functional abnormalities in both the spleen and kidneys is critical to the long-term management of SCD patients. This is because the gradual chronic infarct on the spleen may mirror cumulative structural damage on other solid and vascular organs such as the kidneys. Ultrasonography offers a non-invasive and accessible means of evaluating organ morphology, while estimation of glomerular filtration rate (eGFR) provides a functional assessment of renal health.[3] However, data on the correlation between splenic and renal findings in Nigerian patients with SCD are sparse.

This study assessed the prevalence of autosplenectomy and shrunken kidneys—and evaluated renal function using eGFR—in patients with SCD at a tertiary hospital in Nigeria. Furthermore, we investigated the correlation between splenic size, kidney size, and renal function, thereby contributing to a better understanding of systemic organ involvement in this population.

Methods

This was a cross-sectional study conducted at Ahmadu Bello University Teaching Hospital (ABUTH), Zaria, following ethical approval obtained from the Health Research Ethics Committee (HREC) of ABUTH Zaria (Reference No. ABUTHZ/HREC/W48/2022). The study enrolled 175 participants diagnosed with Sickle Cell Disease (SCD) who provided informed consent (for adults) or assent with parental consent (for children and adolescents).

The sample size used a prevalence of autosplenectomy of 55% in SCD patients in Zaria from a previous study.[1] The minimum sample size for this cross-sectional study was determined using the Cochran formula for estimating sample size in prevalence studies. The study was designed with a power of 80% and a confidence level of 95%, ensuring adequate precision for detecting significant associations. Although the calculated initial sample size for an infinite population was 384, the application of the finite population correction for the study's accessible population (N = 320 SCD patients) yielded a minimum required sample of 175, which was achieved.

Participants were consecutively recruited from the paediatric and adult haematology sickle cell clinics at ABUTH. Both children and adults with confirmed diagnoses of SCD, in their steady state, were eligible for inclusion. Exclusion criteria included diabetics, chronic hypertensives, the acutely ill, and refusal to participate.

Data were collected using a structured, interviewer-administered questionnaire, which included sections on demographic characteristics. The data were subsequently entered into a secured database for analysis.

Radiological assessments were performed using abdominal ultrasonography (GE Versana Premier, 2019 model; S/No 6041412WXO) to evaluate splenic and renal morphology within 60 days of enrolment. Participants also provided blood and on-the-spot mid-stream urine samples for laboratory analysis. Serum creatinine levels were measured, and dipstick urinalysis was conducted to assess kidney function.

The estimated glomerular filtration rate (eGFR) was calculated to evaluate renal function:

*For adult participants, the CKD-EPI 2021[6] (Chronic Kidney Disease Epidemiology Collaboration) equation was used.

*For children and adolescents, the Schwartz formula[7] was applied.

These methods allowed for the evaluation of both structural (radiological) and functional (eGFR-based) markers of renal changes, as well as splenic size, among individuals with SCD, whether or not they were on treatment for nephropathy.

Data were analysed using the Statistical Package for the Social Sciences (SPSS) version 25 (IBM Corp., Armonk, NY, USA). Statistical significance was set at $p < 0.05$ with a 95% confidence interval. Continuous variables that were not normally distributed were summarised using medians and interquartile ranges (IQRs), while categorical variables were expressed as frequencies and percentages. Pearson's correlation coefficient was used to assess the relationship between splenic and renal sizes. Associations between categorical variables were evaluated using the Chi-square test or Fisher's exact test, as appropriate.

Results

A total of 175 patients were enrolled for this study. The median age of all the study participants was 15.0 years (IQR 8.0 to 24.0 years). The median age for the adult subset of the population was 25.0 years (IQR 21.0 to 31.0 years), while that of the paediatric age group was 9.0 years (IQR 6.0 to 13.0 years). The majority of participants were female, comprising 117 (66.9%) participants. Haemoglobin electrophoresis patterns revealed 166 (94.9%) had HbSS, while 4 (2.3%) had HbSS+F and 5 (2.9%) had HbSC.

Autosplenectomy was identified in 69 out of 175 participants across all age groups (39.4%) and absent in

Table 1. Correlation between splenic size, average kidney size, and eGFR.

Parameter		Splenic size	Kidney size	eGFR
Splenic size	*r*	1	0.617	0.086
	p	—	<0.001	0.133
Average kidney size	*r*	0.617	1	0.059
	p	<0.001	—	0.305
eGFR	*r*	0.086	0.059	1
	p	0.133	0.305	—

r = Pearson's correlation coefficient; eGFR = estimated glomerular filtration rate. Statistical significance set at p < 0.05.

Table 2. Relationship between autosplenectomy and shrunken kidneys, eGFR, and other markers of kidney damage among SCD patients.

Autosplenectomy vs shrunken kidneys (adults)				
Autosplenectomy	**Shrunken: Yes**	**Shrunken: No**	**Test statistic**	**P value**
Yes	1	46	Fisher's exact	0.298
No	3	29		
Autosplenectomy vs eGFR category (all age groups)				
Autosplenectomy	**<60**	**≥60**	**Test statistic**	**P value**
Yes	5	62	Chi-square	0.258
No	13	87		
Autosplenectomy vs proteinuria (all age groups)				
Autosplenectomy	**Present**	**Absent**	**Test statistic**	**P value**
Yes	14	55	Chi-square	0.212
No	14	92		
Autosplenectomy vs haematuria (all age groups)				
Autosplenectomy	**Present**	**Absent**	**Test statistic**	**P value**
Yes	5	64	Chi-square	0.309
No	4	102		

eGFR categories in mL/min/1.73 m². Adult subgroup analysis for shrunken kidneys; all other analyses across all age groups.

106(60.6%) participants. Among the 156 adults, splenic data were available for 79, of whom 47 (59.5%) had autosplenectomy; shrunken kidneys were identified in 5 of the 156 adults (3.2%). None had enlarged kidneys.

Proteinuria was present in 28 (16.0%) and haematuria in 9 (5.1%) participants. All participants with haematuria also had proteinuria. Regarding renal function, 18/167 (10.8%) of participants had an estimated glomerular filtration rate (eGFR) below 60 mL/min/1.73 m², while 149 (89.2%) had eGFR values within the normal or mildly impaired range (≥ 60 mL/min/1.73 m²).

There was a statistically significant moderate positive correlation between splenic size and kidney size (r = 0.617, p < 0.001). There was a very weak and non-significant correlation between splenic size and eGFR (r = 0.086, p = 0.133), and between kidney size and eGFR (r = 0.059, p = 0.305) (Table 1).

In the adult subgroup, the relationship between autosplenectomy and the presence or absence of shrunken kidneys was not statistically significant (Fisher's exact test, p = 0.298). There was no statistically significant association between autosplenectomy and eGFR categories among the general participants (all age groups) (Chi-square test, p = 0.258). Other analyses are shown in Table 2.

Discussion

This study demonstrates a high prevalence of autosplenectomy and renal impairment among individuals with sickle cell disease (SCD) in a Nigerian tertiary hospital, reinforcing the systemic and progressive nature of SCD-related complications. The prevalence of autosplenectomy demonstrated in this study is consistent with previous findings in similar environments. A previous study among SCD patients in Zaria reported a prevalence of 55.4%, using non-visualisation of the spleen on ultrasound as a proxy for autosplenectomy.[1] Regional studies from Ghana and Cameroon also support these observations, highlighting the increasing frequency of autosplenectomy with age in SCD patients.[2,3] This is consistent with the pathophysiological progression of repeated vaso-occlusion leading to splenic infarction, fibrosis, and eventual atrophy.[2,3] Similar pathophysiologic mechanisms might likely be ongoing in other organs, including the kidneys.

Data from this study are comparable to earlier Nigerian studies that reported variable degrees of renal dysfunction among SCD patients.[4,5] Madu et al. observed a chronic kidney disease (CKD) prevalence of 38.9% in Enugu, based on eGFR and proteinuria.[4] Similarly, Arogundade et al. found that 37.2% of SCD patients had proteinuria, haematuria, or a reduced glomerular filtration rate (GFR) < 60 mL/min.[5] These variations may be due to differences in diagnostic tools, genetic modifiers, and access to early intervention.

Importantly, this study also evaluated the correlation between spleen and kidney sizes, finding a statistically significant moderate positive relationship. This suggests that splenic and renal atrophy may occur in parallel, possibly due to shared mechanisms of chronic ischaemia from sickling-induced microvascular occlusion. However, the correlations between organ size and renal function (eGFR) were not statistically significant, suggesting that anatomical atrophy may not always be associated with functional decline—particularly in early disease stages.

Markers of glomerular and tubular injury utilized in this study are important, as prior reports have indicated that urinalysis may detect subclinical renal damage before reductions in eGFR become evident.[8,9] This supports the inclusion of routine urinalysis in SCD renal screening protocols, especially in low-resource settings.

While autosplenectomy is often associated with increased infection risk and other complications,[10,11] this study did not find statistically significant associations between autosplenectomy and markers of renal damage. Our findings are suggestive of a potential relationship between splenic size reduction and decreasing renal volume, thus meriting further investigation through longitudinal studies. It is possible that chronic systemic hypoxia, endothelial dysfunction, and inflammation underlie parallel injury processes in both organs.[12]

Overall, the findings underscore the importance of integrated screening for splenic and renal abnormalities in patients with SCD. Prompt recognition of organ damage is critical to improving long-term outcomes, particularly in regions where late presentation and limited resources are common. We recommend larger, multi-centre studies among patients with SCD in order to further evaluate these findings.

Conflict of Interest

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. The authors declare no conflict of interest.

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