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ORIGINAL ARTICLE

Expression of Serum Secretory Phospholipase A2 and Its Association with Clinical Characteristics in Sickle Cell Anaemia Patient: A Case-Control Study in Ghana

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Abstract

Background: Secretory phospholipase A2 (sPLA2) has been implicated in the pathogenesis and complications of SCA, however its pathophysiology is not fully understood. This study determined the levels of sPLA2 in SCA patients and its association with different clinical characteristics.

Materials and Methods: This case-control study recruited a total of 90 participants, 45 SCA patients and 45 control subjects. Venous blood sample and serum were used to estimate full blood count (FBC) and sPLA2 respectively. The collected data was organised in Microsoft excel and analysis done with Statistical Package for the Social Sciences (SPSS-version 26). Statistical significances was set at $P<0.05$.

Results: The mean values of haematological indices showed significant differences between the control and sickle cell anaemia groups: RBC [$p<0.001$], Hb [$p<0.001$], HCT [$p<0.001$], WBC [$p<0.001$], MCV [$p<0.001$], RDW-SD [$p<0.005$], and PLT [$p<0.001$]. The mean sPLA2 concentration was significantly higher in SCA cases than in the control group [(60.67±19.43)µg/L vs. (23.18±4.32) µg/L; $p < 0.001$]. The sPLA2 concentrations between SCA patients with respect to the use of Hydroxyurea treatment showed no significant differences, [$p=0.581$].

Conclusion: Secretory phospholipase A2 was elevated in SCA patients. Those who presented with vaso-occlusive recorded the highest concentrations of sPLA2. White blood cell count, mean cell haemoglobin concentration, Red Cell Distribution width-standard deviation and platelets were significantly elevated in SCA whereas RBC, Hb, and HCT were low. RDW-SD showed significant variations in the different clinical presentations of SCA. RDW-SD and sPLA2 levels revealed a negative correlation in SCA.

Keywords: *secretory phospholipase A2; haematological indices, clinical state, Sickle cell anaemia, Hydroxyurea usage.*

Introduction

The incidence of sickle cell disease (SCD) in new-borns is high worldwide, with a 5% prevalence and over 300,000 reported cases, mainly in developing countries (1). A large proportion of SCD cases are recorded in Africa (2). SCD is a significant public health concern in Africa as it is one of the most common inherited condition in the continent with an annual incidence of over 200,000 births (1, 3). Majority of children born with SCD approximately 80%, are located in sub-Saharan Africa (3). The incidence of sickle cell trait, thus healthy carriers, varies significantly across Africa, with equatorial areas having the highest prevalence of 10% to 40%, compared to Northern and Southern Africa, where the frequency is lower at 1% to 2% and less than 1%, respectively (4, 5, 6). With respect to Ghana, Sickle cell disease affects approximately 15,000 (2%) new-borns each year, over half of these diagnoses (55%) represent the homozygous variant of the disease (1).

The enzymatic activity of secretory phospholipase A2 (sPLA2) involves the breakdown of glycerophospholipids at the sn-2 position, resulting in the production of lysophospholipids and free fatty acids. These enzymes have low-molecular-mass and structurally similar, ranging from 14 to 18 kDa (7). SPLA2 is a protein enzyme that is involved in the cleavage of phospholipids, producing lysophospholipids and free fatty acids. This enzyme is produced by multiple cells and can be triggered by various inflammatory signals, such as interleukin-1 (IL1) and tumour necrosis factor (TNF) (8). Through its ability to generate intermediates including lysoplatelet activating factor and arachidonic acid, sPLA2 is a key mediator of inflammation between proximal and distal effectors and has been implicated in inflammation (9). The enzymatic action of phospholipase A2 leads to the breakdown of phospholipids, creating lysophospholipids and free fatty acids. When arachidonic acids is one of the resulting fatty acids, it triggers the synthesis of various inflammatory mediators, including thromboxane, leukotrienes, and prostaglandins. In addition to free fatty acids, these mediators have been implicated in the development of acute lung injury (10).

Among the complications of SCA, acute chest syndrome (ACS) is responsible for the second-highest number of hospital admissions and the primary cause of death in SCD (11, 12, 13). The incidence of ACS is high among patients with SCD, with the majority experiencing at least one episode (12, 13). Additionally, approximately 50% of ACS cases are associated with vaso-occlusive crisis (VOC) (11). The presence of elevated levels of sPLA2 in serum or plasma has been identified as a reliable indicator of an impending ACS (12).

Research has demonstrated that concentrations of sPLA2 are high in ACS and that sPLA2 levels begin to increase 24 to 48 hours prior to clinical detection of ACS (12, 13, 14). Overall, the evidence suggests that sPLA2 play a role in the pathogenesis of SCA and may be a potential target for therapeutic intervention but little is known about how this cytokine influences other clinical states of the condition.

Studies has been conducted in various parts of the globe investigating the underlying mechanisms and the pathophysiology of SCA. Previous studies have implicated the involvement of sPLA2 in SCA pathogenesis (12, 13). Therefore, sPLA2 involvement in SCA cannot be overlooked, making sPLA2 an important subject worthy of investigation in SCA. Research has been conducted in various parts of the world on the association of sPLA2 with SCD; however, this is not case in the Ghanaian context, very little has been studied on sPLA2 and its association with clinical severity in SCA. It is however imperative that attention be given the wider scope of the subject with respect to geographical distribution.

Materials and Methods

Study Design/Site

This was a case-control design study among sickle cell anaemia patients (SCA) conducted between March to September 2023. The study was a multicenter study carried out at the sickle cell clinics of four (4) hospitals; Holy Family Hospital located in the Bono East Region of Ghana, Pope John of God Hospital, Duayaw Nkwanta, in the Tano North Municipal of the Ahafo Region, Bono Regional Hospital situated in Sunyani, and the Tamale Teaching Hospital (TTH) located in the Northern Region of Ghana. The TTH Hospital, which is a referral center for the five Northern Regions, was the primary sampling facility for the study. Digitally, the hospital may be found at NT-0101-5777 (15).

Ethical Consideration

Ethical approval for this study was obtained from the Research and Ethics Committee of the University for Development Studies, Tamale, Ghana (UDS/RB/033/22). The sampling facilities provided certifications for the study. Before consideration and participation in the study, each subject received a thorough description of the study and signed an informed consent form.

Study Population and Sample Size

The minimum number of participants required for establishing desired statistical power is 24 obtained using the Kelsey's formula (16) for case-control study. However, this study employed 90 participants comprising; 45 SCA patients as cases and 45 apparently healthy controls.

Inclusion/Exclusion Criteria

For case selection, clinically diagnosed and confirmed by haemoglobin electrophoresis sickle cell patients were included. Apparently healthy individuals with no known chronic medical conditions and homozygous HbA were recruited as controls. Patients with underlying chronic medical conditions and pregnant women were excluded from this study.

Sample Collection and Processing

To ensure participant anonymity and proper sample tracking, the tubes were labelled with codes corresponding to participant's identification. About 5ml of venous blood were collected from each participant; 3ml into EDTA tubes for full blood count (FBC) and 2ml into plain tubes for Serum Secretory phospholipase A2 (sPLA2) measurements. Full blood count analysis was done using a 5-part differential URIT 5390 haematology analyser (URIT- Medical Electronics Company Ltd, China). The sPLA2 levels were measured with sPLA2 ELISA kit (Biobase, China) using a Poweam WHYM200 microplate reader (China).

Full Blood Count (FBC) Estimation

Full blood count for each sample were performed for the EDTA tube samples using a five-part differential URIT 5380 haematology analyser (Japan) within 2 hours of collection. To estimate haemoglobin, the automated analyser uses spectrophotometry and the Coulter principle of impedance for measurement. By generating an electric field around a calibrated micro-aperture, through which the blood cells pass after being diluted in an electrolytic diluent, the blood cells are measured. With the exception of SHb (sulphaemoglobin), all haemoglobin derivatives Hb (haemoglobin), Hi (methaemoglobin), and HbCO (carboxyhaemoglobin) are transformed to HiCN (cyanmethhaemoglobin) by a lysing agent. The absorbance is then measured at 540nm

Secretory Phospholipase A2 Estimation

Serum Secretory phospholipase A2 concentration was assayed using a sandwich enzyme-linked immunosorbent assay (ELISA) (Biobase, China). Microtitter plate wells were coated with purified human sPLA2 antibody forming a solid phase antibody, sPLA2 was

added to the wells and upon the addition of labeled HRP becomes antibody-antigen-enzyme-antibody complex, upon washing and the addition of TMB substrate solution forms blue coloration at HRP enzyme-catalysis. Sulphuric acid solution was added to terminate reaction at endpoint, the optical density of the resulting color change was measured using a spectrophotometer at 450 nanometers and sPLA2 concentration by comparing the OD of the samples to the standards.

Data Analysis

Data obtained was entered into Microsoft excel (MS excel 2019) and analysis carried out with IBM statistical package for the social sciences (SPSS) software Version 26.0. Normality was checked employing Shapiro-Wilk normality test, skewness and kurtosis (Z-value), histograms graphs and Q-Q plots inspections. Descriptive results were expressed as proportions and mean ± SD. Non-parametric data were presented as median and interquartile ranges. Independent sample *t*-test was used to compare means between parametric data while Kruskal-Wallis statistics was used to compare non-parametric data. One-way analysis of variance (ANOVA) and post hoc test was used to compare hematological parameters of SCA patients in different clinical states. Correlation between sPLA2 and haematological indices were done using Pearson's and/or Spearman correlation. Statistical significances was considered at $P<0.05$ at 95% confidence interval of the Difference.

Results

Socio-Demographic Characteristics of the Study Population

Table 1 shows the demographic characteristics summary of the study participants. Females were more (53.3%) compared with males 46.7%. The median age of the sickle cell cases population was 14(8.5-20.5) years. Majority of which were females 28(62.2%). The median age of the apparently healthy controls was 24(21.5-26) years, consisting of 25 (55.6%) males and 20 (44.4%) females.

Comparison of Haematological Parameters between SCA

Patients and Controls

The mean WBC [10.25±4.77(10^9/L) vs 3.39±136(10^9/L), p<0.001], MCV [83.97±10.85(fL) vs 92.36±9.33(fL), p<0.001], MCHC [34.5(33.7-36.0)x10^3/µL vs 30.3(27.5-35.4)x10^3/µL, p<0.001], RDW-SD [52.89±16.33(fL) vs 44.62±3.79(fL), p<0.005], and PLT [339±136(10^9/L) vs 245±76.82(10^9/L), p<0.001] were significantly higher in the sickle cell anaemia group compared with the control group. However, red blood cell [4.57±0.47 (10^12/L) vs 3.24±1.0 (10^12/L), p<0.001], Hb [13.18±1.32 (g/dL) vs 9.10±1.94 (g/dL), p<0.001] and HCT [42.20±5.75 (%) vs 26.36±6.01 (%), p<0.001] were significantly higher in the controls compared with SCA cases.

Comparison of Haematological Parameters between Vaso-Occlusive Crisis (VOC), Haemolytic Crisis (HA) and Steady State (SS) Sickle Cell Anaemia Patients

The red cell distribution width-SD (RDW-SD) showed statistically significant variation (p=0.038) when the mean values of the haematological indices were compared among the various clinical presentations of the sickle cell subjects (Table 3).

Comparison of Haematological Indices and sPLA2 Levels between SCA Patients on Hydroxyurea Treatment and Hydroxyurea-Naïve patients

Sickle cell anaemia (SCA) patients were categorised into patients undergoing Hydroxyurea treatment and those not being managed with Hydroxyurea. Out of the 45 SCA patients participating in the study, 64.4% were being treated with Hydroxyurea and

35.6% were not undergoing Hydroxyurea treatment. Participants under hydroxyurea treatment had relatively higher MCHC value compared with those with no such treatment (35.1±2.3 (10^3/µL) vs 33.4±1.5 (10^3/µL), p=0.013) (Table 4).

Serum sPLA2 Concentration among SCA Cases and Non-SCA Controls

The association of serum sPLA2 levels between SCA and controls is shown in Figure 1. The mean sPLA2 concentration was significantly higher in SCA cases than in the control group respectively [(60.67±19.43) µg/L vs. 23.18±4.32) µg/L; (p < 0.001)].

Correlation between sPLA2 Levels and Haematological Indices in SCA

RDW-SD showed an inverse relationship with sPLA2 in SCA cases (r = -0.369; p<0.013). A measure of the relationship between sPLA2 and Haemoglobin, White Blood Cells, Red Blood Cells, Mean corpuscular Volume, Men Cell Haemoglobin, Men Cell Haemoglobin Concentration, and Platelets showed no significant association.

Comparison of sPLA2 Concentration between Different Clinical States among SCA Cases

Comparison of sPLA2 levels between patients presenting with three different clinical manifestations among the SCA cases including; Vaso-occlusive Crisis (n=13), Haemolytic Crisis (n=24) and individuals who were in steady state (n=8). Participants who presented with vaso-occlusive crisis had markedly high levels of sPLA2 concentrations with a mean value of 78.89±15.65µg/L, followed by participants presenting with haemolytic crisis with a mean value of 58.48±14.35µg/L. Participants presenting with no crisis and in the steady state presented a mean concentrations of 37.59±5.8µg/L. The sPLA2 levels differ significantly (p<0.001) among the three different clinical manifestations.

Table 1: Socio-Demographic Characteristics of the Study Population

Variable	*N*	Cases, n (%)	Controls, n (%)
Gender			
Male	42 (46.7)	17 (37.8)	25 (55.6)
Female	48 (53.3)	28 (62.2)	20 (44.4)
Age (years)			
<10	12 (13.3)	12 (26.7)	0 (0.0)
10-19	21 (23.3)	16 (35.6)	5 (11.1)
20-29	51 (56.7)	14 (31.1)	37 (82.2)
>29	6 (6.7)	3 (6.7)	3 (6.7)
Educational status			
No Education	1 (1.1)	1 (2.2)	0 (0.0)
Basic School	21 (23.3)	21 (46.7)	0 (0.0)
JHS	7 (7.8)	6 (13.3)	1 (2.2)
SHS	14 (15.6)	10 (22.2)	4 (8.9)
Tertiary	47 (52.2)	7 (15.6)	40 (88.9)

Abbreviations: *%, percent; SCA=sickle cell anaemia; SHS=Senior High School; JHS=Junior High School.*

Table 2: Comparison of haematological parameters between non-SCA controls and patients with SCA

Parameters	SCA (n=45)	Controls (n=45)	*p-value*
WBC (10^9/L)	10.25±4.77	4.75±1.16	<0.001
RBC (10^12/L)	3.24±1.00	4.57±0.47	<0.001
Hb (g/dL)	9.10±1.94	13.18±1.32	<0.001
HCT (%)	26.36±6.01	42.20±5.75	<0.001
MCV (fL)	83.97±10.85	92.36±9.33	<0.001
MCH (pg)	29.09±4.23	28.77±2.19	0.649
MCHC (10^3/µL)	34.5(33.7-36.0)	30.3(27.5-35.4)	<0.001
RDW-SD (fL)	52.89±16.33	44.62±3.79	<0.001
PLT (10^9/L)	339±136	245±76	<0.001

Note: *p<0.05 was considered statistically significant. Kolmogorov-Smirnoff and Shapiro-Wilk test were used to test for normality. Non-parametric data (presented in median (25th-75th percentiles)* **Abbreviations:** *SCA=sickle cell anaemia; n= Total number; Hb=haemoglobin; MCH=mean cell haemoglobin; MCHC=mean cell haemoglobin concentration; MCV=mean cell volume; PLT=platelets; RBC=red blood cell; RDW-SD=red cell distribution width; WBC=white blood cells; sPLA2=secretory phospholipase A2).*

Table 3: Comparison of haematological parameters among SCA patients in different clinical states

Parameter	Clinical State			*p-value*
	VOC (n=13)	Haemolytic Crisis (n=24)	Steady State (n=8)	
WBC (10^9/L)	9.33±5.0	10.67±5.4	10.46±1.3	0.719
RBC (10^12/L)	3.7±1.0	3.0±1.0	3.1±0.48	0.106
Hb (g/dL)	10.1±1.8	8.6±2.1	9.3±0.7	0.076
HCT (%)	29.4±5.7	24.4±6.4	27.1±1.9	0.054
MCV (fL)	81.2±12.5	84±10.6	88.3±7.6	0.358
MCH (pg)	28.6±4.9	29±4.3	30.1±2.7	0.713
MCHC (10^3/µL)	34.3±2.7	34.6±2.1	34.1±1.2	0.834
RDW-SD (fL)	45.9±16.8	52.7±15.3	64.5±13.3	0.038
PLT (10^9/L)	322±133	342±147	357±120	0.841

Note: *p<0.05 was considered statistically significant. Kolmogorov-Smirnoff and Shapiro-Wilk test were used to test for normality. Non-parametric data (presented in median (25th-75th percentiles)* **Abbreviations:** *VOC=Vaso-occlusive crisis; n= Total number; Hb=haemoglobin; MCH=mean cell haemoglobin; MCHC=mean cell haemoglobin concentration; MCV=mean cell volume; PLT=platelets; RBC=red blood cell; RDW-SD=red cell distribution width; WBC=white blood cells.*

Table 4: Haematological indices between SCA patients on Hydroxyurea treatment and those who are Hydroxyurea- Naive.

Parameter	Hydroxyurea Treatment Status		*p-value*
	Yes(n=29)	No (n=16)	
WBC (10^9/L)	9.9±3.6	10.7±6.4	0.589
RBC (10^12/L)	3.2±0.9	3.3±1.2	0.660
Hb (g/dL)	9.2±1.7	9.1±2.2	0.928
HCT (%)	26.2±5.2	26.6±7.4	0.865
MCV (fL)	84.8±10.9	82.4±10.9	0.474
MCH (pg)	29.9±4.3	27.6±3.8	0.084
MCHC (10^3/µL)	35.1±2.3	33.4±1.5	0.013
RDW-SD (fL)	52.2±15.9	54.2±17.5	0.697
PLT (10^9/L)	341±134	334±144	0.875
sPLA2 conc (**µg/L)**	59.5±18.3	62.8±21.7	0.581

Note: **Significant. p<0.05 was considered statistically significant. Kolmogorov-Smirnoff and Shapiro-Wilk test were used to test for normality. Non-parametric data (presented in median (25th-75th percentiles)* **Abbreviations:** *n= Total number; Hb=haemoglobin; MCH=mean cell haemoglobin; MCHC=mean cell haemoglobin concentration; MCV=mean cell volume; PLT=platelets; RBC=red blood cell; RDW-SD=red cell distribution width; WBC=white blood cells.*

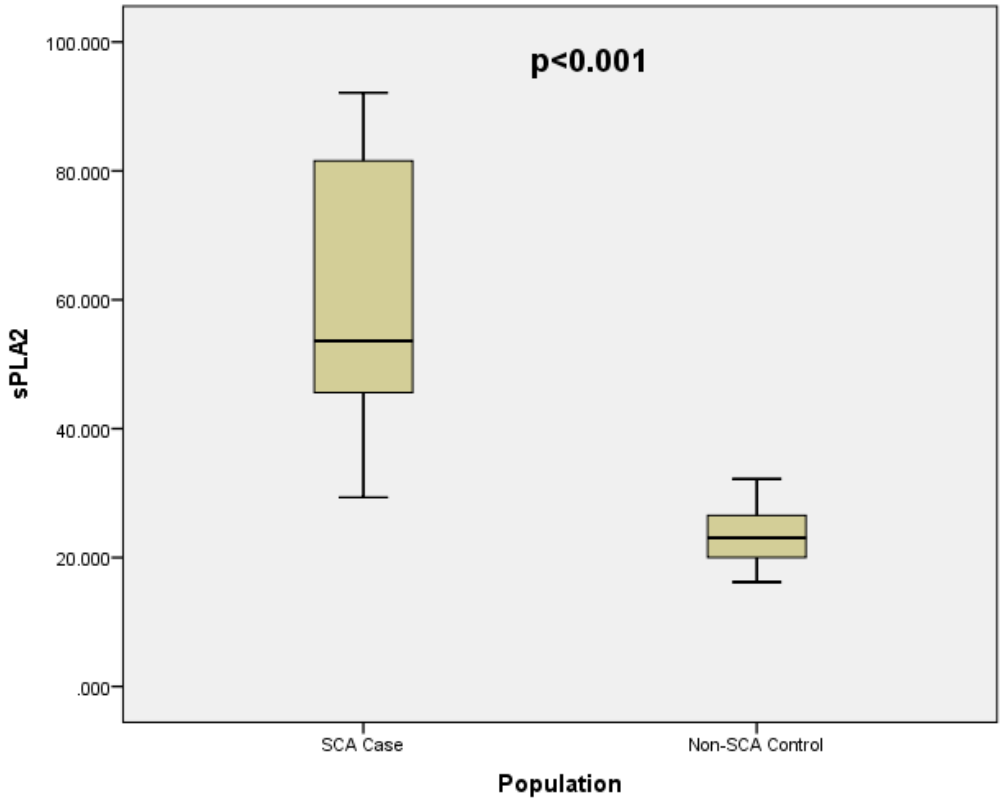

Figure 1: Serum sPLA2 (µg/L) among SCA cases and controls.

sPLA2= secretory phospholipase A2, SCA=sickle cell anaemia, uglL=microgram per litre. Student T test was used to compare the levels of SPLA2 between cases and controls. P<0.05 was considered statistically significant.

Table 5: Correlation between sPLA2 and haematological indices in SCA

Parameter	Correlation (r)	P-Value
Haemoglobin	r = 0.093	p=0.545
White Blood Cells	r = -0.126	p=0.411
Red Blood Cells	r = 0.090	p=0.555
Mean corpuscular Volume	r = 0.034	p=0.823
Mean Cell Haemoglobin	r = 0.067	p=0.660
Mean Cell Haemoglobin Concentration	r = -0.038	p=0.805
Red Cell Distribution width-SD	r = -0.369	p=0.013
Platelets	r = -0.151	p=0.321

Note:* = *Correlation significant at the 0.05 level; r = Strength of relationship; p, significance relation-*

ship. Correlation of Parametric data was generated by Pearson's correlation, and non-parametric data generated by spearman correlation, p<0.05 was considered statistically significant.

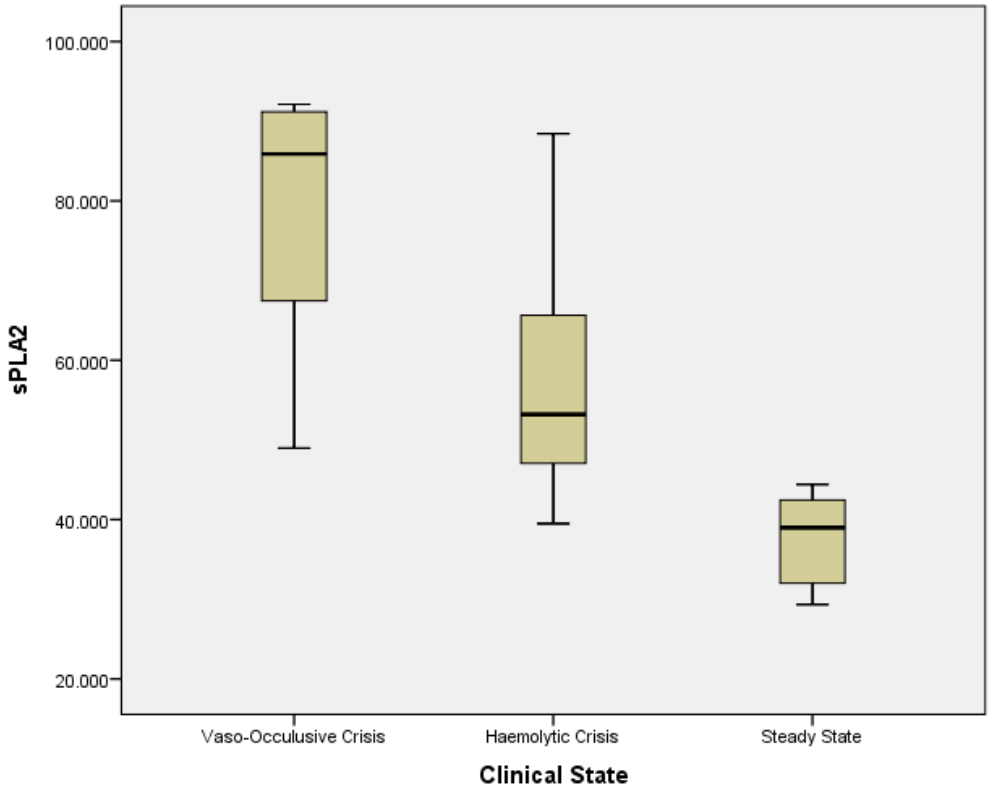

Figure 2: Comparison of sPLA2 (µg/L) between different clinical States in SCA. *sPLA2= secretory phospholipase A2, SCA=sickle cell anaemia, µglL=microgram per litre. ANOVA was used to compare the levels of SPLA2 between clinical states. P<0.05 was considered statistically significant.*

Discussion

Sickle cell disease is identified to be among the most common genetic conditions leading to illness and death with a significant public health concern (17) The condition affects approximately 15, 000 (2%) newborn per year in Ghana (6).

The findings showed that WBC and platelets were significantly high in the SCA group as compared to the controls. The findings of increased platelet and WBC counts from the current study is consistent with that of Omoti's in a research in Benin City, Nigeria, the study recorded high PLT levels in SCD patients both crisis and steady state (18). Elevated WBC and elevated PLT levels has been reported in a similar study conducted in Ghana by (1). Again, a study in Bahrain reported that PLT has a correlation with SCD, (19) which sustains the findings in this study. Among the indices expected to elevate in any form of SCA complications are WBC and PLT (20) as observed in this current study. The high platelet count recorded among the sickle cell anaemia group could be due to the reduced splenic sequestration of circulating immature reticulated platelets and underlying inflammatory conditions associated with sickle cell crises as reported by a similar study (19).

Mean cell haemoglobin concentration (MCHC) and red cell distribution width-standard devi-

ation (RDW-SD) were higher in SCA patients compared to non-SCA controls. A recent study at Al-Quadisiyah in Iraq had findings consistent with the current study (21). The high values of haemoglobin could be as a result of the overall decrease in the cell size in sickle cell, reducing the haemoglobin to volume ratio in the cells as recorded by a recent study on the sickling of cells in sickle cell disease (22). Another reason for high MCHC in sickle cell anaemia group could be attributed to haemolytic anaemia, sickle cells are removed from circulation faster than the haemopoietic system can produce mature red cells to replenish the haemolysed mature red cells, and this is compensated with larger immature cells with relatively higher mean cell haemoglobin concentration (23). Furthermore, the significantly high RDW-SD in SCA compared to controls could be as a results of RBC heterogeneity in sickle cell anaemia (24), thus the anaemia in SCA causes the release of immature red cells into circulation casing high variation in the RBCs as a bone marrow compensatory mechanism. However, the finding of high MCHC concentration contradict a study by Antwi-Boasiako et al (1) that found lower MCHC in SCA patients. The study recruited sickle patients with HBSS and HB SC genotypes and focused on adult patients whiles this current study only included only HBSS individuals who were relatively younger, thus accounting for the difference in findings.

Comparing haematological indices between the three clinical states presented revealed, RDW-SD was lowest in vaso-occlusive crisis (VOC), followed by haemolytic crisis, steady state patients showed the highest cell distribution. This finding is in line with an earlier finding by (25) which demonstrated a similar finding between steady state and VOC. In addition, the findings of a study conducted in Ghana also presented a significant variation in RDW between steady state and SCA patients who are undergoing VOC (1). This finding of elevated RDW-SD in sickle cell anaemia may be because of the stimulation of haemopoiesis in SCA as it is a state of chronic haemolysis.

A recognized clinical aspect of SCD's pathogenesis is persistent haemolytic crises (26). Red cells have a high tendency of lysis and adhesion to the endothelium of blood vessels SCD (27, 28). As expected, in comparison to the population of SCA patients, RBC, Hb and HCT were considerably greater in the control group. The low RBC, Hb and HCT findings observed in the study corroborates findings from similar studies (1, 18). The low levels of RBC count in SCA compared to the control participants with $p<0.001$ is consistent with previous study by Grau et al (27). Decrease in RBC survival, haemolytic crisis and low erythropoietin response could be the cause of low Hb and RBC count in the SCA cases (29) as observed in the current study.

Affirming other studies, the current study found that the MCV was significantly lower among the SCA cases compared with non-SCA controls. This findings in agrees with findings of a study conducted in Iraq (21). The low MCV seen in SCA patients could be attributed to the sickling out of the cells leading to microcytosis (30), reducing the overall surface area and volume of the cells making the cells appear smaller.

The findings in the current study recorded no significant differences between the WBC of patients under Hydroxyurea treatment and those not on treatment, this findings contrast that of Antwi-Boasiako et al (1) which found that patients under Hydroxyurea treatment have lowered levels of WBC in comparison to those without. A study that investigated the role of Hydroxyurea in reducing oxidative stress among SCA patients found that patients under the treatment of the drug had no significant differences in MCHC levels (31). This contradicts the findings in this study which found a substantial difference ($p=0.013$) in MCHC levels between patients under Hydroxyurea treatment and those not under the drugs treatment. The reason could be linked the function of Hydroxyurea, which is known

to increase total and foetal haemoglobin and keep the red cells large as discussed by a recent study that investigated sickle cell anaemia in children (32).

In comparison with the controls, SCA patients had higher levels of sPLA2. This finding is agrees with a study by Dang et al (2005) which compared sPLA2 levels between healthy and SCA patients (12, 33). The significantly high concentrations could be attributed to the inflammatory conditions among the SCA cases including acute ACS. The sPLA2 is an enzyme involved in the hydrolysis of phospholipids yielding inflammatory intermediate including prostaglandins, thromboxane and leukotrienes which plays a role in vaso-occlusion crises through the processes of clot formation, tightening of the airway muscles and mucus production. Previous studies affirm that sickle cell crisis is an inflammatory response accompanied by factors such as anaemia and ACS (12).

The study compared sPLA2 levels between SCA patients presenting with different clinical manifestation; thus patients experiencing VOC had high levels of sPLA2 compared to those presenting with other forms of crisis. The findings agrees with studies by Paul and colleagues (12) and Bhasin and Sarode (13) who reported high sPLA2 levels found in SCD patients in VOC. High levels of sPLA2 in SCD maybe due to several different biological process that arise during crisis including; inflammation and tissue damage (34), haemolysis and phospholipid release into blood (35, 36), ischaemia and perfusion injuries (37), activation of immune cells such as macrophages and neutrophils, and oxidative stress (38, 39).

Conclusion

Secretory phospholipase A2 was elevated among SCA patients. Patients with vaso-occlusive recorded the highest concentrations of sPLA2. White blood cells, mean cell haemoglobin concentration, Red Cells Distribution width-standard deviation and platelets were found to be significantly elevated in SCA whereas RBC, Hb, and HCT were low in SCA patients compared to healthy controls. RDW-SD and sPLA2 revealed a negative correlation in SCA. Given the observed negative correlation between RDW-SD and sPLA2 levels in SCD, further research in much larger population should be considered to illuminate the underlying biological processes directing this observed correlation. Additionally, traversing the potential therapeutic implications of modulating sPLA2 levels together with monitoring RDW-SD could pave the way for novel interventions aimed at alleviating the clinical course of SCA.

Authorship Contributions Statement

All the authors involved in this work played a significant role in various aspects, such as conception, study design, data curation, laboratory investigations, statistical analysis, and drafting of this manuscript. Furthermore, they provided final approval for the version to be published, agreed to the journal to which the article was submitted and are accountable for all aspects of this work.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

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