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Research Article

Some Haematological Parameters and Parvovirus B19 Prevalence among Children of African Descent in Sokoto North Western Nigeria

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Abstract

Introduction: Human Parvovirus B19 (HPVB19) belongs to the family Parvoviridae and it causes Erythema infectiosum, aplastic crises in persons with blood disorder and prolonged anaemia in immunocompromised persons. Haematological abnormalities are among the most common manifestation of advanced parvovirus B19 infection.

Objectives: The aim of this study was to determine some haematological parameters and parvovirus B19 IgG antibody prevalence among children attending Emergency Pediatric Unit (EPU) of Specialist Hospital Sokoto (SHS).

Materials and Methods: The study population included Ninety-Six children attending EPU of SHS (comprising of 57 males and 39 females). Prevalence of Parvovirus B19 IgG antibody and the association of some Haematological parameters of Packed Cell Volume (PCV), Platelet Count (PLC) and Total Leukocyte Count (TLC) were determined. Plasma samples from subjects were analysed for HPV B19 IgG antibodies by ELISA while the haematological parameters were analysed using the 5-part differential Haematology analyzer (Orphee, Switzerland). Data obtained was analyzed using the statistical software (SPSS Version 20.0).

Results: Of the total number of subject tested, 33 (34.4%) were positive for Parvovirus B19 antibody and 63 (64.6%) had no detectable parvovirus B19 IgG antibody. The mean ± standard deviation of some haematological parameters as observed in the study subject (children) were 32.8 ± 0.5%, 5.18 ± 0.08 and 264.39 ± 6.67 for PCV TLC and PLC respectively. Children that were positive for Parvovirus B19 IgG antibody had a mean PCV of 31.80%, TLC of 4.70 × 109 and PLC of 271 × 109. The prevalence of parvovirus B19 IgG antibody was higher among children within age group of 1-5 years (23%) followed by 6-10 years (7%) and 11-15 years (3%) ($p = 0.88$). The prevalence of parvovirus B19 IgG antibody was higher among male children (20%) compared to Females children (13%) ($p = 0.86$).

Conclusion and Recommendations: It is recommended that clinicians caring for children be made more aware of the existence of this virus as well as the possible haematological alterations that could accompany it in our environment. Hospital laboratories should be encouraged to introduce diagnostic tests for parvovirus B19 infection.

Keywords: *Parvovirus B19; Children; Haematological Parameters; Emergency Paediatric Unit; Specialist Hospital Sokoto*

Introduction

Parvovirus is the common name applied to all the viruses in the Parvoviridae taxonomic family. Parvoviruses are linear, non-segmented single-stranded DNA viruses [1]. Parvovirus B19 (B19), which is common throughout the world, has the potential to precipitate severe anaemia in children with pre-existing moderate anaemia, particularly those with significant haemolysis [2]. The virus is named for the patient code of one of the blood bank samples involved in the discovery [3].

Several seroprevalence studies have shown that the prevalence rates of anti-parvovirus b19 IgG antibody range from 1 to 15% in children below 5 years, 15 to 30% in children between 5 to 19 years, 30 to 60% in adults and 80% and above in the elderly population [4]. Transmission of the virus may occur at any age. This virus can be transmitted through respiratory secretion, transfusion of blood or blood product, or virtually from mother to foetus and may lead to hydrops foetalis [5].

Human parvovirus B19 is responsible for a variety of clinical syndromes, such as erythema infectiosum, non-immune hydrops foetalis, transient aplastic anaemia, and arthropathies. HPV is also suspected of playing a role in the pathogenesis of various chronic inflammatory and autoimmune diseases (systemic lupus erythematosus, rheumatoid arthritis, Kawasaki disease and multiple sclerosis). In the period between July 1991 and March 1992, 48 patients with aplastic crisis were hospitalized at Saudi Aramco-Dhahran Health center. Forty-six patient had homozygous sickle cell disease, one had haemoglobin H disease and one had hereditary elliptocytosis. Evidence of recent human parvovirus infection was present in 91% of cases. Leukopenia was present in 21%, neutropenia in 27% and thrombocytopenia in 41%. This differs from previous reports in which red blood cell aplasia causing anaemia was the only haematologic finding reported in most patient [6].

Erythema infectiosum is the most common clinical manifestation of Parvovirus B19 during childhood. After a prodromal period of about 2 weeks, many times unnoticed, but sometimes including: fever, headache and non-specific gastrointestinal symptoms, a rash erupts. The rash is characterized by red cheeks with circumoral pallor (slapped cheeks). The rash consists of maculae that undergo central fading which extends during the next 1 - 4 days to the trunk and limbs. It may include vesicles and be itchy and scaly. The rash is likely due to the formation and deposition of immune complexes in the skin and elsewhere [7]. Exposure to sun light, heat [8], emotion and exercise [7] may intensify the rash.

Human parvovirus (HPV) B19 causes significant morbidity and mortality in children with sickle cell disease (SCD), but there is paucity of data about the epidemiology of HPV B19 infection and its associated complications in the general population among children. The study to evaluate haematological abnormalities in children with parvovirus B19 is very important in order to prevent haematological complications that may arise during the infection. Furthermore, no study has been conducted on parvovirus B19 and its effect on haematological parameters among children in Sokoto. The study would provide haematological information that could be used in taking preventive actions in the management of children with parvovirus B19 infection.

Aim of the Study

The aim of the study is to determine the prevalence of parvovirus B19 antibody and some haematological parameters among children attending the Emergency pediatric unit of Specialist Hospital Sokoto (SHS).

Methodology

The study was carried out using Parvovirus B19 ELISA kit (Demeditec Diagnostics GmbH, Germany). The test is a quantitative method was used for the determination of the presence of Parvovirus B19 IgG antibody in serum of children below 15 years attending to the paediatric unit of SHS. Full blood count was determined using the 5-part differential haematology analyzer (Orphee, Switzerland).

Study design

The present case study determined FBC parameters and prevalence of Parvovirus B19 among 96 consecutively-recruited children attending the Pediatric unit of SHS Sokoto, Nigeria.

Study site

The study was conducted at the Department of Haematology in the School of Medical Laboratory Science, in Usmanu Danfodiyo University Sokoto in collaboration with Paediatric unit of SHS, Sokoto. The study sites and participating hospital have enabling environment to carry out this study. Sokoto State is located extreme North West of Nigeria near to confluence of Sokoto River and the Rima River. With an average annual temperature of 28.3°C (82.9°F), Sokoto is on the whole a very hot area. However, maximum day time temperature is most of these generally under 47°C (104°F). The warm months are February to April when daytime temperature is on the excess of 40°C (113°F). The rainy season is from June to October during which showers are daily occurrence. Report from the 2007 national population commission indicated that the State had a population of 3.6 Million [9]. The Paediatric Unit is a Department in SHS, Sokoto, providing continually improving healthcare services to children below the age of 15 year. Majority of patient received at this hospital are people of Sokoto, Kebbi and Zamfara states as well as Children from the neighboring Niger Republic.

Sample size calculation

The sample size was determined based on a formula [10] for population that is > 10,000: $n = (z)^2pq \div d^2$

Where:

n = Minimum sample size

z = Standard normal deviation (1.96)

p = Proportion of success or prevalence (15.7%) [11]

q = 1 - p

d = Tolerance limit, the minimum is 0.05.

$n = (z)^2pq \div d^2$

$n = (1.96)^2 \times 15.7\% \times 1\text{-}p \div 0.05^2$

$n = 3.8416 \times 0.157 \times 1\text{-}0.5 \div 0.0025$

$n = 3.8416 \times 0.157 \times 0.843 \div 0.0025$

n = 203.

Study subject

A total of 96 subjects aged 1 - 15 years constituted the subject for this study comprising of 57 male and 43 females attending EPU of SHS, Sokoto North Western Nigeria.

Inclusion criteria

All children within the age range of 1 - 15 years whose parents/guardians have offered verbal informed consent for their ward to be recruited as subjects were consecutively recruited into this study from among children visiting the EPU of SHS in Sokoto, Nigeria.

Exclusion criteria

All children > 15 years and those whose parents/guardians have not offered verbal informed consent for their ward to be recruited as subjects were excluded from the study.

Sampling method

Ninety-six children who met the eligibility criteria for the study were consecutively recruited as subject for this cross-sectional study to avoid bias.

Method of data collection

Socio-demographic data was collected using a self-administered questionnaire from each participant. Data collected include age, gender, ethnicity, religious affiliation and level of education.

Statistical analysis

The data collected was recorded on an excel spreadsheet and later subjected to statistical analysis using statistical software (SPSS Version 20.0). Results were expressed as mean and standard deviation. Differences in values based on socio-demographic variables of subjects was determined and compared statistically. A p-value of ≤ 0.05 was considered as significant in all statistical comparisons.

Ethical consideration

Ethical clearance for the study was sought and obtained from the ethics and research committee of SHS Sokoto before the commencement of the study.

Informed consent

Verbal informed consent was obtained from parents/guardians of all study participants and socio-demographic information was collected using a questionnaire.

Questionnaire

A questionnaire was distributed to all consenting parents to collect socio-demographic data of study subject.

Sample collection

Blood samples (5 milliliters) were aseptically collected from subjects attending the paediatric unit of SHS Sokoto into EDTA anticoagulated tube and non-anticoagulated tube. The sample in the non-anticoagulated tube was allowed to clot and centrifuged to obtain serum. The serum was used for parvovirus B19 IgG antibody testing using Parvovirus B19 IgG antibody ELISA kit while the EDTA anticoagulated sample was used for determination of Full blood count using the Mythic 5-part differential haematology analyzer (Orphee, Switzerland).

Method

Parvovirus B19 IgG antibody

Principle of the test method (Parvovirus B19 IgG antibody)

The Demeditec Parvovirus B19 IgG enzyme immunoassay kits (Demeditec Diagnostics, Germany) was used for the *in vitro* quantitative measurement of the amount of immunoglobulin class antibodies for B19 present in the serum. Testing was carried out strictly following the manufacturer's standard operating procedure. The microtiter wells were coated with recombinant parvovirus B19 antigen (VP1 proteins). The antigen was derived from the entire VP1 unique region of B19. The test kits are designed for the measurement of parvovirus infections in humans only. Prevalence was defined by the presence of B19 IgG antibodies in the tested sera. Positive or negative cases were determined by comparing the absorbance value of each sample with that of the cut-off value. Based on the manufacturer's instructions, specimens with an absorbance value less than the cut-off value were recorded as negative while specimens with a value above the cut-off value were recorded as positive.

Full blood count was determined using Mythic 22 CT, 2008 Haematological analyzer (Orphee, Switzerland). The analyzer is based on **i**mpedance principle developed by Wallace Coulter in 1956. The Coulter counter system is based on the principle that RBC or WBC is a poor conductor of electricity compared to the diluents such as saline. When the diluent is displaced by cells, it causes a measurable change in resistance. The cells are allowed to pass through an aperture through which an electric current is flowing. Cell passing through the aperture displace the diluents; and being bad conductors of electricity, increase the resistance which is counted as a voltage pulse, which are converted to digital recording. The cell suspension is drawn through the aperture with the help of a vacuum pump into a system of tubing.

Result

A total of nine six (96) children attending EPU of Specialist Hospital Sokoto comprising of 57 male and 39 females with mean age of 7.5 ± 6.5 constituted the subject for this study. Of the total number of subject tested, 33 (34.4%) were positive for Parvovirus B19 antibody and 63 (64.6%) had no detectable parvovirus B19 IgG antibody. Figure 1 shows the prevalence of parvovirus B19 IgG among children attending Emergency Paediatric Unit of SHS. The mean ± standard deviation of some haematological parameters as observed in the study subject (children) were 32.8 ± 0.5%, 5.18 ± 0.08 and 264.39 ± 6.67 for PCV TLC and PLC respectively. Table 1 shows the mean values for some haematological parameters among the subjects. Children that were positive for Parvovirus B19 IgG antibody had a mean PCV, TLC and PLC of 31.80%, 4.70 × 10^9 and 271 × 10^9 respectively. Table 2 shows the haematological changes as observed in the PCV, TLC and PLC among subject reactive for the Parvovirus B19 IgG antibody. The prevalence of parvovirus B19 IgG antibody was higher among children within age group of 1 - 5 years (23%) followed by 6 - 10 years (7%) and 11 - 15 years (3%) (p = 0.88). The prevalence of parvovirus B19 IgG antibody was higher among male children (20%) compared to female children (13%) (p = 0.86). Table 3 comparison of age and some haematological parameters of children studied. Result obtained from table 4 shows the effect of gender on haematological parameters of children. Table 5 shows the prevalence of parvovirus B19 among children of different age group. Result obtained shows that the prevalence was highest among children within age group of 1 - 5 (23%) followed by 6 - 10 (7%) and 11 - 15 (3%) respectively (p = 0.88). Table 6 show the prevalence of parvovirus B19 among children of different gender. Result obtained showed that there was no significant difference in the mean haematological values based on gender (p = 0.86).

Haematological parameters	Mean Value	Standard Deviation
PCV (%)	32.80	8.72
PLT (×10^9/L)	5.18	1.91
TLC (×10^9 /L)	264.39	72.91

Table 1: *Some haematological parameters among children attending EPU of SHS.*

Parvovirus B19 IgG Status	PCV (%)	Haematological parameters (Mean value) PLT ($\times 10^{9}$ /L)	TLC ($\times 10^{9}$ L)
Reactive	31.79	271	4.70
Non-Reactive	33.09	261	5.35

Table 2: *Some haematological parameters among children react for parvovirus b19 igg compared to those non-reactive.*

Age Group (years)		Haematological parameters (Mean value)	
	PCV (%)	PLT ($\times 10^{9}$/L)	TLC ($\times 10^{9}$/L)
1 - 5	32.80	260	5.07
6 - 10	32.40	288	5.24
11 - 15	33.40	264	5.15

Table 3: *Comparison of age and haematological parameters of children attending EPU of SHS.*

X^2 = 0.6 p-value = 0.30.

Gender		Haematological parameters	
	PCV (%)	PLT ($\times 10^{9}$/L)	TLC ($\times 10^{9}$/L)
Male	32.5	263	5.42
Female	33.15	263	4.80

Table 4: *Comparison of genders and haematological parameters of children attending EPU of SHS.*

X^2 = 1.12 p-value = 1.88.

Age group (years)	Parvovirus B19 IgG Result		Total
	Reactive N (%)	Non-Reactive N (%)	
1 - 5	23 (69.7)	45 (71.4)	68
6 - 10	7 (21.2)	11 (17.5)	18
11 - 15	3 (9.1)	7 (11.1)	10
Total	33 (100)	63 (100)	96

Table 5: *Comparison of age and prevalence of parvovirus B19 IgG among children attending EPU of SHS.*

X^2 = 0.029 p-value = 0.88.

Gender	Parvovirus B19 IgG Result		Total
	Reactive	Non-Reactive	
Male	20	37	57
Female	13	26	39
Total	33	63	96

Table 6: *Comparison of gender and prevalence of parvovirus B19 infection.*

X^2 = 0.03 p-Value = 0.86.

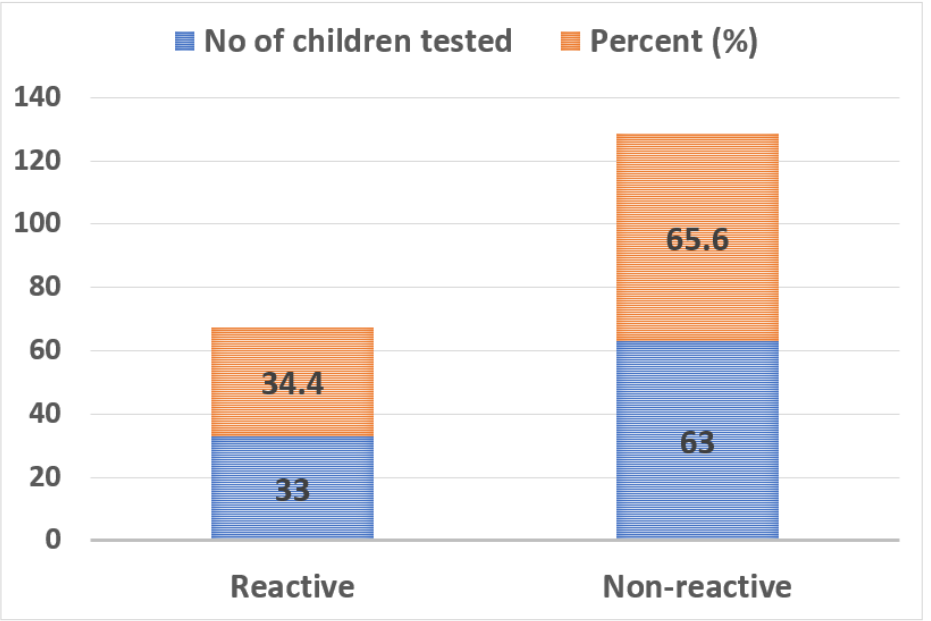

Figure 1: *Prevalence of parvovirus B19 IgG among children attending emergency paediatic unit of SHS.*

Discussion

This study indicates that parvovirus B19 infection is common among children in Sokoto. Out of the 96 subjects studied, 34.4% were positive for IgG antibody. Our prevalence is consistent with a previous report among 57 anaemic and 115 non-anaemic age-matched pre-school children in Ilorin, Nigeria assayed for human parvovirus B19-specific IgM antibodies which indicated that 17 (29.8%) of anaemic children and 18 (15.7%) of the non-anaemic children were positive for parvovirus B19 infection [11].

Our observed prevalence is consistent with the prevalence observed among 6060 children in Germany where the age-specific IgG-positivity rate increased from 12.2% at 2 years of age to 71.9% in those older than 10 years [12]. The observed prevalence in this study is higher than a 17%, 19% and 4% prevalence observed respectively in Middle Eastern and Asia countries [13], Kuwait [14] and Singapore [15] respectively. However, the prevalence observed from this study is consistent with the 35% prevalence reported among Brazilian children aged 1 - 5 years [16]. The prevalence of parvovirus B19 IgG antibody in this study is lower compared to a rate obtained in a previous study in Lagos Nigeria which observed a prevalence of 55.9% [17]. Similarly, a previous report in neighboring Niger Republic observed 70% parvovirus B19 prevalence [18]. Among 128 children tested for HPV in Israel [19] 48 (37.5%) had evidence of acute infection based on the presence of immunoglobulin M antibodies. Our finding is consistent with a previous report that investigated the prevalence rates of HPV B19 among 633 patients with SCD followed up at the Children's Hospital of Philadelphia which indicated a prevalence of HPV B19 immunoglobulin G (IgG) of 30% [20]. Population surveys were performed in 15 villages in Maprik district, East Sepik Province, Papua New Guinea in 2005. Plasma samples collected from children less than 10 years of age were tested for IgM and IgG antibodies to B19 by enzyme immunoassay. The prevalence of IgG antibody to B19 was 53.8% and ranged from 20% in those less than one year of age to 85.5% in those nine years of age [21]. Our finding has significant implications for children living in Sokoto North western Nigeria in particular

and Nigeria in general because of the high incidence of sickle cell disease (2% - 3%) among the Nigerian population [22]. Previous report indicated that the presence of parvovirus B19 infection may exacerbate anaemia in children that have sickle cell disease [23].

Haematological changes are common in Parvovirus B19 infection. In this study, mean ± standard PCV, TLC and PLC count of children positive for Parvovirus B19 were 32.8 ± 0.5%, 5.18 ± 0.08 and 264.39 ± 6.67 respectively. Although parvovirus B19 infection is asymptomatic in 20 - 30 cases, the presence of fever and decrease in haematological count in our region is often assumed to be due to malaria and sickle cell anaemia. However, children with fever due to parvovirus B19 infection could be erroneously treated for malaria especially when other causes are not found. Infection comes up approximately 7 - 10 days after the onset of fever and the rash which is evanescent and may not be visible in persons with dark skin such as our study population [24]. The high prevalence observed in this study may reflect a period of outbreak of parvovirus infection in the locality. Human parvo virus B19 has been associated with several diseases. Aplastic crisis in patient with chronic haemolytic anaemia, erythema, hydrops foetalis and arthritis are among the common diseases caused by this virus infection. In the period between July 1991 and March 1992, 48 patients with aplastic crisis were hospitalized at Saudi Aramco-Dhahran Health center. Forty-six patient had homozygous sickle cell disease, one had haemoglobin H disease and one had hereditary elliptocytosis. Evidence of recent human parvovirus infection was present in 91% of cases. Leukopenia was present in 21%, neutropenia in 27% and thrombocytopenia in 41%. This differs from previous reports in which red blood cell aplasia causing anaemia was the only haematologic finding reported in most patients [25]. Similarly, high B19 IgM levels were found significantly associated with severe anaemia among children admitted to a Kenyan district hospital [26] and in Paupa New Guinea [27].

Parvovirus B19 infection was higher among children in the 1 - 5 years age group (69.7%) compared to 21.2% and 9.1% respectively among children 6 - 10 years and 11 - 15 years respectively. It's important to note that some Amazonian tribes and remote Islands off the coast of Africa have been reported to have escape infection with parvovirus B19. It has been observed that infection occurs throughout life [28]. This happen because there are group of individuals who escape infection in childhood and adolescence. Our observation of Human parvovirus B19 infection prevalence of 34.4 percent confirms that this infection is transmitted most frequently by school-aged children. Our observed prevalence is however higher than rates observed in healthy hosts from the United Kingdom and Australia where 27% [29] to 28% [30] are infected by 11 years of age. The prevalence of parvovirus B19 IgG antibody was higher among male children (20%) compared to females children (13%). The reason for this male gender increased predisposition to parvovirus B19 is unknown. Hormonal factors may potentially play a role.

Conclusion

In conclusion, the finding in this study indicates a human Parvovirus B19 IgG antibodies prevalence of 34.4% among children with an insignificant decrease in their haematological count in Sokoto State, North Western Nigeria. The presence IgG antibody is an indication of a previous infection and immunity against Human parvovirus B19 infection. A significant number of children 65.6% are not immuned and are thus potentially prone to infection that may erroneously be considered as malaria such as erythema infectiosum and aplastic crisis.

Recommendations

From the study result, we recommend that further study be carried out to screen large number of children for parvovirus B19 IgG and IgM antibody. We also recommend that haematological parameters should be determined in patient with the infection to avoid misdiagnosis of patient for malaria instead. There is need for more awareness among clinicians on the clinical signs, diagnosis and management of parvovirus B19 infection and the effect it can potentially have on the haematological parameters of affected children. There is also the need for public awareness on preventive measures to be taken to avoid the infection.

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