Study of Haemoglobinopathies incidence in Ogbonicha District-Ofu LGA, Kogi State, Nigeria.

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Abstract

Background: Haemoglobinopathy is associated with different pathological conditions especially in Africa and other third world countries. This genetically determined blood disorder has posed continued alarming problem in public health especially in Africa and other third world countries. Many Nigerians are yet to have clear understanding of the generation, presentations and management of Haemoglobinopathies perhaps due to their religion or cultural beliefs. Sequel to this problem, it is imperative to provide adequate information for prompt intervention in order to curb the situation. Study provides information on the incidence of same in Ogbonicha District of Ofu Local Government Area, Kogi State, Nigeria. Methods: A total number of 400 volunteered people and were screened for haemoglobin (Hb) variants by alkaline cellulose acetate electrophoresis. Results: Out of the 400 subjects that were screened regardless of age and status, 222 (55.50%) were females and 178 (44.50%) were males. Only three (3) Hb genotypes HbAA (76.50%), HbAS (22.25%) and HbSS (1.25%) were reported in this study. In female, the sickle-cell-trait (HbAS) was 94.37% (67) while the disease state (HbSS) was 5.63% (4) while in males; the sickle-cell-trait was 95.65% (22) and the disease state 4.35% (1). Conclusion: The high prevalence of HbAA with the observed low prevalence of HbSS variants in this population could imply a decline in haemoglobinopathy in the population. However mass literacy campaign and improved counseling on related genetic issuesshould be encouraged and maintained in order to eradicate haemoglobinopathy.

Keywords: haemoglobinopathy, genotypes, gender, Ogbonicha- Nigeria.

I. INTRODUCTION

Haemoglobin genotypes have been associated with different pathological conditions, and many Nigerians are yet to clearly understand the genesis, presentations and management of Haemoglobinopathies perhaps because of the observed high level of ignorance of the disorder due to their cultural beliefs. Survey indicated that no information is available on the incidence of different sickle- cell-diseases and their traits in Ogbonicha district.

WHO figures estimate that 5 % of the world population is carrier for haemoglobin disorders[1] .Haemoglobinopathies are the commonest genetic defect worldwide with an estimated 269 million carriers[2].A study carried out on the Haemoglobin electrophoretic pattern among resident in Sokoto, Nigeria showed all subjects with haemoglobin SS and SC as those less than 20 years of age, also with a high prevalence of haemoglobin variants in the study population [3]. The term haemoglobinopathy applies mainly to the structural alteration of the globin polypeptide chains, which constitute the chain haemoglobin variant from substitution of a single amino acid in globin chain due to a point mutation in the β globin gene. The changed variant may leave the haemoglobin function undisturbed or may produce mild or severe consequences for the carrier and may produce manifestations and findings that occasionally acquire clinical importance. The Haemoglobinopathies may be endemic, with a varying social impact in various populations over the globe [4].More than 700 structural haemoglobinopathy cases have been reported so far [5], over 90% of the cases occur because of substitution of a single amino acid. Several amino acid substitutions are not associated with any significant functional alterations of the respective haemoglobin molecules and, hence, they are listed as simple haemoglobin variants. However, only a few variants produce clinical manifestations, the most frequent haemoglobinopathies are HbC, HbD, HbE and HbS [6]. Each red blood cell contains approximately 640 million haemoglobin with a molecular weight of 68,000 and each molecule of normal adult haemoglobin consist of four (4) polypeptide chains, each with its own haem group with an iron atom in the ferrous state (Fe^{2+}) that sits in the middle of the haem [7].The normal functions and the total amount of haemoglobin depend on its adequate synthesis and precise structure. When these conditions are not met, the red blood cells of the carrier contain a haemoglobin variant, which is as a result of the alteration of the structure of the haemoglobin during genetic events that may have abnormal properties causing interference with oxygen delivery and impairment of the carrier's health. These conditions are described as haemoglobinopathies [8].Haemoglobin variants are a part of the normal embryonic and foetal development, but may also be pathologic mutant forms of haemoglobin in a population, caused by variations in genetics. Some well-known haemoglobin variants considered as non-pathological variants include: Gower I, Gower II, Hb Portland and Foetal haemoglobin (HbF). These variants are found in normal individual depending on the individual stage of development [9]. However, some of these mutant forms of haemoglobin, cause a group of hereditary diseases: their structural abnormality may cause increased destruction of red blood cells; easily denatured haemoglobin; haemoglobin with abnormal oxygen affinity; altered solubility and in few instances reduced globin synthesis; they include HbAS, HbAC, HbSC, HbSE and HbSS. The best known haemoglobinopathy is Sickle-Cell-Disease, which was the first human disease whose mechanism was understood at the molecular level [10].

These hereditary disorders of haemoglobin pose a massive health problem of immense proportion in many countries. The distribution of specific disorder varies geographically and by community [7]. Many studies have associated abnormal haemoglobin with different disease condition in different parts of the world [11]. WHOin 1986 estimated that 7% of the world population is a carrier for haemoglobin disorder. Statistics show that about 300,000 children are born with Sickle-Cell-Disease worldwide annually. They cause severe haemolytic anaemia leading to high degree of morbidity and mortality [12].It is anticipated that the global economic burden of the haemoglobinopathies on public health will increase over the coming decades [13], as certain populations are particularly at risk of having a haemoglobinopathy, for example, in South East Asia, there are 90 million carriers, about 85 million in sub-Saharan Africa and 48 million in the West Pacific region. Sickle haemoglobin (HbS) is the most common and clinically significant haemoglobin structural variant [14].The prevalence rate in Africa in many populations is over 20% and reaches 50% in some tribes. Their blood figures and morphology are normal, as well as their physical development, activity and longevity. Haemoglobin S concentration is less than 50% of total haemoglobin, the rest being haemoglobin A, haemoglobin A_2 and haemoglobin F. the cells do not contain sufficient haemoglobin S to undergo sickling at the lowest oxygen tension normally occurring in the body; however, in some conditions of anoxia complications may occasionally occur [15].Sickle-cell traits (HbA-HbS heterozygote) present a slight anaemia level and under normal circumstances,

present the same biological efficacy than normal haemoglobin a (homozygote). Most epidemiological studies suggest that there is no selective morbidity or mortality attributable to the condition. However, in region of Africa that have a high incidence of malaria, the presence of some amount of sickle-cell trait is somewhat protective against the malaria protozoa, illustrating the relation between biological efficacy and environment in a case known as compensated polymorphism [16].

1.1 Aims and objectives

To identify the incidence of haemoglobinopathies in Ogbonicha District of Ofu LGA, Kogi State, Nigeria also using it as a yardstick to portray one of the numerous grassroots challenges in order to point to government by way of information in planning of her much discussed cliché 'Health for all in the year 2020' on sickle-cell disease.

1.2 Geographical background and the people of Ofu LGA, Kogi State

Geography and People: Ofu is a Local Government area in Kogi State, North Central - Nigeria, the Niger River forming its western boundary. Its headquarters are in the town of Ogwoawo (or Ugwalawo or Gwalawo) to the south of the area at7°14′09″N6°55′32″E. The north easterly line of equal latitude and longitude passes through the LGA. It has an area of 1,680 km² and a population of 192,169 at the 2006 census. [17]. It is made up of nine districts; including Ogbonicha which is made up of a population of about 150 thousand people who are mainly farmers and petty traders. They are predominantly Igala speaking people. The communities have high concentration of primary schools with few community secondary schools. The inhabitants had limited knowledge of sickle-cell disease, but it is misconceived to be caused by witches/wizards. The misconception is strongly believed since the disease presents severe anaemia, which is believed to be caused by witches sucking the blood of the patient. **Food crops**: Maize, beans, groundnuts, rice, cassava, melon, guinea corn, barbara nuts. **Cash crops**: Cocoa, palm trees, including cashew and mangoes. Minerals: Marble, lime, kaoline, feldspars, galena. **Tourism**: Ugbakoji hills in Itobe, Uloko Anao waterfalls at Ofokopi, Ala natural tunnel and Ofakete natural bridge.

II. MATERIALS AND METHODS

A total of 400 subjects from Ogbonicha District of Ofu LGA, Kogi State, Nigeriawere selected for the test irrespective of age and status between June and August 2011. Blood sample was taken from each volunteer and dispensed into sterile bottle containing EDTA anticoagulant. The samples were preserved at 4°C and were transported to Jos with ice pack.Method is by cellulose acetate electrophoresis.

2.1 Preparation of sample

A drop of the red blood cells was added to 5 drops of the haemolysate in a khan tube and a haemoglobin concentration of approximately 10g/100mls was obtained and was used for electrophoresis.

Principle: At alkaline pH, haemoglobin is a negatively charged protein and when subjected to electrophoresis will migrate toward the anode (+). Structural variants that have change in the charges on the surface of the molecule at alkaline pH will separate from Hb A [18].

2.2 Reagents and Equipment:

TEB buffer pH 8.6: Tris-Hydroxyl methyl amino methane- 14.5g, Ethylene diamine tetra- acetic acid- 1.5g, Boric acid- 0.9g, Distilled water 1 litre. Shandon Southern Universal Electrophoresis Tank U77 with its power supply.

- The labeled cellulose acetate strip was marked in pencil at the origin, approximately 4cm from the cathode end.

- The strip was placed on the surface of the buffer in the tank, allowing the buffer to impregnate the strip by capillarity before it was submerged completely.
- The impregnated strip was removed from the buffer using forceps and was lightly blotted to remove excess moisture. Opaque spots were avoided.
- The strip was positioned with the point of application on the cathode side placed across the bridge in the electrophoretic tank.
- The strip was secured with wick of Whatman No. 1 filter paper soaked in the buffer.
- The samples were mixed and were applied on the cellulose paper on the bridges with the aid of an applicator 3cm from the origin
- The tank was covered and a constant voltage of 350V(25mA unit) was maintained through the power supply units for 15 minutes
- After 15 minutes the electrophoretogram was removed with the aid of a toothless forceps. The migration was visualized directly and the result was recorded before staining with controls applied.
- After this, the electrophorectogram was stained in Ponceau S for 5 minutes and de-stained with changes of 5% Glacial acetic acid until background of the paper became white.The cellulose acetate was blotted and was allowed to air dry and was stored in a protective envelop.

III. RESULTS

From the total of 400 screened blood samples, the distribution of the different haemoglobin genotypes was HbAA 306 (76.50%), HbAS 89(22.25%) and HbSS 5 (1.25%). However, HbAC and HbSC were not encountered.Based on gender distribution; there were 178(44.5%) males and 222(55.5%) females. Results also showed HbAA 155(50.65%); 151(49.35%), HbAS 22(24.72%); 67(75.28%) and HbSS 1(20%); 4(80%) male and females respectively.

Table 1: Distribution of haemoglobin genotypes

		Haemoglobin genotype		
Sex	No. screened	Hb AA	HbAS	HbSS
Females	222	151	67	4
Males	178	155	22	1
Total	400	306	89	5

Table 2: Percentage distribution of haemoglobin genotypes

		Haemoglobin genotype		
Sex	No. screened	Hb AA	HbAS	HbSS
Females	55.5%	49.35%	75.28%	80%
Males	44.5%	50.65%	24.72%	20%
Total	100	100	100	100
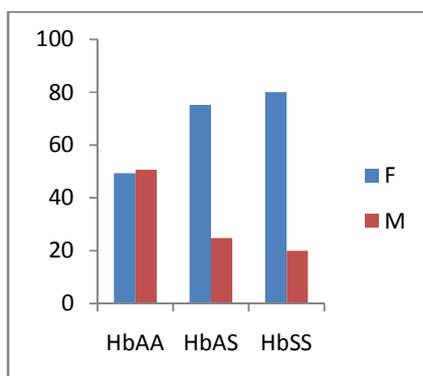
Figure1: Percentage distribution of haemoglobin genotype
IV. DISCUSSION

The percentage distribution of subjects for haemoglobin genotype by wayof gender status showed significant differences between males and females in the distribution of the haemoglobin variants. The difference is a reflection of the total gender representation in the sampled population of 178(44.5%) males and 222(55.5%) females. Illustration from tables and graphreflects the frequency distribution of only three different haemoglobin genotypes HbAA 306 (76.50%), HbAS 89(22.25%) and HbSS 5 (1.25%) respectively even though other studies in Nigeria have reported the presence of up to six genotypes [19],[20], [21],[22].However, the observed high incidence of HbAA and HbAS in the population with frequency of HbAA being significantly higher than HbAS is in agreement with previous reports that the normal haemoglobin (HbAA) range from 55 to 75%, while that of sickle cell trait(HbAS) 20-30% in Nigeria thus falling within the lower range [23], [24]. The HbAA frequency reported in this study (76.50%) appears higher than those reported in previous studies 71.02% [25], 70% [23], 68% [20] and 66% [24] respectively in Nigeria. The value of HbSS from this study (1.25%) is also lower than the range 30-46% generally reported for Africans and 9% for black population in the U.S.A [26], [27]. This decline could beattributed to the African urbanization over the years despite the challenges associated with socio- cultural beliefs, poverty and gender inequalities.

V. CONCLUSION

The low incidence in HbSS as against reports ofvery high in Nigeria and the very high prevalence of HbAA implies that the sickling gene pool is at a gradual - declining rate, thus lowering the occurrence of haemoglobinopathies in the Nigerian population.

Recommendations

More on mass literacy campaign to educate people especially the rural dwellers on the need to have their blood screened distribution of haemoglobin variants and its implication and, counseling will be useful in health care planning and allocation of resources.

Conflict of Interest: No conflicting interest.

Ethical Issues: Clearance was obtained from the PHC Monitoring unit of Ogbonicha district of Ofu Local Government Area, Kogi State, Nigeria.

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