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SICKLE CELL TRAIT;
PREVALENCE AMONG PRIMARY SCHOOL CHILDREN OF MAKKAH CITY

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ABSTRACT... tariq_h_ashour@hotmail.com **Aims and Objectives**: To detect the prevalence of sickle cell trait among primary school children(boys and girls) in Makkah city. **Patients & Methods:** 3980 Saudi Children (2104 boys and 1876 girls) at the age of 6-12 years were selected from various primary schools of Makkah city at random. After completion of a questionnaire, 5 ml of venous blood was collected from each child and subjected to cellulose acetate gel electrophoresis at alkaline pH. Abnormal results were confirmed by agarose gel electrophoresis at acidic pH. **Results:** Sixty children (36 boys and 24 girls) were found to have sickle cell trait, which gives prevalence of 1.71% in boys and 1.28% in girls. High levels of HbF were detected in 45 boys (2.14%) and 40 girls (2.13%).

Key words: Sickle cell trait, sickle cell disease, sickle cell gene, Prevalence, Incidence, Anemia, HbF. HbS, Makkah, Saudi Arabia, School children.

INTRODUCTION

The sickle cell gene is now known to be wide spread throughout the world and reaching its highest incidence in equatorial Africa, but also present in Middle East, Sicily, Southern Italy, Northern Greece, Southern Turkey, Iran and central India. In the Kingdom of Saudi Arabia, Eastern province is the most affected area[1]

Skicle cell trait (SCT) that is the carrier state of sickle cell hemoglobin is heterozygous for sickle cell gene. In this condition haemoglobin S (HbS) comprises about 38-45% of the total haemoglobin, the rest being HbA, HbA2 and HbF[2]. Therefore the red cells in sickle cell trait do not contain sufficient HbS to undergo sickling at the lowest oxygen tension (<40%) normally occurring in the body , and the red cell life span remains normal[3]. Sickle cell trait does not cause anaemia and in general is asymptomatic. However there is some evidence that sickle cell trait is a risk factor for sudden death during unaccustomed exercise. Sickle cell hemoglobin is present throughout the Kingdom of Saudi Arabia with highest incidence in the Eastern and Southern and lowest in the central regions[4,5,6]

The reported incidence in the Kingdom is 2-20% for

the carrier state and 1.4% for the major sickle cell anemia in some areas. Sickling disorder, in general, run a relatively mild course in the eastern region[7,8]. This appears to be due to modification of the DNA adjacent to the sickle cell gene, which permits the patients to produce an unusually high level of HbF to inhibit red cell sickling[9]

AIM OF THE STUDY

To detect the prevalence of sickle cell trait in school going children in Makkah city and to formulate strategies to reduce morbidity and mortality due to the severity of sickle cell disorders.

PATIENTS & METHODS

Saudi School going children of 6 to 12 years of ages were selected at random from various primary schools of Makkah city. A total number of 3980 students (boys and girls) were recruited for the study after getting permission from parents and school authorities. The ethical committee of the faculty of medicine and medical sciences, Umm Al-Qura University also approved the project.

All students had a quick medical examination by a doctor after completion of a questionnaire having relevant information about name, sex, age , address and family history including parent's relationship and socio economic status.

About 5 ml of venous blood was collected in a vacutainer with EDTA and transported to the laboratory immediately. Samples for haemoglobin electrophoresis were run on daily basis in batches. Blood samples were run on cellulose acetate membrane at alkaline pH (Titan gel Alkaline-Hb , Cat 0185, Helena France, SA), using automatic electrophoresis system (Polyslit, Media stain, Junior24 densitometer, Helena France, SA) as per manufacturer's instructions. Blood samples with abnormal haemoglobin bands were also run on agarose gel at acid media (Titan gel Acidic-Hb, Cat 0186, Helena France SA), using the above system with manufacturer's instructions.

The results of the selected group of 50 boys and 50 girls from the normal individuals in the study group with normal CBC and Hb electrophoresis patterns were used as a control group.

STATISTICAL ANALYSIS

Data was expressed as mean±SEM. Incidence of various forms of abnormal haemoglobin and other parameters was calculated as percentages.

RESULTS

Cellulose acetate membrane electrophoresis at alkaline pH was carried out on all blood samples. Abnormal Hb bands were confirmed with agarose gel electrophoesis at acidic pH. The results are presented in table I. Sixty children (6 boys and 24 girls) had sickle cell trait with an overall incidence of 1.51% in the study population. The prevalence in the boys was 1.71% while in girls, it was 1.25%. About 45 boys (2.14%) and 40 girls (2.13%) having high levels of HbA2 were also found.

Table-I Comparison of various HbS between control, sickle cell trait and increased HbF samples

Parameter	Control boys n=50	Control girls n=50	Sickle cell trait (HbAS)		Increased HbF	
			boys n-36	girls n=24	boys n=45	girls n=40
HBA%	96.5±0.8	96.5±0.8	42.95±0.18	43.79±0.08	77.58±0.12	79.68±0.14
HBA2%	2.64±0.5	2.64±0.5	2.34±0.22	2.64±0.52	2.43±0.54	2.33±0.43
HbF%	0.73±0.5	0.73±0.5	1.68±0.34	1.71±0.30	16.01±1.55	18.20±1.25
HbS %	Nil	Nil	52.0±0.47	50.4±0.64	Nil	Nil

The overall incidence of consanguineous marriages was about 44% in this study. Among the parents of affected group of students the incidence was 54%.

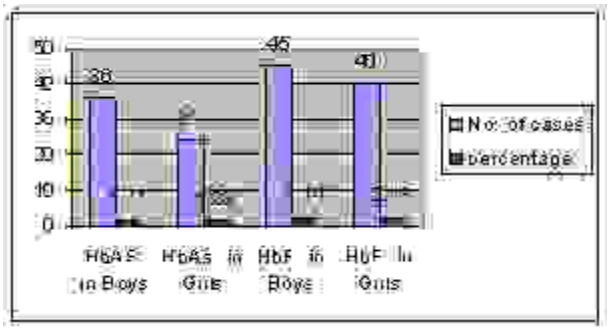

Fig 1: Prevalence of abnormal haemoglobins in primary school boys & girls of Makkah city.

DISCUSSION

Makkah is the most prestigious holy city in the Islamic World. The city had a special religious and spiritual value as a center for pilgrimage, even before the advent of Islam. It is situated about 100 KM from Jeddah, the major Saudi Arabian port on the Red Sea, in the western province of the Kingdom. It is about 2000 feet above the sea level. Within the city, the population is cosmopolitan, since for centuries pilgrims from all over the world, have been settling among the original inhabitants. However the towns and villages surrounding Makkah are relatively isolated and are occupied mainly by Arabian tribes who work on their farms and practice animal breeding[10].

Sickle cell disease is a homogenous haemoglobinopathy characterized by the inheritance of two abnormal haemoglobin genes. Sickle cell anaemia constitutes the most common genetic disorder in the world. Affected patients carry a heavy burden of morbidity and early mortality. Sickle cell trait is the heterozygous and asymptomatic carrier state for HbS gene. In sickle cell trait, HbS comprises 38-45% of the total haemoglobins, the rest being HbA, HbA2 and HbF. No significant clinical or haematological manifestations are seen in these subjects. The life expectancy and overall mortality rates for people with sickle cell trait are the same as for the general population. Most epidemiological studies suggest that no selective morbidity or mortality is attributed to the condition until and unless the carrier is subjected to unfavourable circumstances like lower oxygen tension in the body[2]

Although SCT is considered to be a harmless condition in ordinary circumstances, a large number of pathological conditions have been attributed to it as it may cause vascular occlusion especially with high fever. This occlusion can lead to splenic, pulmonary, pituitary, cerebral, retinal, renal and bone infarcts. Priapism can also occur[11,12]. Sickle cell disorders are often under diagnosed. One of the main risks is sudden death in infancy, and when this occurs the true cause is often overlooked. Many patients may be asymptomatic for long times. Manifestations in those who are not symptom free may be mistakenly attributed to a variety of other medical causes. Correct diagnosis, genetic counseling and education of the parents reduce the mortality and improve quality of life.

International guidelines on the management of SCT are also available[13]. However early diagnosis is essential for the implication of these guidelines. Therefore, neonatal screening for sickle cell disorders is highly recommended world wide[13,14].

The present study was conducted to identify sickle cell trait in school going children in Makkah city. This study may help to formulate the strategies that will reduce morbidity and mortality due to sickle cell disorders in the Kingdom.

Random blood samples from 2104 boys and 1876 girls were collected from various primary schools of Makkah city and analyzed electrophoretically to determine the prevalence of sickle cell trait. 60 children (36 boys and 24 girls) were found to have sickle cell trait, an incidence of 1.71% in boys and 1.28% in girls. With the discovery of various red cell

genetic disorders, several studies have been conducted in different parts and communities of Saudi Arabia, to determine the frequency of these disorders as well as their role in the public health. The reported incidence of sickle cell carrier state was 2-27% in the Kingdom. It was about 0.197% in Al-Qassim, 6.8% in Badar, 13.3% in Aseer, 23.9% in Khaiber and 0.08% in Madina[4,5,6,7,15,16], The present study confirmed the wide variations in the incidence of SCT in different cities of the Kingdom. Highest frequency of haemoglobin S gene is seen in Eastern province and lowest in cental region[8,9,17].

The prevalence of sickle cell trait in other parts of the world and the neighboring countries was reported as; Bahrain10%, Iraq 16%, Oman 6.1%, Iran 1.43%, Jordan 1%, Lebanon 1%, Libya 2%, Morocco 2%, Palestine 1% Qatar 1%, Sudan 2%, Syria1%, Yemen 4% and in UAE 2%[18] It has been reported that SCD in Arabian Gulf has distinct clinical and electrophoretic patterns as compared to the disease in USA and Africa[19-21]

In some recent studies the reported frequency of SCT in India is 14.4% and 21.3% in females and males respectively. In Kuwait it is 6% and in Mexico 12.8%[(22-25)], while in Pakistan the published incidence of sickle cell disorder is 5.1%[26].

In this study high levels of HbF were found in 45 boys (2.14%) and 40 girls (2.13%). It has been reported that high levels of HbF and lower levels of HbA2 in patients with SCD are found in Eastern Province of Saudi Arabia[1,27]. Levels of HbF vary markedly in individual with sickle cell gene and some children maintain high levels of gamma chain synthesis into adolescence and adult life[28] HbF molecules interfere with polymerization of HbS molecules and hence inhibit sickling, so the individuals are protected from the life threatening complications of SCD[29,30]. In the present study the concentrations of HbF were different in boys and girls. There is slight increase in the HbF concentration in girls as compared to boys. However this increase is not statistically significant and is comparable with other studies[31]. The inheritance of genes determining high levels of HbF is not well understood. In most of cases, either one or both parents show a modest elevation of HbF within the normal range. HbF levels decline with age and are higher in females than in males[1].

The overall incidence of consanguineous marriages is about 44% among the parents of the study population in present study. In the affected group of students , the incidence was 54%. Therefore, the main factor, which may increase or decrease the risk of having an affected child, is the parent's relationship. The risk of hemoglobinopathies increases with consanguineous marriages[32]. This is due, the fact that all the hemoglobinopathies are transmitted only through heredity. The abnormal hemoglobin is passed on through parents who carry the abnormal gene i.e. carrier. When two carriers are married, there is a one-in-four chance that any child they have, will inherit an abnormal gene from each parent and have a severe form of the disease. There is a two- in-four chance that the child will be a carrier and one-in-four chance that the child will be normal.

CONCLUSIONS

The incidence of sickle cell trait in Makkah is not very high but alarming especially because of high rate of consanguineous marriages in the Saudi society. It is therefore, suggested that neonatal and prenatal screening programme for SCT may be started at National level. Public Health Education programme is also important to realize the importance of screening program to reduce mortality and morbidity due to red cell genetic disorders especially for tribes around the cities.

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