Research Paper

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Palmar Main Line Polymorphisms in Sickle Cell Anemia Patients of Andhra Pradesh, South India

Medical Science

KEYWORDS : Sickle Cell Hemoglobin, Case control study, Dermatoglyphics, Main line terminations, Andhra Pradesh, India.

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ABSTRACT

This study was designed to examine the prevalence of main line terminations among the sickle cell anemia patients, individuals with sickle cell trait and normal controls. The sickle haemoglobin status was confirmed by cellulose acetate electrophoresis. The dermatoglyphic termination patterns of palmar D, C, B and A – lines were studied. The results obtained in the present study revealed that except for B-line all the main line termina¬tions in sickle cell anemia cases significantly differed from the controls. The differences are apparently the result of high frequency of D-line terminating at ulnar positions, low frequency of C-lines terminating at ulnar and low frequency of A-lines termina¬ting at ulnar position on palms of the patients when compared to controls.

Introduction

Dermatoglyphic patterns stay constant during life and may sometimes play a significant role in the diagnosis of many disorders with genetic background [1]. Dermal ridges provided significant insight into the phenotype effect of genetic disorders [2, 3]. Dermatoglyphic patterns are influenced by both genetic as well as the multifactorial causes. Although fingerprints and handprints are widely used in forensic science, their diagnostic application in medicine is more frequent [4-6]. Ever since Cummins [7, 8] demonstrated abnormalities in the dermatoglyphics of the palms of Mongols, a considerable amount of research has been directed in delineating association of dermatoglyphics with hereditary disorders. These studies have initiated using the dermatoglyphic patterns as a diagnostic tool and/or markers for various diseases. The course of termination of palmar intertriradii (main lines) is an important dermatoglyphic marker in population variation studies. The terminations of these palmar main lines - D, C, B and A give an idea about the transverse and vertical alignment of ridges across the palm. Since the classification of C-line terminations by Plato [9], it attained much importance and many studies have been reported from different populations of the World. Studies on the polymorphisms of main lines in diseases seem to be lacking except for few studies [10, 11]. Review of literature on palmar dermatoglyphics in sickle cell anemia disease revealed that no work has been done on Indian sub continent to establish an association.

Sickle-cell anemia (SCA) is a common genetic disorder which is inherited as an autosomal recessive condition. Inheritance of mutant hemoglobin genes from both parents leads to this condition. Individuals with two normal HB alleles will have normal red cells. The nomenclature for normal adult hemoglobin protein is HB AA. Individuals with one abnormal HB allele are considered as sickle cell trait (HB AS) and with two abnormal HB alleles as sickle cell disease (HB SS). It affects millions of people worldwide. As per WHO report, 60 million carriers of sickle cell and 1, 20,000 sickle cell homozygotes are added every year in the world. India is the home of several hemoglobin variants causing much suffering to afflicted individuals and impose considerable financial, genetic and psycho-social burden on family, society and nation at large. In India, there are over 42 million carriers and over 12,000 infants are born each year with a major and clinical significant haemoglobinopathies such as sickle cell disease [12]. The prevalence of sickle cell disease in Andhra Pradesh is 34.6% [13]. This study was designed to examine the prevalence of termination patterns of palmar D, C, B and A – lines among the sickle cell anemia patients, individuals with sickle cell trait and normal controls. The aim of the study is to describe the extent to which these three groups are alike or otherwise in these dermatoglyphic markers.

Materials and Methods, Patients and controls:

Palm prints of 59 sickle cell anaemia patients (25 females and 34 males), sixty cases of carriers of sickle cell (30 females and 30 males) and sixty age matched controls (30 females and 30 males) reported at local King George Government hospital, Visakhapatnam were analysed for various dermatoglyphic patterns. The suspected cases of hereditary anaemia were referred by the hospital to the laboratory of department of Human Genetics, Andhra University for confirmation of the genotype. The sickle haemoglobin status was confirmed by cellulose acetate electrophoresis [14]. Both sickle cell anaemia and carrier cases were selected from the confirmed cases. The attendants, who accompany the patients, were taken as controls after confirmation of their genotype (HB AA) status by electrophoresis.

Data:

After obtaining the consent from both cases and controls to participate in the study, palm prints were taken using Ink and paper method [15]. Termination of palmar main lines - D, C, B and A were done following the guidelines of Cummins and Midlo [15]. The classification of C line termination of palm established by Plato [9], was followed. The four triradii points located in the interdigital areas, at the base of the digits, and designated a, b, c and d triradii, respectively were identified. The ridge that extend from each triradius point and ends on the outer border of the palm is a Main line and are designated as A, B, C and D Main lines, respectively. The four likely termination patterns are: (1) Ulnar termination: in which the line terminates on the ulnar (little finger) border of the palm; (2) Radial termination: line terminates on the radial (thumb) side of the palm; (3) Proximal termination: line terminates on the base of the little or ring fingers or the interdigital area between these fingers; and (4) Absent termination: the triradius and by extension the line are missing or not present at all.

The data obtained were subjected to simple statistical analysis for presenting frequency tables and the significance of differences between different groups were assessed by using chi-squares with the level of significance set at $p<0.05$.

Results

The percentage frequencies of termination of main lines in sickle cell anemia patients, trait and controls were represented in

Table 1: Distributions of main line terminations among sickle cell anemia patients, traits and controls

Sex	Termination of D-line												χ^2 value
	HB SS (N=34 Males; 25=Females)				HB AS (N=30 Males; 30 Females)				HB AA (N=30 Males; 30 Females)				
	ULNAR	RADIAL	PROXIMAL	ABSENT	ULNAR	RADIAL	PROXIMAL	ABSENT	ULNAR	RADIAL	PROXIMAL	ABSENT	
Males	30.88	67.65	0.00	1.47	21.67	78.33	0.00	0.00	31.67	68.33	0.00	0.00	3.72
Females	42.00	58.00	0.00	0.00	25.00	73.33	0.00	1.67	15.00	81.67	0.00	3.33	11.47*
M+F	35.59	63.56	0.00	0.85	23.33	75.83	0.00	0.83	23.33	75.00	0.00	1.67	6.392
Termination of C-line													
Males	33.82	64.70	0.00	1.47	35.00	58.33	0.00	6.67	58.33	31.67	0.00	10.00	16.98***
Females	44.00	46.00	0.00	10.00	40.00	50.00	0.00	10.00	48.33	41.67	0.00	10.00	0.9267
M+F	38.13	56.78	0.00	5.08	37.50	54.17	0.00	8.33	53.33	36.67	0.00	10.00	12.19**
Termination of B-line													
Males	100.00	0.00	0.00	0.00	98.33	0.00	0.00	1.67	98.33	0.00	0.00	1.67	1.146
Females	100.00	0.00	0.00	0.00	98.33	0.00	0.00	1.67	95.00	1.67	0.00	3.33	3.63
M+F	100.00	0.00	0.00	0.00	98.33	0.00	0.00	1.67	96.67	0.83	0.00	2.50	4.807
Termination of A-line													
Males	95.59	4.41	0.00	0.00	91.67	8.33	0.00	0.00	98.33	0.00	1.67	0.00	16.98***
Females	92.00	8.00	0.00	0.00	91.67	6.67	1.66	0.00	93.33	0.00	3.33	3.33	0.9267
M+F	94.07	5.93	0.00	0.00	91.67	7.50	0.83	0.00	96.66	0.00	2.50	1.66	15.43**

*p<0.05, **p<0.01, ***p<0.001

D - Line terminations: The palmar D – line most commonly terminated along the radial side followed by ulnar side of the palm in both males and females of all the three groups HB SS, HB AS and HB AA. D-lines were not terminated on the proximal side of the palm in any of the sampled subjects. The *c*hi-square value indicated a significant variation in distribution of palmar D-line terminations across the three groups in females ($p<0.05$). When compared between males and females, in HB SS and HB AS the males whereas in HB AA the females showed the D – line termination towards the radial side.

C - Line terminations: Terminations of C line in males of sickle cell differed significantly from the controls, owing mainly to a decrease in the frequency of C lines ending at ulnar position and an increase at radial position in the sickle cell patients. A similar decrease of C-line terminations was observed in individuals with sickle cell trait also. The same was observed in females across the two sickle cell groups. The chi-square value indicated a significant variation in distribution of palmar C-line terminations across the three groups in males ($p<0.05$). Although the C-line terminates frequently on radial side followed by ulnar side in women also, terminations of C line in females of the three groups were statistically insignificant ($p>0.05$). C-lines were not terminated on the proximal side of the palm in any of the sampled subjects. Sickle cell subjects had lesser proportion of absent pattern of C-line termination when compared between the three groups, but this difference was statistically insignificant ($p>0.05$).

B - Line terminations: The palmar B – line most commonly terminated along the ulnar side of the palm in both males and females of all the three groups HB SS, HB AS and HB AA. C-lines were not terminated on the radial side of the palm in both HB SS and HB AS subjects whereas a small proportion is seen in controls. Moreover, none of the C-lines were terminated on the proximal side of the palm in any of the sampled subjects. Although differences in values occur between the three groups, they were not statistically significant.

A - Line terminations: The palmar A– line most commonly terminated along the ulnar side of the palm in both males and females of all the three groups HB SS, HB AS and HB AA. A small proportion of A-lines were terminated on the radial side of the palm in both HB SS and HB AS subjects and none were observed in HB AA subjects. None of the A-lines were terminated on the proximal side of the palm in HB SS and HB AA subjects, whereas a few were seen in controls. The chi-square value indicated a significant variation in distribution of palmar A-line terminations across the three groups in males ($p<0.001$).

Discussion

The main lines indicate the direction of palmar ridge alignment in any given individual or population [16]. These terminations of the palm have been found to have a genetic component and are truly polymorphic since they demonstrate qualitative (directional) as well as quantitative variations manifested in the degree of transversality. They also act as good discriminates in finding the genetic aetiology of an illness [17]. Dermatoglyphic studies on main line terminations have been carried out in a large number of behavioral abnormalities such as schizophrenia [18, 19], manic-depressive psychosis and depressive neurosis [17], mental retardation and juvenile delinquency [17], diabetes [10], retinoblastoma [20, 21] and cataracts [11].

A study carried out by Padma and Murthy [11] on cataracts, found significant variations for all the four main line terminations (D, C, B and A) in senile and cortical cataracts, while among other types of cataract, congenital cases differed significantly in D and A line, zonular in C and A line and nuclear in B and A line terminations compared with controls. The results obtained in the study on schizophrenics [18, 19], revealed that in the C main line endings of palm, patients and normals exhibit significant differences. However, this is not in agreement with the earlier observations of Singh [22], Kurien et al [23], Rothhammer et al [24], and Karmakar and Malhotra [25], who noted that in the main line endings, schizophrenics and normals behave alike. With the exception of main line C, none of the other palmar main lines (D, B and A) showed any significant difference between schizophrenics and normals in their studies [18, 19].

While considering the model types of c-line terminations, it was observed that the frequency of proximal and absent types was considerably higher in cleft lip with or without cleft palate patients and isolated cleft palate cases as compared to the controls. Similarly, the D-line termination was absent in cleft lip with or without cleft palate in comparison to controls [26]. In another study, Balgir [17] also reported the elevation of C and D terminations in manic-depressive psychosis.

The results obtained in the present study revealed that except for B-line all the main line terminations in sickle cell anemia cases significantly differed from the controls. The differences are apparently the result of high frequency of D-line terminating at ulnar positions and low frequency at radial position, low frequency of C-lines terminating at ulnar and high frequency at radial position and low frequency of A-lines terminating at ulnar position on palms of the patients when compared to controls. So far, no research has been done on main line terminations in patients with sickle cell anemia. So, the present findings indicate the necessity of further investigations on the main line polymorphisms in sickle cell disease to confirm and determine the functional significance of this association.

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