DERMATOGLYPHIC PATTERNS IN ANGIOGRAPHICALLY PROVEN CORONARY ARTERY DISEASE

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ABSTRACT

Dermatoglyphics is the scientific study of epidermal ridges and their configurations on the palmar region of hand and fingers and plantar region of foot and toes. Against the genetic background of dermatoglyphic patterns and coronary artery disease, the study was undertaken to determine the correlation between them. The present study includes 150 cases of angiographically proven coronary artery disease (CAD) and 150 cases of healthy normal individuals. The palmar prints of both hands were taken on white paper by Ink method as described by Cummins and Midlo. It is noted that there is significant decrease in loops with corresponding increase in whorls in males, (M+F) combined series and left hand of CAD patients. The true palmar pattern is significantly decreased in thenar area in females; third interdigital area in (M+F) combined series and right hand; and fourth interdigital area in left hand of CAD patients. There is significant increase in '4' palmar triradii in males, (M+F) combined series and right hand; and '5' palmar triradii in females with significant decrease in '6' palmar triradii in both sexes and both hands of CAD patients. The mean value of atd angle is significantly increased in males, (M+F) combined series and left hand of CAD patients as compared to the controls. There is no significant correlation in ab ridge count and CAD.

Keywords: Dermatoglyphics patterns; coronary artery disease; prediction; diagnosis.

INTRODUCTION:

Dermatoglyphics is the scientific study of epidermal ridges and their configurations on the palmar region of hand and fingers and plantar region of foot and toes. The term dermatoglyphics was coined by Cummins and Midlo in 1926 and was derived from Greek words 'derma' means skin and 'glyphics' means carvings[1]. The ridges are differentiated in their definitive forms during third and fourth month of foetal life and once formed remain permanent and never change throughout the life except in the dimension in proportion to the growth of an individual. The original ridge characteristics are not disturbed unless the skin is damaged to a depth of about one millimeter[2].

Development of dermatoglyphic pattern is under genetic control. This is evident from the clear resemblance of dermatoglyphics among related person [3]. Dermatoglyphics as a diagnostic aid is now well established in a number of diseases, which have a strong hereditary basis, and is employed as a method of screening abnormal anomalies [4].

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Coronary artery disease (CAD) is the leading cause of cardiovascular mortality worldwide, with >4.5 million deaths occurring in the developing world. Despite a recent decline in developed countries, both CAD mortality and the prevalence of CAD risk factors continue to rise rapidly in developing countries[5]. Each year, near 500,000 Americans die of CAD. About 1.5 million individuals in the US suffer an acute myocardial infarction annually and approximately one third of them die. At least 250,000 people a year die of a heart attack before they reach the hospital[6]. The aetiology of CAD is multifactorial with genetics playing an important role. Taking into consideration of genetic predisposition of dermatoglyphics and coronary artery disease, the study was undertaken to find out correlation between them. So that dermatoglyphics may be helpful in the diagnosis of predisposition towards this disease at an earlier age. Thus, with regard to the high incidence of CAD in the world, the existence of such relation might be important in the screening program for prediction of CAD even in healthy individual at an earlier age.

MATERIAL AND METHODS:

The present study was carried out in the Department of Anatomy, NKP Salve Institute of Medical Sciences, Nagpur from July 2007 to August 2009. It includes 150 patients of Coronary Artery Disease. The age ranges

from 35-76 years with mean age of male and female is 55.18 years and 53.83 years respectively in CAD. Similarly equal numbers of normal healthy individual were included as controls. The individuals with history/ family history of hypertension, diabetes or any cardiac problem were excluded from controls. The age ranges from 31-75 years with mean age of male and female is 41.29 years and 43 years respectively in controls. There were 120 males and 30 females in each group. All the patients were taken from the private Heart Hospitals, Nagpur. The patients who were diagnosed after coronary angiography were only included in the study. Even the patients of ischaemic heart disease with normal coronary angiography were excluded from the study.

The Palmar Prints of the patients and the controls were taken on the Map Litho White paper by ink method as described by Cummins and Midlo[7]. Kores Camel duplicating ink was spread with the help of a roller over an inking slab of size 12" x 8" made of plain glass. Both hands were washed with soap and water. After soaking, the palm and fingers were placed on the inking slab. The smeared palm and fingers of both hands were then kept on the white paper with firm pressure on the dorsum of hand and interdigital area. The dermatoglyphic patterns were thus recorded and parameters like fingertip patterns (Loop, Arches, Whorls), true palmar patterns, number of palmer triradii, atd angle and ab ridge count were studied. The dermatoglyphic patterns on right and left hand were analysed according to sex and are subjected to statistical test to evaluate significant pattern. Statistical evaluation was done by chi square method and t-test.

RESULTS:

3.1: Total fingertip patterns

The frequency distribution of total fingertip patterns in CAD and controls is given in table 1. In CAD males, there is decrease in the frequency of loops/ arch pattern and increase in the frequency of whorl pattern with statistically significant difference is seen in loop pattern ($P<0.01$) and whorl pattern ($P<0.001$). In CAD females, there is decrease in the frequency of loops/ arch pattern and increase in the frequency of whorl pattern but no statistically significant difference is seen in any fingertip patterns. In CAD (M+F) combined series, there is overall decrease in the frequency of loop and arches; and significant increase in the frequency of whorls with statistically significant difference is seen in loop pattern ($P<0.001$) and whorl pattern ($P<0.0001$). In Right hand and Left hand also, there is decrease in the frequency of loops/ arch pattern and increase in the frequency of whorl pattern in CAD as compared to the controls with statistically significant difference is seen in whorl pattern in Right hand ($P<0.01$) and loop pattern and whorl pattern in Left hand ($P<0.01$).

3.2: True palmar patterns

The palm has been divided into several anatomically well divided areas to carry out dermatoglyphic analysis. These include thenar, interdigital areas- ID1, ID2, ID3, ID4 and hypothenar areas. (Figure 1)

As shown in table 2, the palmar patterns are predominantly seen in hypothenar area followed by ID4 and ID3 area in all groups of CAD and controls. Also the frequency of total palmar pattern in CAD is decreased in both sexes and both sides as compared to the controls. There is decrease in the frequency of palmar pattern in all areas except ID2 area in CAD males; hypothenar area in CAD females; hypothenar, ID1, ID2 area in CAD (M+F); hypothenar, ID1, ID2, ID4 in right hand; and ID2 area in left hand with significant decrease in palmar pattern in thenar area in CAD females ($P<0.05$), ID3 area in CAD (M+F) and CAD right hand ($P<0.05$) and ID4 area in CAD left hand ($P<0.05$)

3.3: Number of palmar triradii

Usually there are five triradii found in each palm. Four triradii are present in the metacarpal regions at the base of index, middle, ring and little finger labelled as a, b, c, d- triradius respectively; and the fifth triradii is found in the proximal region of palm near the wrist crease and labelled as 't '- axial triradius. The triradius is sometimes missing or fused or there may be an additional triradius / triradii. Table 3 shows frequency distribution of number of palmar triradii in CAD and controls.

There is increase in the frequency of '5' palmar triradii in CAD females and '4', '5' and '7' palmar triradii in CAD males, CAD (M+F) and in both hands with significant increase in '4' palmar triradii in CAD males ($P<0.01$), CAD (M+F) ($P<0.01$) and CAD right hand ($P<0.05$); and 5 palmar triradii in CAD females ($P<0.05$). Also there is significant decrease in the frequency of '6' palmar triradii in CAD males ($P<0.01$), CAD females ($P<0.05$), CAD (M+F) ($P<0.001$), CAD right hand ($P<0.05$) and CAD left hand ($P<0.01$) as compared to the controls.

3.4: atd Angle

The atd angle is formed by lines drawn from triradius 'a' to axial triradius 't' and from 't' to the triradius 'd'. As

SEX / SIDE	Subject	FINGERTIP PATTERNS		
		LOOPS	ARCHES	WHORLS
MALE	**CAD**	608	75	517
	CONTROL	685	94	421
	Chi Sq	9.68	0.03	0.05
	P-Value	**0.0018579**	0.1509736	**0.0000706**
	Remarks	**S**	NS	**S**
FEMALE	**CAD**	171	27	102
	CONTROL	185	30	85
	Chi Sq	1.71	0.008	1.99
	P-Value	0.2799481	0.7806566	0.1584624
	Remarks	NS	NS	NS
M+F	**CAD**	779	102	619
	CONTROL	870	124	506
	Chi Sq	10.91	2.11	17.84
	P-Value	**0.0009571**	0.1463103	**0.0000240**
	Remarks	**S**	NS	**S**
RT HAND	**CAD**	385	51	314
	CONTROL	421	66	263
	Chi Sq	3.28	1.82	7.04
	P-Value	0.0699164	0.1776786	**0.0079651**
	Remarks	NS	NS	**S**
LT HAND	**CAD**	394	51	305
	CONTROL	449	58	243
	Chi Sq	7.90	0.36	10.70
	P-Value	**0.0049505**	0.5506489	**0.0010721**
	Remarks	**S**	NS	**S**

Table 1: Frequency distribution of total fingertip patterns in CAD and Controls

(M= male; F=female)

(S=Significant; NS= Non significant)

SEX / SIDE	Subject	TRUE PALMAR PATTERNS IN DIFFERENT AREAS						Sum Total
		HYPO	THENAR	ID1	ID2	ID3	ID4	
MALE	**CAD**	208	108	11	23	109	121	580
	CONTROL	208	111	11	15	126	142	613
	Chi Sq	0.02	0.03	0.05	1.4	2.53	3.36	1.47
	P-Value	0.8931879	0.8545806	0.8272256	0.2366678	0.1119504	0.0666267	0.2260832
	Remarks	NS	NS	NS	NS	NS	NS	NS
FEMALE	**CAD**	48	8	3	1	17	35	112
	CONTROL	46	21	3	2	27	31	130
	Chi Sq	0.05	6.55	0.18	0.00/0.34	2.91	0.3	1.8
	P-Value	0.8246371	**0.0105006**	1.0000000	1.0000000	0.0882123	0.5819889	0.1798555
	Remarks	NS	**S**	NS	NS	NS	NS	NS
M+F	**CAD**	256	116	14	24	126	156	692
	CONTROL	254	132	14	17	153	173	743
	Chi Sq	0.01	1.55	0.04	0.94	4.53	1.72	2.9
	P-Value	0.9089743	0.2136584	0.8465264	0.3316487	**0.0333278**	0.1893375	0.0887504
	Remarks	NS	NS	NS	NS	**S**	NS	NS
RT HAND	**CAD**	131	50	4	16	79	72	352
	CONTROL	129	52	2	10	100	71	364
	Chi Sq	0.03	0.01	0.17	1.05	5.54	0.00/0.01	0.28
	P-Value	0.8651347	0.9029951	0.6843327	0.3048678	**0.0185821**	1.0000000	0.5962964
	Remarks	NS	NS	NS	NS	**S**	NS	NS
LT HAND	**CAD**	125	66	10	8	47	84	340
	CONTROL	125	80	12	7	53	102	379
	Chi Sq	0.02	2.25	0.05	0.00/0.07	0.38	4.09	3.34
	P-Value	0.8768849	0.1331889	0.8247217	1.0000000	0.5402914	**0.043167**	0.0674445
	Remarks	NS	NS	NS	NS	NS	**S**	NS

Table 2: Frequency distribution of true palmar pattern in CAD and Controls
(Hypo= hypothenar; ID1=First interdigital area; ID2= Second interdigital area; ID3= Third interdigital area; ID4= Fourth interdigital area)

SEX / SIDE	Subject	NUMBER OF PALMAR TRIRADII					
		4	5	6	7	8	9
MALE	**CAD**	17	137	55	25	6	0
	CONTROL	2	133	85	13	5	2
	Chi Sq	10.74	0.08	8.48	4.12	0.09	0.50
	P-Value	**0.0010479**	0.7825279	**0.0035894**	**0.0424979**	0.7603458	0.4985562
	Remarks	**S**	NS	**S**	**S**	NS	NS
FEMALE	**CAD**	2	46	9	3	0	0
	CONTROL	2	34	19	4	1	0
	Chi Sq	0.26	4.54	4.66	0.15	0	---
	P-Value	0.6110693	**0.0331600**	**0.0309022**	0.6969097	1.0000000	---
	Remarks	NS	**S**	**S**	NS	NS	---
M+F	**CAD**	19	183	64	28	6	0
	CONTROL	4	167	104	17	6	2
	Chi Sq	8.86	1.54	12.57	2.40	0.09	0.50
	P-Value	**0.0029126**	0.2141930	**0.0003911**	0.1211491	0.7705879	0.4991653
	Remarks	**S**	NS	**S**	NS	NS	NS
RT HAND	**CAD**	11	93	32	12	2	0
	CONTROL	2	91	47	5	4	1
	Chi Sq	5.15	0.01	3.87	2.24	0.17	0.00
	P-Value	**0.0232990**	0.9056273	**0.0492679**	0.1340594	0.6800514	1.0000000
	Remarks	**S**	NS	**S**	NS	NS	NS
LT HAND	**CAD**	8	90	32	16	4	0
	CONTROL	2	76	57	12	2	1
	Chi Sq	2.59	2.28	9.20	0.35	0.17	0.00
	P-Value	0.1077982	0.1311139	**0.0024178**	0.5515673	0.6800514	1.0000000
	Remarks	NS	NS	**S**	NS	NS	NS

Table 3: Frequency distribution of number of palmar triradii in CAD and Controls

Sex	Side	CAD				Controls				Comparison with control			
		Mean	SD	SE-M	CV	Mean	SD	SE-M	CV	t-value	Std T	P-value	Remarks
MALE	R	40.77	5.02	0.46	12.32	39.61	4.07	0.37	10.27	1.983	1.970	**0.048**	S
	L	41.09	5.01	0.46	12.19	39.54	4.21	0.38	10.64	2.595	1.970	**0.010**	S
	R+L	40.94	5.02	0.46	12.26	39.58	4.14	0.38	10.46	3.240	1.965	**0.001**	S
FEMALE	R	40.47	4.49	0.82	11.08	40.17	4.28	0.78	10.64	0.265	2.002	0.792	NS
	L	42.20	5.18	0.94	12.26	41.10	4.72	0.86	11.49	0.860	2.002	0.393	NS
	R+L	41.34	4.84	0.88	11.67	40.64	4.50	0.82	11.07	0.821	1.980	0.413	NS
M+F	R	40.71	4.91	0.40	12.06	39.72	4.10	0.33	10.33	1.895	1.968	**0.059**	NS
	L	41.31	5.04	0.41	12.21	39.85	4.34	0.35	10.90	2.688	1.968	**0.008**	S
	R+L	41.01	4.98	0.41	12.14	39.79	4.22	0.34	10.62	3.252	1.964	**0.001**	S

Table 4: Statistical Calculation for atd angle in CAD and Controls

Standard t-value for respective df at 5% level of significance

(R= right; L= left)

(SD= standard deviation; SE-M= standard error of mean

CV= coeffecient of variation in %)

Sex	Side	CAD				Controls				Comparison with control			
		Mean	SD	SE-M	CV	Mean	SD	SE-M	CV	t-value	Std T	P-value	Remarks
MALE	R	39.68	4.78	0.44	12.05	39.33	5.21	0.48	13.26	0.542	1.970	0.588	NS
	L	40.17	4.91	0.45	12.24	40.43	5.23	0.48	12.93	0.397	1.970	0.692	NS
	R+L	39.93	4.85	0.45	12.15	39.88	5.22	0.48	13.10	0.098	1.965	0.922	NS
FEMALE	R	38.43	5.39	0.98	14.01	40.40	5.54	1.01	13.72	1.396	2.002	0.168	NS
	L	40.67	6.47	1.18	15.91	41.40	5.11	0.93	12.34	0.485	2.002	0.630	NS
	R+L	39.55	5.93	1.08	14.96	40.90	5.33	0.97	13.03	1.312	1.980	0.192	NS
M+F	R	39.43	4.91	0.40	12.46	39.54	5.28	0.43	13.36	0.187	1.968	0.852	NS
	L	40.27	5.24	0.43	13.02	40.63	5.20	0.42	12.81	0.597	1.968	0.551	NS
	R+L	39.85	5.08	0.41	12.74	40.08	5.24	0.42	13.08	0.546	1.964	0.585	NS

Table 5: Statistical Calculation for a-b Ridge Count in CAD and Controls
Standard t-value for respective df at 5% level of significance
(R= right; L= left)

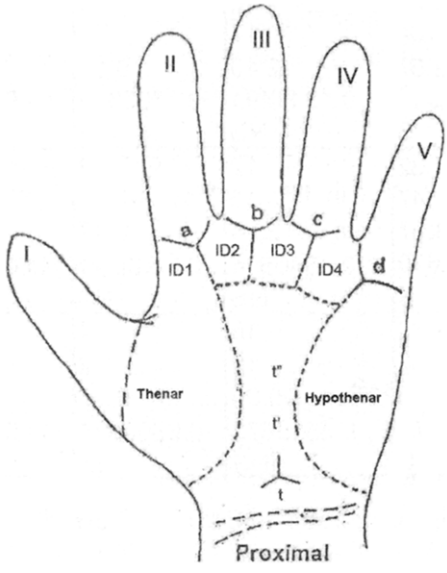

Figure 1: Showing different palmar areas and palmar triradii

per table 4 there is increase in the mean value of atd angle in both sexes and in both hands with significant increase in CAD males (P<0.001), CAD (M+F) (P<0.001) and CAD left hand (P<0.01).

3.5: ab ridge count

ab ridge count is the number of ridges between triradii 'a' and 'b'. As per table 5, there is slight increase in the mean value of ab ridge count in CAD males and decrease in CAD females, CAD (M+F) and in both hands as compared to the controls but not statistically significant.

DISCUSSION:

Coronary artery disease is the most important cause of mortality and morbidity in the world with myocardial infarction and angina as the most common clinical manifestations. Dermatoglyphics as a diagnostic tool is now well established in a number of diseases, which have strong hereditary basis. CAD being the hereditary background, certain dermatoglyphic variation is to be expected in it.

In the present study, loops are decreased and whorls are increased in CAD in both sexes and both hands with significant decrease of loops in males (P<0.01), (M+F) combined series (P<0.001) and left hand (P<0.01); and significant increase of whorls in males (P<0.001), (M+F) combined series (P<0.0001) and left hand (P<0.01). Rashad and Mi [8] and Rashad et al.[9] also reported significantly lower frequency of ulnar loops and higher frequency of whorls in myocardial infarction patients. Anderson MW et al.[10] also noted decrease in the loop pattern and increase in whorl pattern in myocardial infarction but not statistically significant difference when compared with the controls. Bhatt[11], Dhall et al. [12] and Jalali et al.[13] also revealed significant decrease in loops and increase in whorls in contrast to Shamsadini S et al.[14] who reported significant increase in the frequency of loops in myocardial infarction patients (P< 0.001). As similar to the present study, decrease frequency of arches were seen in other studies[9,12]. However, Jalali et al.[13] found two fold increase in the frequency of arch pattern in myocardial infarction patients (P<0.0001).

In the present study, the true palmar pattern is decreased in both sexes and both sides with significant decrease in thenar area in CAD females (P<0.05), ID3 area in CAD (M+F) (P<0.05) and CAD right hand (P<0.05), and ID4 area in CAD left hand (P<0.05) as compared to the controls. No study has been carried out on palmar pattern in CAD, hence could not be compared. However, Takashina et al. [15] observed significant increase in the loop pattern in

hypothenar area in acquired heart disease (33%) as compared to the congenital heart disease (21%). Also there was increase frequency of palmar pattern in hypothenar area in congenital heart disease [16] and ID3 area in rheumatic heart disease [17]. Ana Tarca [18] also noticed increase frequency of ulnar loop pattern in hypothenar area in non-insulin dependant diabetes mellitus (NIDDM-type 2).

There is significant increase in '4' palmar triradii in CAD males ($P<0.01$), CAD (M+F) ($P<0.01$) and CAD right hand ($P<0.05$); and '5' palmar triradii in CAD females ($P<0.05$) with significant decrease in '6' palmar triradii in CAD males ($P<0.01$), CAD females ($P<0.05$), CAD (M+F) ($P<0.001$), CAD right hand ($P<0.05$) and CAD left hand ($P<0.01$) as compared to the controls. This finding is reported for the first time in CAD.

In the present study, the mean value of atd angle is significantly increased in males ($P<0.001$), (M+F) combined series ($P<0.001$) and left hand ($P<0.01$) of CAD patients as compared to the controls. No such findings were reported previously in the literature. However, increase atd angle was reported in hypertensive patients [19], congenital heart disease [16,20], and Down 's Syndrome [21]. But Kulkarni and Herekar[22] observed decrease atd angle in essential hypertension.

In the present study, the mean value of ab ridge count is slightly increased in CAD males and decreased in CAD females, CAD (M+F) and in both hands as compared to the controls but not statistically significant. No study has been carried out on ab ridge count in CAD, hence could not be compared. However, Ana Tarca [18] found reduced ab ridge count in non insulin dependent diabetes mellitus (NIDDM-type 2).

CONCLUSIONS:

Thus from the present study, it appears that there do exists a variation in the dermatoglyphic patterns in CAD with an advantage of being very simple and economical 'ink' method. Moreover the materials required for the dermatoglyphic procedure are easily available and portable. As the specific features of dermatoglyphic patterns are present in the CAD, it can be use for mass screening program for prediction of CAD even in healthy individual at an earlier age.

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