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The analysis of digital-palmar dermatoglyphics in a sample of individuals affected by essential hypertension

In this research the digital and palmar dermatoglyphics of a sample of 97 individuals from Sardinia affected by essential hypertension were examined with the aim of identifying possible peculiarities. As already observed by other authors, the tendency towards a distal position of the axial triradius, a dermatoglyphic characteristic common in many pathologies, was also confirmed in our sample. Furthermore, some characteristics not observed in previous works which are distinctive to hypertensive subjects of both sexes are identified: a transversal tendency of the ridges and a greater asymmetry of the TRC (total ridge count). The asymmetry of the TRC is usually explained as a consequence of disturbances during embryologic development; in our case these disturbances seem to be represented by changes in arterial pressure levels originating during the prenatal period.

Key words: dermatoglyphics, essential hypertension

Introduction

Recent investigations show that individuals suffering from essential hypertension (arterial pressure higher than 140/90 mmHg, with no apparent cause) show particular dermatoglyphic characteristics (Godfrey et al., 1993; Jain et al., 1984; Palyzova et al., 1991; Pursnani et al., 1989) (Table 1). In general it seems that the digital characteristics of hypertensive subjects show, among other things, a tendency towards an increase of the whorls and of the TRC. Among palmar characteristics there is a more frequent absence of the triradius t. According to Godfrey et al., (1993), the dermatoglyphic characteristics typical of hypertension are more evident in the right hand and there would also seem to be an association between high blood pressure levels and the length of the palm (measured by means of the distances dt and at).

With the aim of verifying these results, we wished to analyse the dermatoglyphic structure of a sample of Sardinian individuals affected by essential hypertension. To verify the association between hand length and blood pressure observed by Godfrey et al. (1993) anthropometric measurements of height, length and breadth of the hand and length of the palm were also taken.

Materials and methods

The sample examined consists of 97 Sardinian adults (45 male and 52 female) all clinically defined as essentially hypertense. The observations were carried out at the Institute of Cardiology of Cagliari University and at the Cardiological Division of the San Michele Hospital in Cagliari.

Digital and palmar prints for each individual were taken following the classic procedure indicated by Cummins and Midlo (1961). The dermatoglyphic characteristics analysed are:

a) Digital:
- single digital patterns and pattern intensity (PI);
- total ridge count (TRC);
- TRC asymmetry;

b) Palmar:
- *a-b* count;
- A-*d* count;
- atd angle;
- palmar patterns;
- modal types of line D;
- main lines index (MLI);
- the Turpin and Lejeune coefficient (TLC);
- axial triradius configurations.

The following anthropometric measurements were also taken: total height, sitting height, weight, length and breadth of hand, length of palm.

The methods used to classify the dermatoglyphic characteristics follow the indications of Cummins and Midlo (1961).

Since dermatoglyphic characteristics generally show a marked sexual dimorphism, the statistical evaluations were performed for each sex separately.

In the first analysis the sample of hypertensive subjects was subdivided into three groups: one group having average values of the dermatoglyphic characteristic under examination (average +/- standard deviation), one group with lower than average values and one group with higher values. To visualize likely particular trends linked to blood pressure variations, the average maximum and minimum blood pressure values were observed in each group.

Later, the correlation between individual blood pressure values and the corresponding values of the dermatoglyphic quantitative variables and of the anthropometric variables were analysed.

A statistical comparison between the dermatoglyphic characteristics of our sample and a sample of 360 apparently healthy Sardinian individuals (180 males and 180 females) (Floris, 1981), was then performed. The values of the quantitative variables were compared by the Student's t, while those of the qualitative variables were compared by the χ^2 . Since the control group is a random sample in which the possibility of hypertensive individuals cannot be excluded, the comparison has only an indicative value.

Results

The values relative to the dermatoglyphic characteristcs examined are shown in Table 2 (quantitive variables) and Table 3 (qualitative variables).

After dividing the male and female samples into three further subgroups (average values, lower than average values, higher than average values), the distribution of the corresponding blood pressure values was examined. The only variables which showed a describable trend in blood pressure values are as follows.

In males (see Figure 1):

- MLI values: with the increase of values (and therefore of epidermal ridges horizontality) there is also an increase in maximum, but particularly minimum, blood pressure values;
- *a-b* count values: as these values increase, maximum and minimum blood pressure values decrease;
- A-*d* count values: with the increase of values (and therefore of epidermal ridges verticality), both maximum and minimum blood pressure values decrease.

In females (see Figure 2);

- PI values: with the increase of values (and generally speaking, therefore, the number of whorls), minimum blood pressure levels decrease, while maximum levels remain almost constant;
- MLI values: as these values increase so, too, do maximum and minimum blood pressure values.

In the correlation analyses, no quantitative dermatoglyphic characteristic shows a significant relation with the blood pressure values.

The stastistical comparison between the variables under examination in the group of hypertense and in the control group showed some significant differences (Table 4). In males the CTL value ($t=2.02$, $p<0.05$) is higher in hypertense subjects than in healthy subjects, indicating a more horizontal trend of the epidermal ridges. This tendency is also confirmed by the high values of ILP, by the rather low values of the A-d count and especially by the configuration of the types of line D, which are more frequently types 11 and 9, with a lower frequency of type 7 ($\chi^2=10.00$, $p<0.01$). The types and combinations of the axial triradius ($\chi^2=27.12$, $p<0.01$) show greater frequency of the triradius in position t'. TRC asymmetry is greater in the hypertense ($t=2.56$, $p>0.05$).

In females digital patterns ($\chi^2=26.32$, $p<0.01$) show a higher frequency of whorls and a lower frequency of ulnar loops; the configurational areas ($\chi^2=32.17$, $p<0.01$) show a greater frequency of patterns in the hypothenar area and a lower frequency in the fourth interdigital area; the types and combinations of the axial triradius ($\chi^2=25.21$, $p<0.01$) show greater frequency of triradii in position tt'' and a lower frequency in position t. As in males, the asymmetric values of the TRC are greater, if not significantly so, in hypertense women.

Only in females did the correlation between the values of the anthropometric variables under examination show any significant association and that was between: height and maximum pressure (0.30, $p<0.05$), length of the hand and minimum pressure (right hand: 0.34, $p<0.05$; left hand: 0.36, $p<0.05$) (Table 5).

Discussion

The analyses performed confirm only in part the results which have already appeared in literature on the dermatoglyphic patterns in hypertense individuals (shown in Table 1) and bring to light some new characteristics.

As already observed, our sample also shows a distal positionof the axial triradius in both sexes. This characteristic is recurrent and common to many pathologies (Floris et al., 1994).

The high frequency of whorls seen by various authors only appears in the female group and shows a statistically significant difference in comparison with the control group. However, this observation is not confirmed in analyses within the same group, since in that ambit minimum blood pressure values decrease as the number of whorls increase.

A new observation from this research regards a more horizontal trend of the epidermal ridges in hypertense individuals. This characteristic, although present in females, is more evident in the males.

One result which is particularly interesting is the one relative to the asymmetry of the TRC. A greater asymmetry is seen in hypertense individuals of both sexes, and in the sample of males it is significantly different compared to the control group.

It is common belief that the genes which determine right side characteristics are the same as those which determine the left side (Waddington, 1957). Deviation from perfect symmetry is therefore interpreted as an effect of disturbances during the normal process of embryologic development; the greater the asymmetry, the greater the disturbance. It is well known that females react better than males to disturbances which happen during growth canalization. As a result, besides being usually less mesolabile, females have a greater symmetry of bilateral characteristcs.

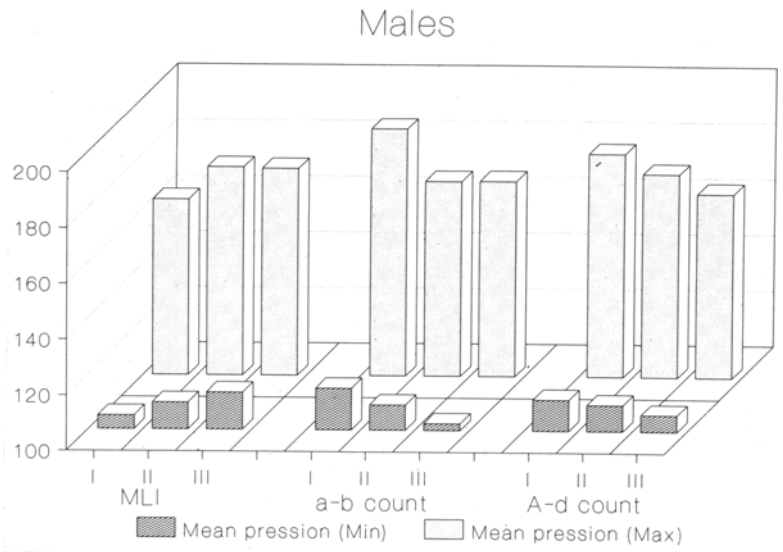
Our observation of more evident TRC asymmetry in males testifies, therefore, to the existence of some element of disturbance during the embryologic period. This is in agreement with the hypothesis of Godfrey et al. (1993), according to which the increase of blood pressure seen in adults originates during the embryologic period and gives rise to a particular dermatoglyphic structure.

As far as the connection between high blood pressure and shape of the hand brought to light by Godfrey et al. (1993), our sample sees the connection only in the female group and only for the minimum pressure. Since in this research the length of the hand was measured directly and not by means of *dt* and *at* distances, we believe that the importance of the conclusions previously reached by other authors should be reevaluated.

Conclusions

Based on observations reached, with this contribution it can therefore be concluded that:

- there are differences in the behaviour of hypertense individuals according to sex;
- there is a tendency towards a distal position of axial triradius, as seen in other literature, confirming a characteristic recurring in many pathologies. To a limited extent a greater number of whorls and a lower number of ulnar loops are observed in females;
- the decrease of the *atd* angle and the increase of the TRC observed by various authors were not noticed in this sample;
- there are some distinctive characteristics present in hypertense individuals of both the sexes which had not been observed in previous works: the trend of the epidermal ridges (more horizontal in the hypertense), the asymmetry of the TRC (greater in the hypertense, especially in males);
- in agreement with Godfrey et al. (1993) the dermatoglyphic peculiarities seen are interpreted as a consequence of the high blood pressure levels, already present during the fetal period.



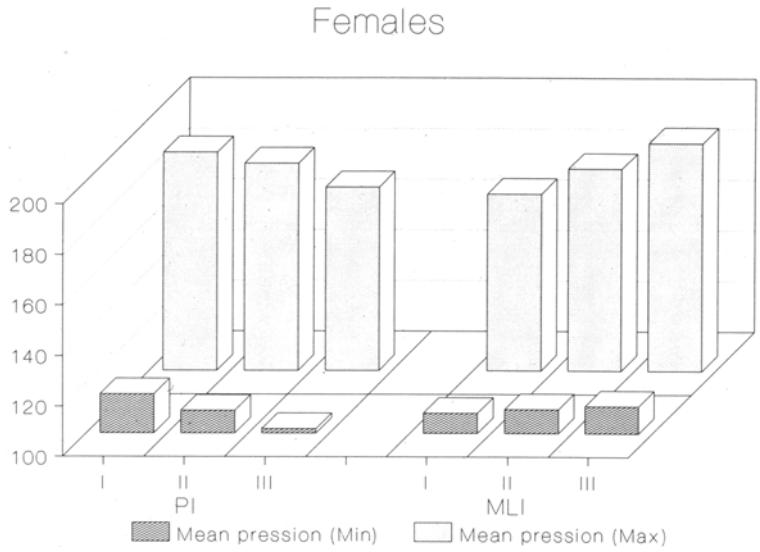


Figure 1. Trend of the average minimum and maximum blood pressure values in three groups identified by average values of dermatoglyphic patterns (average +/- standard deviation) (II), lower than average values (I), and higher values (III). Male sample.

Figure 2. Trend of the average minimum and maximum blood pressure values in three groups identified by average values of dermatoglyphic patterns (average +/- standard deviation) (II), lower than average values (I), and higher values (III). Female sample.

TABLE 1- Dermatoglyphic characteristics associated to essential hypertension according to data from literature.

Characteristic	Expression	Author
Digital characteristics		
Whorls	> frequency	Jaim et al., 1984
		Pursnani et al., 1989
		Palyzova et al., 1991
		Godfrey et al., 1993
Ulnar loops	< frequency	Jaim et al., 1984
		Pursnani et al., 1989
		Palyzova et al., 1991
TRC	increase	Jaim et al., 1984
		Pursnani et al., 1989
		Palyzova et al., 1991
		Godfrey et al., 1993
Palmar characteristics		
atd angle	decrease	Pursnani et al., 1989
		Godfrey et al., 1993
	increase	Palyzova et al., 1991
Axial triradii	decrease of type t	Palyzova et al., 1991
		Jaim et al. 1994
	only in females	Pursnani et al., 1989
	absence in both palms	Pursnani et al., 1989
		Palyzova et al., 1991

TABLE 2 - Quantitative dermatoglyphic characteristics in the group of men and women affected by essential hypertension (dx + sn).

	Males	Females
MLI	17.50 ± 3.70	16.11 ± 3.73
TRC	137.05 ± 43.13	135.69 ± 51.20
Asymmetry (TRC)	5.32 ± 9.29	4.11 ± 9.33
PI	13.04 ± 3.62	12.75 ± 4.52
a-b count	82.14 ± 9.93	78.88 ± 14.06
A-*d* count	91.40 ± 18.50	90.17 ± 26.12
atd angle	89.06 ± 17.98	88.84 ± 22.25
CTL	55.59 ± 7.41	52.51 ± 8.35

TABLE 3 - Qualitative dermatoglyphic characteristics in the group of men and women affected by essential hypertension (dx + sn).

	Males	Females
Digital patterns:		
Whorls	34.00	37.19
Ulnar loops	57.11.	51.45
Radial loops	5.33	2.70
Arches	3.56	8.67
Palmar patterns:		
Hypothenar area	42.22	49.04
Thenar area	6.67	12.50
Interdigital area II	4.44	2.88
Interdigital area III	63.33	47.12
Interdigital area IV	44.44	51.92
Position of the axial triradius:		
t	39.33	40.38
t'	17.98	7.69
t"	/	1.92
tt'	2.25	7.69
tt^{tu}	7.87	17.31
tt"	7.87	4.81
others	21.35	20.19
Modal types of D line:		
Type 11	25.00	23.08
Type 9	63.10	52.75
Type 7	11.90	24.18

TABLE 4 - Results of the statistical comparison between individuals affected by essential hypertension and the control group.

	Males	Females
Digital patterns	$\chi^2 = 0,36$	$\chi^2 = 26,32^{**}$
TRC	$t = 0,79$	$t = 1,46$
Asymmetry (TRC)	$t = 2,56^{*}$	$t = 0,28$
PI	$t = 0,16$	$t = 1,01$
MLI	$t = 1,70$	$t = 0,06$
a-b count	$t = 0,43$	$t = 1,46$
A-*d* count	$t = 1,32$	$t = 0,86$
atd angle	$t = 0,14$	$t = 1,32$
CTL	$t = 2,02^{*}$	$t = 0,14$
Palmar patterns	$\chi^2 = 7,14$	$\chi^2 = 32,17^{**}$
Types of the axial triradius	$\chi^2 = 27,12^{**}$	$\chi^2 = 25,21^{**}$
Types of D line	$\chi^2 = 10,00^{**}$	$\chi^2 = 2,63$

$p < 0,05$; $p < 0,01$

TABLE 5 - Correlation between the values of the anthropometric variables and maximum and minimum blood pressure levels.

	Males		Females	
	max. pres.	min. pres.	max.pres.	min.pres.
Height	0.23	0.16	0.30*	0.18
Lenght right hand	0.16	0.05	0.07	0.34*
Lenght left hand	0.14	0.09	0.07	0.36**
Lenght right palm	0.14	0.13	0.15	0.26
Lenght left palm	0.12	0.15	0.11	0.27
Width right hand	0.13	0.19	0.04	0.09
Width left hand	0.09	0.16	0.08	0.09

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