CHARACTERISTICS OF THE PALMAR AXIAL TRIRADIUS IN PATIENTS WITH CONGENITAL HEART DISEASE AND THEIR NEXT OF KIN

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Dermatoglyphic characteristics of the palmar axial triradius were studied in 330 patients of Russian nationality with various forms of congenital heart disease and in 285 of their next of kin. The results of a study of the dermatoglyphics of 684 school children of Russian nationality in junior schools in Moscow are described as the control. Changes in the characteristics of the palmar axial triradius in patients with congenital heart disease and their next of kin were found compared with the control subjects. In some cases the changes in these characteristics among the next of kin compared with the control group were more marked than those in the patients themselves, evidence of the important role of hereditary factors in the formation both of these characteristics and of many congenital heart defects.

An increase in the frequency of other developmental defects and anomalies has been found in patients with congenital heart diseases and this has been interpreted by many writers as the result of an embryopathy. One well-known anomaly associated with congenital heart disease is a distal position of the palmar axial triradius, [7, 3, 4]. Duplication of the proximal axial triradius has also been found in association with a ventricular septal defect [6]. Other dermatoglyphic characteristics of the axial triradii (combinations, number on the palms, and so on) have received little study.

The etiology of congenital heart disease has not yet been studied because of the great diagnostic difficulties. The study of anomalies of the dermatoglyphics in patients with congenital heart diseases and their relatives would shed some light on the etiology and pathogenesis of congenital heart defects.

EXPERIMENTAL METHOD

The frequency of various positions of the axial triradius on the palm, combinations of the axial triradii, their duplications, and their number were studied in patients with congenital heart defects and their next of kin. Altogether 330 patients (138 male and 192 female) of Russian nationality with various forms of congenital heart disease (mainly the more common defects – Fallot's tetrad, strial and ventricular septal defects, patent ductus arteriosus), admitted for treatment to the A. N. Bakulev Institute of Cardiovascular Surgery, Academy of Medical Sciences of the USSR, were investigated. The diagnosis was made at operation or during cardiac catheterization. The next of kin of most patients (95 males and 190 females) were examined. As the control, the results of a study of the dermatoglyphics of 684 school children of Russian nationality attending junior schools in Moscow and the results of a special medical examination of 308 school children with the study of their pedigrees are given.

The palmar axial triradius was studied on prints of the palms on chalked paper obtained with the aid of printers' ink. The proximal (t), intermediate (t'), and distal (t") positions of the axial triradius were estimated according to the international classification of dermatoglyphics [5] and by determining the index

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TABLE 1. Frequency of Various Characteristics of Palmar Axial Triradii in Patients with Congenital Heart Diseases and Their Next of Kin (for both palms, in percent)

Characteristics of axial triradii	Male sex			Female sex		
	control	patients	relatives	control	patients	relatives
A. Position:	(*n*=696)	(*n*=276)	(*n*=190)	(*n*=672)	(*n*=384)	(*n*=342)
proximal (t)	65,04	70,29	73,16*	56,99	57,29	60,53
intermediate (t^t)	20,00	13,77* $P<0,01$	4,74‡	26,94	17,19‡	15,50‡
($t' + tt'$)	27,48	18,48†	13,16‡	34,38	23,96‡	25,15†
distal ($t'' + tt'' + t't'' + tt't''$)	6,05	10,13*	12,63†	7,44	17,44‡	13,15†
B. Most proximal position (t^t)	(*n*=318) 0,63	9,42‡	3,68	(*n*=242) 0,83	8,33‡	2,92
C. Combinations:	(*n*=696)			(*n*=672)		
($tt' + tt'' + t't'' + tt't''$)	10,94	11,95	19,47†	11,61	19,78*	19,88*
D. Three triradii and more on the two palms	(*n*=159) 18,87	(*n*=138) 26,80	(*n*=95) 31,58*	(*n*=121) 14,87	(*n*=192) 38,44‡	(*n*=171) 37,74‡
E. Duplications	(*n*=696)	(*n*=276)	(*n*=190)	(*n*=672)	(*n*=384)	(*n*=342)
(tt)	0,72	7,25‡	3,68†	0,30	7,29‡	8,48‡
($t't'$)	0,14	1,09†	1,58†	0	2,86‡	2,05‡
($t''t''$)	0,14	1,81†	3.16‡	0	2,86‡	2,34‡
($tt + t't' + t''t''$)	1,00	10,14‡	8,42‡	0,30	13,02‡	12,87‡

*P < 0.05.
†P < 0.01.
‡P < 0.001.

of the position of the axial triradius on the long axis of the palm* which, unlike determination of the width of the angle ATD, remains almost unchanged with the increase in size of the palm during growth. If the index was 35% or less, the axial triradius was described as proximal, with an index of 35-40% as intermediate, and with an index of more than 40%, as distal. If a combination of several triradii was present on the palm, the most distal triradius was selected as the criterion of position. Axial triradii located at the border or in the region of the thenar eminence (t^t) beyond the fold of the thumb, or with a very low index (below 10%) were excluded from the proximal class. Duplications of the axial triradii included combinations immediately next to each other and they either formed a small loop whorl between them (the ridge count between the main radius of the wall was below 10) or they did not form a whorl, disturbing the role of topology of the dermatoglyphics (Penrose's rule [8]). When the total number of triradii was counted all axial triradii of both palms without exception were included. A statistical analysis of the results was carried out by determining the u-criterion for an alternative distribution [2].

EXPERIMENTAL RESULTS

The results of the analysis of the position of the axial triradii are given in Table 1 (A, B). Comparison of the position of the proximal, intermediate, and distal axial triradii in the patients and in the control subjects showed that the frequency of the distal position of the axial triradii was considerably increased in the male and female groups with congenital heart disease. The frequency of the proximal position of the axial triradii was unchanged in these patients. Meanwhile, the most proximal position of the axial triradii (t^t; Table 1, B) in the patients occurred more frequently (P < 0.001). As a result of both these phenomena, the frequency of intermediate axial triradii was considerably reduced in the patients.

Comparison of the next of kin of the patients with the control subjects revealed similar changes, and in this case the decrease in frequency of the intermediate axial triradii was even more marked than in the patients, and in the male group it was significantly lower not only than in the control group, but in the group of patients (for t' alone, P < 0.01).

*To determine the index a straight line was drawn between the middle of the distal carpal crease and the middle of the proximal crease of the middle finger (a); a perpendicular was drawn from the axial triradius to this line (a), which it divided into proximal (b) and distal (c) segments. The index x was determined as the ratio of b to *a* expressed as a percentage, where a was taken as 100; i.e., $x = b \cdot 100/a$.

The frequency of combinations of axial triradii (Table 1, C) in the female patients was higher than in the control ($P < 0.05$). In the groups of male and female relatives of the patients the frequency of the combinations was the same and was much higher than the frequency of this feature in the control subjects, and in the male group it was also higher than in the patients. Approximately the same differences were found in the groups tested as regards the frequency of individual with 3 triradii or more (Table 1, D). However, in the male patients the increase in the frequency of individuals with this characteristic compared with the control was greater.

All forms of duplications of the axial triradii (Table 1, E) were much more frequent in the patients and their relatives than in the control group.

These observations showing an increase in the frequency of a distal position of the axial triradius in patients with congenital heart diseases thus confirm the results of most other investigations conducted on groups of persons of other nationalities, and the increase in the frequency of this characteristic in the patients' relatives agrees with data given by Cascos [4] for an increase in correlation between the width of the angle ATD for mother and child ($r = 0.43 \pm 0.14$ in the "genetic fraction" compared with 0.23 ± 0.09 in the whole group of congenital heart defects and 0.29 in a sample population). Meanwhile in the present investigation an increase in the frequency of the proximal axial triradii and a decrease in the frequency of intermediate axial triradii were observed, although this was not described in the previous investigation.

The results of these tests confirm the data of David [6] who found an increase in the frequency of duplications of the proximal axial triradius in association with a ventricular septal defect. At the same time, an increase in the frequency of duplications of all types of axial triradii has also been found in association with most other forms of congenital heart defects. Duplication of the intermediate and distal axial triradii in the control group (especially in females) is exceptionally rare, but it was much more frequent in the patients and their relatives.

Consequently, this characteristic is very important not only in connection with the diagnosis of congenital heart defects, but also in medical-genetic counseling.

Two other characteristics (combinations of axial triradii and the presence of three triradii or more on both palms) showed similar patterns by virtue of the fact that they reflect approximately the same phenomenon: an increase in the number of axial triradii in patients with congenital heart defects and, in particular, in their male relatives.

Changes in the frequency of these characteristics in the patients' relatives, in some cases even more marked than in the probands themselves, demonstrate the important role of inherited factors in the formation both of these characteristics themselves and in a high proportion of congenital heart defects.

The discovery of anomalies of the dermatoglyphics of the palms in association with an increase in the frequency of developmental defects of other organs in patients with congenital heart diseases [1] suggests that congenital heart defects are merely a "symptom" of a more general lesion of the connective tissue in embryogenesis and that they are not strictly defined entities in the pathogenetic sense.

The characters of the dermatoglyphics studied in this investigation can be used as diagnostic features for the discriminatory study of the dermatoglyphics of patients together with their relatives, with an appropriate control for comparison. In medical-genetic counseling these characteristics can indicate an increased risk of the development of congenital heart defects in the patients' families.

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