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Qualitative Dermatoglyphic Traits in Brachial Plexus Palsy

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A B S T R A C T

It has been considered for many years that the cause of perinatal brachial plexus palsy (PBPP) is excessive lateral traction applied to the fetal head at delivery, in association with anterior shoulder dystocia, but this do not explain all cases of brachial plexus palsy. The incidence found in several family members could be suggestive for inheritance with variable expression. The aim of this study was to prove early found confirmations of genetic predisposition for PBPP. In the previous studies, the quantitative dermatoglyphic analysis showed some differences in digito-palmar dermatoglyphs between patients with PBPP and healthy controls. Now this qualitative analysis will try to determine hereditary of those diseases. We analyzed digito-palmar dermatoglyphics from 140 subjects (70 males and 70 females) diagnosed with PBPP and 400 phenotypically healthy adults (200 males and 200 females) from Zagreb area as control group. The results of Chi-square test showed statistically significant differences for frequencies of patterns on fingers in females between the groups observed. Statistically significant differences were found on palms in III and IV interdigital areas in both males and females and in thenar and I interdigital area only in females. As it was found in previous researches on quantitative dermatoglyphic traits, more differences are found between females with PBPP and control group, than between males. The fact, that the main presumed cause of PBPP is obstetrical trauma, it could be associated with congenital variability in formation of brachial plexus.

***Key words**: qualitative dermatoglyphics, brachial plexus palsy, genetic predisposition*

Introduction

The incidence of perinatal brachial plexus palsy (PBPP) in Croatia corresponds to 3.4/1000 newborn[1] and is still a relatively common birth defect and almost a sporadic disorder. In Sweden it increased significantly from 1.4/1000 in 1980 to 2.7/1000 in 1997, while in Netherlands it is estimated 4.6/1000 newborn[2–4], in Bosnia and Herzegovina 1.89/1000, and in England less than 1/1000.[5] The obstetrical BP paralysis may be classified as follows: 1) Erb-Duchenne upper-arm paralysis, in which the C5 and C6 nerves or their derivatives are principally involved; 2) Klumpke's lower-arm paralysis, in which the C8 and T1 nerves are affected; or 3) paralysis of the entire arm, in which there is some involvement of all components of the BP[6–8].

The incidence of Erb's palsy, a type of PBPP, in Pennsylvanian population is similar to that of other studies and has remained unchanged over the past 30 years, even as cesarean rate has risen from 5 to 20 %[9]. Although the etiology of PBPP varies, birth trauma is considered to be the major cause of the defect[10–13]. The risk factors for obstetrical brachial plexus palsy include: (1) large birth weight, (2) shoulder dystocia and prolonged second stage of labour, (3) instrumental vaginal delivery (forceps delivery, vacuum extraction), (4) diabetes mellitus and mother's obesity, (5) breech presentation, (6) delivery and infant with obstetrical brachial plexus palsy in antecedent delivery. Some brachial plexus injuries occur in the absence of shoulder dystocia, and can be associated

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with cesarean delivery but it is not always associated with the history of difficult or traumatic delivery[14,5]. Gherman et al[16] concluded in their researches that some palsies appeared to be of intrauterine origin and more likely to persist. In some cases the congenital brachial palsy was detected as a sporadic disorder. Pedigree analysis of two Egyptian families, with the congenital brachial palsy was detected. The high rate of consanguinity among them, highly suggestive of autosomal recessive inheritance with variable expression, could be confirmed[17]. The variations during the intrauterine formations of brachial plexus were analyzed by Kerr[18]. Uysal et al.[19] observed that formation of the BP was completed by the 13th week of gestation.

The digito-palmar dermatoglyphics were formed at the same time, when brachial plexus was completed, and some influences in formation of BP could be reflected on dermatoglyphics. In our previous study of quantitative dermatoglyphic analysis we found some differences in digito-palmar dermatoglyphics between patients with PBPP and healthy controls and that could be the confirmation of hereditary influenced disease[20]. This was the reason why we continued with our analysis of qualitative dermatoglyphic traits: to confirm previous conclusions.

Materials and Methods

Qualitative dermatoglyphic traits were examined in 141 patients (71 males and 70 females), with PBPP. The control group comprised 400 phenotypically healthy adults (200 males and 200 females) from Zagreb area[21]. The digito-palmar prints were taken by Cummins and Midlo[22] and analyzed according to the Holt[23] and Miličić et al.[24] methods.

The absolute and relative frequencies of qualitative variables of digito-palmar dermatoglyphics were counted: on fingers – whorls, ulnar loops, radial loops and arches, on palms – patterns in thenar and I interdigital area, patterns in II, III IV interdigital area, and in hypothenar area. The Chi-square test was used for testing the differences between PBPP patients and controls.

Results

The relative frequencies of qualitative dermatoglyphic traits on fingers in patients with brachial plexus palsy (PBPP) are presented on Table 1 for males and Table 3 for females. Their control groups are presented in table 2 for control males and table 4 for control females. Using Chi-square test among males with PBPP and control group for frequencies of patterns on fingers Table 5, we did not find any statistically significant results. When we analyzed frequencies of patterns in females we found statistically significant difference for both hands (χ^2= 17.708; p<0.001). The significance for the right hand was as low as 0.05 (χ^2=9.005; p<0.029), but for the left hand very high (χ^2=17.708; p<0.001).

The relative frequencies of qualitative dermatoglyphics on palms from PBPP patients and controls are presented on Table 6 for males and Table 7 for females. In males we found statistically significant differences for frequencies of patterns in III (χ^2=24.307; p<0.001) and IV (χ^2= 6.554; p<0.01) interdigital area. In females the statistically significant differences were found on thenar (χ^2= 7.559; p<0.01) and also in III (χ^2=27.598; p<0.001) and IV (χ^2=55.007; p<0.001) interdigital area.

TABLE 1
RELATIVE FREQUENCIES OF QUALITATIVE DERMATOGLYPHIC TRAITS ON FINGERS IN PATIENTS WITH BRACHIAL PLEXUS PALSY PBPP (N=70) – MALES

	Whorl	Loop ulnar	Loop radial	Arch
Right hand				
Finger 1	46.5	49.3	–	4.2
Finger 2	35.2	29.6	22.5	12.7
Finger 3	26.8	62.0	1.4	9.9
Finger 4	50.7	46.5	–	2.8
Finger 5	16.9	80.3	–	2.8
Total fingers right	35.21	53.52	4.79	6.48
Left hand				
Finger 1	40.8	54.9	–	4.2
Finger 2	35.2	32.4	18.3	14.1
Finger 3	19.7	70.4	1.4	8.5
Finger 4	39.4	56.3	1.4	2.8
Finger 5	14.1	85.9	–	–
Total fingers left	29.86	60.00	4.23	5.91
Total fingers	32.54	56.76	4.51	6.20

TABLE 2
RELATIVE FREQUENCIES OF QUALITATIVE DERMATOGLYPHIC TRAITS ON FINGERS IN HEALTHY CONTROLS (N=200) – MALES

	Whorl	Loop ulnar	Loop radial	Arch
Right hand				
Finger 1	54.00	54.00	–	1.00
Finger 2	40.00	26.00	22.50	11.50
Finger 3	23.00	68.00	1.00	8.00
Finger 4	57.00	41.00	0.50	1.50
Finger 5	22.50	76.00	–	1.50
Total right	39.30	51.20	4.80	4.70
Left hand				
Finger 1	37.00	59.00	0.50	3.00
Finger 2	32.00	36.50	20.50	11.00
Finger 3	18.50	70.50	0.50	10.50
Finger 4	42.50	55.00	–	2.50
Finger 5	12.50	85.00	–	2.50
Total left	28.60	61.20	4.30	5.90
Total fingers	33.95	56.20	4.55	5.30

TABLE 3
RELATIVE FREQUENCIES OF QUALITATIVE DERMATOGLYPHIC TRAITS ON FINGERS IN PATIENTS WITH BRACHIAL PLEXUS PALSY PBPP (N=70) – FEMALES

	Whorl %	Loop ulnar %	Loop radial %	Arch %
Right hand				
Finger 1	42.9	57.1	–	–
Finger 2	52.9	30.0	11.4	5.7
Finger 3	30.0	68.6	–	1.4
Finger 4	50.0	50.0	–	–
Finger 5	21.4	78.6	–	–
Total right	36.86	55.43	5.43	2.29
Left hand				
Finger 1	37.1	61.4	1.4	–
Finger 2	41.4	31.4	20.0	7.1
Finger 3	35.7	60.0	1.4	2.9
Finger 4	48.6	47.1	4.3	–
Finger 5	21.4	77.1	–	1.4
Total left	39.43	56.86	2.29	1.43
Total fingers	38.14	56.14	3.86	1.86

TABLE 4
RELATIVE FREQUENCIES OF QUALITATIVE DERMATOGLYPHIC TRAITS ON FINGERS IN HEALTHY CONTROLS (N=200) – FEMALES

	Whorl %	Loop ulnar %	Loop radial %	Arch %
Right hand				
Finger 1	45.50	51.50	0.50	2.50
Finger 2	38.00	36.50	13.50	12.00
Finger 3	18.00	77.00	1.50	3.50
Finger 4	50.00	48.00	–	2.00
Finger 5	15.50	84.00	–	0.50
Total fingers right	33.40	59.40	3.10	4.10
Left hand				
Finger 1	40.50	54.50	0.50	4.50
Finger 2	38.00	32.50	17.50	12.50
Finger 3	23.00	70.00	2.00	5.00
Finger 4	39.50	58.001	–	2.50
Finger 5	11.00	87.00	–	1.50
Total fingers left	30.40	60.40	4.00	5.20
Total fingers	31.90	59.90	3.55	4.65

TABLE 5
CHI SQARE TEST OF QUALITATIVE DERMATOGLYPHIC TRAITS ON FINGERS BETWEEN PATIENTS AND HEALTHY CONTROLS

	Males Patients/Control N= 71/200	Females Patients/Control N=70/200
	χ^2; p<	χ^2; p <
R1	3.734; p<0.155	2.493; p<0.476
R2	0.620; p<0.892	5.511; p<0.138
R3	0.888; p<0.828	5.830; p<0.120
R4	1.593; p<0.661	1.443; p<0.486
R5	1.398; p<0.497	1.605; p<0.448
Total R	3.023; p<0.388	9.005; p<0.029
L1	0.895; p<0.827	4.343; p<0.227
L2	0.962; p<0.810	1.680; p<0.641
L3	0.848; p<0.838	4.584; p<0.205
L4	2.972; p<0.396	12.449; p<0.006
L5	1.882; p<0.390	4.773; p<0.092
Total L	0.209; p<0.976	10.619; p<0.014
Total R+L	1.106; p<0.776	17.708; p<0.001

Discussion

This research on qualitative dermatoglyphic traits has shown statistically significant differences for frequencies of patterns on fingers in females between the groups observed: on palms in III and IV interdigital areas in both males and females and in thenar and I interdigital area only in females.

As it was already found in previous researches on quantitative dermatoglyphic traits[20], more differences were found among females with PBPP and control group, than in males, in spite of almost equal incidence in both sexes.

Uysal et al.[19] studied 200 BPs (bilaterally dissected; left and right sides) from 100 spontaneously aborted fetuses (50 male and 50 female fetuses) without detectable malformations. They found out that there were no variations in 93 BPs (46.5%), but 107 BPs (53.5%) were observed to have different variations. They also found out that morphological variations were more frequently observed among female fetuses and right sides. There could be the congenitally influenced predisposition for further injuries during the delivery if there were some risk factors present. The variabilities found during the formation of BP could be reflected on dermatoglyphic patterns, as well. So, what we found in frequencies of patterns in females, was the statistically significant difference for both hands. It confirmed previous studies[20] that it could affect fingers, the TRC (total ridge count) in females with PBPP was TRC=155.59, statistically different from control groups TRC=131.38, or palms in palmar interdigital areas III and IV which corresponded to the b-c ridge count and c-d ridge count differences from previous studies. We confirmed that previously found differences were more often found in females what suggested genetic susceptibility for the occurrence of PBPP, especially in girls. It was important to acknowledge the fact that there were three pairs of relatives in our samples (two sisters, brother and sister, mother and daughter) with PBPP.

TABLE 6
RELATIVE FREQUENCIES OF QUALITATIVE DERMATOGLYPHIC TRAITS FOR IGHT AND LEFT PALMAR AREAS AND TOTAL, AND CHI SQUARE TEST BETWEEN PATIENTS WITH BRACHIAL PLEXUS PALSY (70) AND HEALTHY CONTROL MALES

	Right hand			Left hand			Total R+L		
Palmar areas	Patients N=71	Control N=200	χ^2; p<	Patients N=71	Control N=200	χ^2; p<	Patients N=71	Control N=200	χ^2; p<
Thenar and I interdigital area	15.5%	13.2%	0.149; p<0.699	7.0%	8.5%	0.173; p<0.677	11.3%	11.0%	0.008; p<0.930
II interdigital area	4.2%	2.0%	0.069; p<0.793	4.2%	5.0%	1.031; p<0.310	4.2%	3.5%	0.155; p<0.694
III interdigital area	14.1%	24.5%	24.906; p<0.001	21.1%	56.5%	3.338; p<0.068	17.6%	40.5%	24.307; p<0.001
IV interdigital area	28.2%	47.0%	0.700; p<0.403	31.0%	36.5%	7.624; p<0.006	29.6%	41.8%	6.554; p<0.011
Hipothenar	28.2%	33.5%	3.603; p<0.056	45.1%	32.5%	0.683; p<0.409	36.6%	33.0%	0.612; p<0.434

TABLE 7
RELATIVE FREQUENCIES OF QUALITATIVE DERMATOGLYPHIC TRAITS FOR IGHT AND LEFT PALMAR AREAS AND TOTAL, AND CHI SQUARE TEST BETWEEN PATIENTS WITH BRACHIAL PLEXUS PALSY (70) AND HEALTHY CONTROL FEMALES

	Right hand			Left hand			Total R+L		
Palmar areas	Patients N=70	Control N=200	χ^2; p<	Patients N=70	Control N=200	χ^2; p<	Patients N=70	Control N=200	χ^2; p<
Thenar and I interdigital area	14.3%	10.5%	1.929; p<0.165	21.4%	8.5%	6.003; p<0.014	17.9%	9.5%	7.559; p<0.006
II interdigital area	5.7%	1.0%	0.005; p<0.946	2.9%	5.5%	1.225; p<0.268	4.3%	3.3%	0.328; p<0.567
III interdigital area	17.1%	25.5%	27.807; p<0.001	12.9%	53.5%	4.477; p<0.034	14.0%	39.5%	29.332; p<0.001
IV interdigital area	12.9%	58.0%	25.618; p<0.001	20.0%	47.0%	29.991; p<0.001	16.4%	52.5%	55.007; p<0.001
Hipothenar	30.0%	33.5%	1.114; p<0.291	24.3%	37.05	2.054; p<0.152	27.1%	35.3%	3.076; p<0.080

Very few studies showed higher incidence for PBPP in girls (Mandić et al.[25], Zancoli et al.[26], Greenwald et al.[27] and Stojčević-Polovina et al.[1]), but variability of innervations of BP found more often in girls could correspond to this incidence[19]. The fact is that the main cause of PBPP is obstetrical trauma and it could be associated with congenital variability in formation of brachial plexus. In further researches it will be very important to detect if some type of variability is more frequent in PBPP. On the other hand, the empiric fact that PBPP is more frequent in some families seems to reveal that genetic predisposed variability might contribute to the development of PBPP [28].

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KVALITATIVNA SVOJSTVA DERMATOGLIFA I KLIJENUT BRAHIJALNOG SPLETA

S A Ž E T A K

Već se mnogo godina razmatra uzrok kljenuti brahijalnog spleta u djece, a smatra se da je to jaki lateralni pritisak glave kod poroda, povezan s iskrivljenjem ramenog zgloba, no to ne objašnjava sve slučajeve PBPP. Veća incidencija u nekih obitelji može upućivati na nasljednost s različitom ekspresijom. Cilj je ovoga rada dokazati ranije potvrđenu genetsku predispoziciju za PBPP. U ranijim istraživanjima kvantitativnom analizom dermatoglifa, dokazali smo postojanje razlika između otisaka dermatoglifa u ispitanika oboljelih od PBPP i kontrolne skupine. U ovom radu kvalitativnom analizom ćemo pokušati utvrditi postoje li razlike između zdrave populacije i bolesnika s PBPP, te time utvrditi genetsku predispoziciju bolesti. Analizirali smo otiske digito-palmarnih dermatoglifa u 140 ispitanika (70 muškaraca i 70 žena) s PBPP i komparativne skupine od 400 odraslih i fenotipski zdravih osoba (200 muškaraca i 200 žena) zagrebačke regije. Provedbom χ^2-testa nad frekvencijama crteža na prstima između ispitivanih skupina pronašli smo razlike kod žena. Na dlanu smo utvrdili razlike u III. i IV. interdigitalnom prostoru kod muškaraca i žena te na tenaru i I. interdigitalnom prostoru samo kod žena. Kao i u prijašnjem istraživanju kvantitativnih svojstava dermatoglifa, više razlika našli smo između žena s PBPP i kontrolne skupine. Činjenica da je pretpostavljeni glavni uzrok PBPP trauma nastala pri porodu, moglo bi to biti povezano sa nasljednom varijabilnošću razvoja brahijalnog spleta.