Institute of Experimental Morphology, Pathology and Anthropology with Museum
Bulgarian Anatomical Society

Acta morphologica et anthropologica, 28 (3-4)
Sofia ● 2021

Role of dermatoglyphics for breast cancer prevention and prognosis

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Breast cancer in women is an oncological disease with a great medico-social importance because of its wide dissemination, ineffective mass prevention, difficult early diagnosis and unsuccessful delayed treatment. Recently, the armamentarium of preventive methods has been enriched by dermatoglyphics. In the present concise survey, some recent publications by foreign and Bulgarian authors devoted to the role of the dermatoglyphics for the prevention and prognosis of female breast cancer are presented. A special attention is paid to the significant differences between breast cancer females and healthy controls in terms of the qualitative and quantitative dactyloscopic and palmoscopic traits as well as the fluctuation asymmetry findings which could serve as cost-effective and trustworthy analytical tools for effective breast cancer prevention and prognosis.

Key words: female breast cancer, dermatoglyphics, prevention, prognosis

Introduction

Breast cancer in women represents a very serious medical and social problem in the whole world and engages united efforts of scientists and clinicians who uninterruptedly aim at achieving effective prophylaxis, early diagnosis and timely adequate treatment of this malignant disease. Numerous methods for screening and prevention have been developed and applied in many countries. During the recent decades, dermatoglyphics has been successfully introduced for breast cancer prevention and diagnosis in several countries in Asia, Africa and Europe as well.

The purpose of this concise review is to summarize some recent publications devoted to the role of the dermatoglyphics for the prevention and prognosis of female breast cancer.

Challenges of female breast cancer epidemiology

Nowadays breast cancer is the most common malignant neoplasm in women worldwide and in Bulgaria as well. Its incidence rate in Bulgaria and, especially in Northeast

Bulgaria, is permanently high [31,35]. There is an increasing overall trend of newly-diagnosed breast cancer in 53 African countries during the period between 1990 and 2016 [20]. The interest in modern prevention of this socially significant disease continuously increases [21,30,36,39].

The updated estimates on the global cancer burden using the GLOBOCAN 2020 of cancer incidence and mortality produced by the International Agency for Research on Cancer show that female breast cancer is the most frequent malignant neoplasm in women [28]. In 2020, there are a total of 2 261 419 new breast cancer cases (or 1.7%) and 684996 new breast cancer deaths (or 6.9% of all cancer cases) worldwide [9,28]. According to 2018 GLOBOCAN data, breast cancer age-standardized incidence rates are strongly and positively associated with the human development index [24].

The results from the application of mortality and population figures from the WHO and Eurostat databases during the period 1989-2021 demonstrate that progress in cancer epidemiology as well as in primary and secondary cancer prevention because of optimal adoption of breast cancer screening is a key determinant of the decreasing cancer mortality in Europe [6].

Palmar dermatoglyphics is simple, inexpensive, anatomical and non-invasive method [26] that is applied in a variety of medical fields. Several papers describe the peculiarities of the dermatoglyphic examinations in breast cancer patients [22,25,36]. They may be used as a reliable indicator for screening of high-risk population in terms of breast cancer. Usually, two basic classic dermatoglyphic methods are made use of: i) dactyloscopy of finger ridge count and finger indices and ii) palmoscopy assessing the palmar ridge count, palmar maximal atd, adt and dat angles, and palmar main lines A, B, C, and D [4].

In the present survey, the qualitative and quantitative dermatoglyphic traits as well as the fluctuation asymmetry findings are compared between female breast cancer patients and healthy women and the role of their significant differences in terms of disease prevention and prognosis are outlined.

Qualitative palmar dermatoglyphic traits

There are statistically significant differences between 82 breast cancer females and 60 healthy ones in the region of Varna, Bulgaria, in terms of the mean value of palmar thenar fields (p=0.006) as well as of the number and frequency of the palmar patterns in the II-IV interdigital fields of the hypothenar of the left hand (χ^2=4.220; p=0.040) and right hand (χ^2=5.691; p=0.017) [33]. The frequencies of the arches in left-hand (t=2.025; $p<0.05$) and in right-hand hypothenar (t=2.700; $p<0.01$) are significantly less while the frequency of the loops in left-hand hypothenar is reliably higher (t=2.028; $p<0.05$) in breast cancer females than in healthy ones. The sum frequencies of the arches, loops, whorls and image traces in right-hand hypothenar differ significantly between patients and controls (χ^2=3.228; p=0.006).

The sum frequencies of left thumb, left and right index finger papillary traits differ significantly between breast cancer patients and healthy controls (χ^2=3.872; p=0.049; χ^2=49.532; p=0.0001 and χ^2=16.153; p=0.0001; respectively) [37]. The frequencies of arches ($p<0.001$), ulnar loop ($p<0.001$) and whorls ($p<0.0001$) of index finger, of arches of the left-hand fourth finger ($p<0.05$) and little finger ($p<0.05$) as well as of whorls of right-hand index finger, third finger and little finger are significantly different from those of healthy females ($p<0.001$; $p<0.05$ and $p<0.05$, respectively). The frequencies of whorls of patients' right index, middle and little fingers are significantly different from those of healthy females ($p<0.001$; $p<0.05$ and $p<0.05$, respectively). The total frequencies of left and right finger papillary traits differ significantly between breast cancer patients and healthy controls ($\chi^2=18.708$; $p=0.0001$ and $\chi^2=24.594$; $p=0.0001$, respectively). The total frequency of the finger papillary traits of the left and right hand as well as of both hands differs significantly between breast cancer patients and healthy controls ($\chi^2=79.345$; $p=0.0001$) [37].

The sum frequency distributions of the papillary traits of left-hand, right-hand and both-hands' fingerprints differ significantly between patients and controls ($p=0.0001$ each) in the region of Varna, Bulgaria [31]. The frequencies of palmar patterns in left-hand and right-hand c-d IV differ significantly between both groups ($\chi^2=28.828$; $p=0.0001$ and $\chi^2=18.517$; $p=0.0001$, respectively).

In left-hand fourth and little fingers, there are less ulnar loops and arches but more whorls in 50 breast cancer women aged between 30 and 70 years than in 50 age-matched healthy women in India [2]. There are significantly higher frequencies of fingerprint whorls and of fingerprints with ≥6 whorls in 122 breast cancer women than in 22 healthy controls in China ($p<0.001$ and $p<0.01$, respectively) [11]. The frequency of ≥6 whorls is statistically reliably higher in 60 breast cancer females than in 60 healthy ones ($\chi^2=5.71$; $p<0.02$) [3]. The sum frequency of whorls of right-hand index finger and little finger is higher in these patients than in control subjects, too ($\chi^2=5.67$; $p<0.02$ and $\chi^2=7.67$; $p<0.01$, respectively).

There is a reliably higher frequency of fingerprints with ≥6 whorls in 154 breast cancer females (in 48.7%; $\chi^2=27.452$; $p<0.05$) and in 154 ones with increased breast cancer risk (in 47.4%; $\chi^2=61.821$; $p<0.05$) than in 308 healthy controls (in 27.5% of the cases) in Tehran, Iran [1]. The frequency of fingerprints with ≥6 loops is significantly higher in 100 breast cancer women than in 100 healthy ones ($p<0.01$) [16]. The presence of either of radial or ulnar whorls, or of arches in ≥6 fingers in combination with the absence or radial loops and central whorls is significantly associated with breast cancer in 100 females as compared with 100 healthy controls in India [18].

In 50 breast cancer women aged between 25 and 60 years in India, there is a significantly higher frequency of left-hand and both-hands' arches (each $p<0.05$), of left-hand and both-hands' whorls (each $p<0.05$) and of right-hand whorls ($p<0.01$) than in 50 age-matched healthy women [27]. The number of ulnar loops of the right-hand third and fourth fingers as well as of the left-hand index finger is reliably greater in 100 breast cancer women aged between 30 and 60 years than in 100 age-matched healthy ones in India ($p<0.028$, $p=0.030$ and $p<0.048$, respectively) [26]. The number of right-hand and left-hand ulnar loops is significantly smaller (34.4% versus 76.8% and 34.6% versus 77.0%, respectively), while the number of whorls of these hands is statistically reliably greater (53.2% versus 15.8% and 56.0% versus 16.2%) in 100 breast cancer females than in 100 healthy ones in India [12].

Quantitative palmar dermatoglyphic traits

Quantitative dactyloscopic findings

There are significant differences between 82 breast cancer women and 60 healthy ones in the region of Varna, Bulgaria, concerning the finger ridge counts of left-hand index finger (p=0.043) and third finger (p=0.049) as well as of right-hand thumb (p=0.0001) and index finger (p=0.032) (38). Total mean ridge counts of all the fingers of the right hand and both hands are significantly greater in patients than in controls (p=0.027 and p=0.039, respectively). The values of the correlation coefficients of the ridge counts of the first, second and fifth homologous fingers of both hands are smaller while those of the third and fourth homologous fingers of both hands are greater in breast cancer patients than in healthy females. There is a statistically significant difference concerning the third fingers only ($p<0.05$).

By using one-way ANOVA of the ridge counts of a-b, b-c and c-d, the presence of a significant difference between intergroup variation, on the one hand, and residual (not explained) variation, on the other hand, concerning the ridge count of b-c (F=77,134; p=0,0001) is proved [31].

The values of two specific finger indexes, i.e. Dankmeijer index and Poll index of the left hand, right hand and both hands are considerably smaller while those of the P. I. I. Cummins index, Geipel index and Furuhata index of the left hand, right hand and both hands are considerably greater in breast cancer patients than in healthy females [38].

Quantitative palmoscopic findings

The results from independent *t*-test demonstrate that mean values of left-hand palmar ridge counts b-c III (t=7.07; p=0.0001) and a-d (t=2.53; p=0.012) as well as of right-hand ones (p=0.0001 and p=0.0001, respectively) are significantly higher in 82 breast cancer females than in 60 healthy ones in the region of Varna, Bulgaria [31]. Mean values of palmar ridge counts of both hands b-c III (t=9.21; p=0,0001) and a-d (p=0.001) are significantly greater in patients than in healthy women.

The frequencies of left-hand palmar main line A (χ^2=14.96; p=0.0001), A 3(+4) ($p<0.001$) and A 5(5‘+5“+6) ($p<0.001$) and of palmar main line D (χ^2=32.86; p=0.0001), D 9(+10) ($p<0.0001$) and D 11(+12+13) ($p<0.0001$) are reliably different between the patients and controls [32].

There are statistically significantly different frequencies in terms of the palmar main line A (χ^2=22.51; p=0.0001), A 3(+4) ($p<0.001$), A 5(5‘+5“+6) ($p<0.001$), palmar main line D (χ^2=15.65; p=0.0001), D 9(+10) ($p<0.001$), D 11(+12+13) ($p<0.001$), palmar main line B (absence) ($p<0.05$) as well as of palmar main line C (absence) ($p<0.02$) of the right hand between both groups [32].

In three equal groups of 50 women each, there are reliable differences in terms of total and absolute finger ridge counts between breast cancer females and high-breast cancer risk ones, on the one hand, and healthy women, on the other hand ($p<0.05$) (8). Mean finger ridge counts of the left hand and right hand are smaller in 60 women with pathohistologically proved breast cancer than in 60 age-matched healthy women (12.4±2.33 versus 18.4±4.58; $p<0.05$ and 12.4±1.62 versus 19.64±4.67; $p<0.03$, respectively) [3]. Finger ridge counts in each digit of both hands are greater ($p<0.001$) in 100 breast cancer women aged 30-60 years than in 100 age-matched controls in India [26]. There are reliable differences concerning the total right-hand finger ridge count (60.97±14.09 versus 47.41±14.11; $p=0.001$) and the left-hand one (59.36±14.54 versus 47.48±14.01; $p=0.001$) between these patients and controls.

The mean total finger ridge count is smaller in 40 breast cancer women than in 40 healthy ones in India (89.88±13.26 versus 119±10.4; $p<0.001$) [5]. The total finger ridge count is greater ($p\leq0,001$) in 100 women with pathohistologically proved breast cancer women aged 30-50 years than in 100 age-matched controls in India [12] while it is smaller in 20 women aged 20-60 years with malignant breast diseases than in 25 age-matched controls in Nigeria (12.76±0.21 versus 15.51±0.68) ($p<0.05$) [17]. The mean values of the absolute finger ridge count are significantly greater in 100 breast cancer females aged 30-60 years than in 100 age-matched controls in India ($p<0.003$) [26]. The absolute finger ridge count in 100 breast cancer women at a mean age of 45.6±11.0 years differs significantly from that in 100 healthy women at a mean age of 33.3±14.96 years ($\chi^2=12.22$; $p<0.002$) [19].

The mean right-hand a-b ridge counts are 36.79±7.51 in 100 breast cancer patients and 31.40±4.91 in 100 age-matched controls while the mean left-hand a-b ridge counts are 35.18±5.94 and 29.74±5.53, respectively ($p<0.001$) [26]. There is a smaller mean right-hand a-b ridge count (30.83 versus 36.53; $p\leq0.0015$) and left-hand one (32.70 versus 39.16; $p\leq0.0003$) in 30 breast cancer females than in 30 healthy females [7] as well as right-hand and left-hand a-b ridge count ($p\leq0.001$) in other 100 patients aged 30-50 years against other 100 age-matched controls in India [12]. The mean right-hand a-b ridge count (37.08±2.58 versus 33.63±1.97; $p<0.001$) and the mean left-hand one (37.05±2.93 versus 34.45±2.98; $p<0.001$) are greater in 40 breast cancer women than in 40 healthy ones in India [5]. In 150 Indian women divided in three equal groups of 50 women each, there are statistically significant differences concerning the a-b ridge count between breast cancer women and high-breast cancer risk ones, on the one hand, and healthy women, on the other hand ($p<0.05$) [8]. There is a higher mean intensity index of the finger papillary traits in 60 breast cancer females than in 60 age-matched healthy women (12.91 versus 11.33; $t=2.10$; $p<0.03$) (3) as well as of PII Cummins finger index in 30 patients than in 30 age-matched controls (13.73±4.9 versus 11.26±4.45; $p\leq0.0046$) [7].

The examination of the palmar dermatoglyphic traits of three equal groups of 50 women each indicates statistically significant differences in terms of atd angle between breast cancer females and high-breast cancer risk ones, on the one hand, and healthy women, on the other hand ($p<0.05$) [8]. There is a higher incidence of an increased atd angle and b-c ridge count in breast cancer patients in Bosna and Herzegovina [14]. The mean value of right-hand atd angle is significantly smaller ($38.78^0\pm2.08^0$ versus $42.44^0\pm2.18^0$; $p<0.05$) while that of dat angle is greater ($62.90^0\pm2.85^0$ versus $58.20^0\pm2.60^0$; $p<0.05$) in 20 women aged 20-60 years with malignant breast diseases than in 25 healthy women in Nigeria [17]. The significant quantitative palmoscopic differences between 50 breast cancer females and 50 healthy ones aged 25-60 years in India present with significantly greater atd angle values of the left hand ($p<0.05$) and of both hands ($p<0.05$) as well [27]. The mean atd angle values of the left and the right hand is smaller (41.5^0 versus 44.43^0; $p\leq0.021$ and 41.6^0 versus 44.56^0; $p\leq0.036$, respectively) among 30 breast cancer females than among 30 healthy women in India [7].

The mean right-hand atd-angle value (42.65±4.14 versus 37.18±2.58; $p<0.001$) and left-hand one (42.93±3.93 versus 38.15±2.68; $p<0.001$) are significantly greater in 40 breast cancer women than in 40 healthy ones in India [5]. There are statistically reliably smaller left-hand and right-hand atd angle values in 100 females with pathohistologically confirmed breast cancer ($p\leq0.005$) than in 100 healthy females in India [12]. There are reliable differences in terms of the right-hand adt angle (77.75±4.75 versus 79.30±5.43; $p=0.028$) and left-hand one (77.61±3.89 versus 79.41±4.72; $p=0.004$) as well as concerning the dat angle (58.34±4.99 versus 56.14±4.97; $p=0.002$) between 100 breast cancer females and 100 controls in India [26]. The patterns of atd angle demonstrate a significant difference between the left and right palms of breast cancer patients in Bosna and Herzegovina and this palmar parameter identifies women with increased breast cancer risk [13].

The existence of genetic predisposition for breast cancer development is confirmed by the quantitative digital dermatoglyphic analysis in Bosna and Herzegovina [15].

Fluctuating asymmetry

Breast fluctuating asymmetry is higher in healthy women who are free of breast disease but subsequently develop breast cancer than in women who remain disease-free in the same period and both absolute and relative breast volume asymmetries are higher in women who develop cancer than in the control group [23].

The regression analysis of the fluctuating asymmetry in 82 breast cancer women and 60 healthy ones in the region of Varna, Bulgaria, reveals statistically significantly higher correlation coefficient values of the fourth fingers of both hands in breast cancer females than in healthy controls ($p<0.05$) [34]. There are considerably greater fluctuating asymmetry values of a-b II, c-d IV, and a-d palmar ridge counts concerning the fluctuating asymmetry in breast cancer females than in healthy ones. There are higher correlation coefficient values of the fluctuating asymmetry ($1-r^2$) in the ridge count of the homologous thumbs, forefingers and little fingers of both hands.

There is certain evidence that dermatoglyphic fluctuating asymmetry patterns could add some essential diagnostic and prognostic information in breast cancer patients and thus contribute to more effective screening and prevention [29].

There are significant differences between 112 breast cancer women and 112 healthy controls in Han ethnic from Ningxia, China, in terms of the fluctuating asymmetry of the right thumb finger ridge count and atd angle ($p<0.05$), the little finger and atd angle ($p<0.01$) as well as of the little finger and the ridge count of the fourth finger ($p<0.05$) [10]. Fluctuation asymmetry values of both hands derived from quantitative parameters such as finger ridge counts, a-b ridge counts and palmar angles are significantly greater in 100 breast cancer females than in 100 healthy controls for the thumb (by 2.01 times), subtotal ridge count (by 2.10 times) and palmar atd angle (by 2.01 times) in India [16].

Conclusion

These data convincingly prove that qualitative and quantitative dermatoglyphics has been used in different countries as a valuable cost-effective, non-invasive diagnostic and prognostic tool in the socially significant field of breast cancer. The purposeful application of these modern examinations among risk groups could undoubtedly contribute to the further enrichment of the screening and prognostic armamentarium of dermatoglyphics in terms of effective breast cancer prevention and prognosis. The analytical dermatoglyphic approach should be more widely applied in our country.

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