SUPPLEMENT

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Right-sided lateralization of skin temperature in healthy young persons

Abstract

Purpose: Previous studies reported a peripheral immune asymmetry and lateralization of different paired organ cancers. Because of the close relationship of immune system with body temperature, the aim of the study was to test the possible lateralization of skin temperature.

Materials and Methods: Four hundred sixty three healthy subjects (325 women, 138 men) with an average age of 23.62 years (SD = 8.65) participated in this study. All skin temperature measurements were done 8:00-9:00 a.m. Skin temperature was assessed for three different points in skin: axillary, thumb and external auditory.

Results: Skin temperature was statistically significantly higher on the right side of the body than on the left side, when measured by axillary and thumb temperatures. But there was no statistically significant difference in external auditory temperature.

Conclusion: The asymmetry of skin temperature may result from the peripheral immune asymmetry or the asymmetric lymph node distribution.

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The skin, the subcutaneous tissues, and especially the fat of the subcutaneous tissues, act together as a heat insulator for the body. The insulation beneath the skin is an effective means of maintaining normal internal core temperature. Blood vessels are distributed profusely beneath the skin. Especially important is a continuous venous plexus that is supplied by inflow of blood from the skin capillaries. The rate of blood flow into the skin venous plexus can vary from barely above zero to as great as 30% of the total blood volume. A high rate of blood flow to the skin causes heat to be conducted from the core of the body to the skin with great efficiency, whereas reduction in the rate of skin flow can decrease the heat conduction from the core to very low levels [1]. Skin temperature is often assessed in medical care and monitoring, but its asymmetry has not been reported.

Anatomical, biochemical, physiological and pathological asymmetries of the human neuroendocrine and immune systems have been reported [2]. Functional asymmetries of the adrenal glands [3], asymmetries in phenotypic and functional characteristics of cells from lymphoid organs [4] and asymmetrical function of thymus [5], a bilateral immune organ, were shown.

A higher cell-mediated immune hypersensitivity response in the left side of the body has been reported using the tuberculin test in healthy young subjects [6]. This study was supported in mice by using sheep erythrocytes instead of tuberculin test [7]. The latter authors suggested that the higher delayed type hypersensitivity (cell mediated immune hypersensitivity) reaction in the left paw of animals may be dependent on the functional asymmetry of regional lymph nodes [7].

A more frequent appearance of herpes zoster infection in the left body side of women has been reported [8, 9]. Cell mediated immune hypersensitivity was smaller on the involved side than in the noninvolved side of the body in patients with herpes zoster infection [8]. Also, a left-sided lateralization of all immune reactions and diseases was reported in a left-handed female [10].

It has been reported that breast cancer was found to be more frequent on the left side in women [11-14]. Also, the right-sided lateralization of head-neck cancers in right-handed patients and *vice versa* in left-handed ones was reported [15]. In a recent study, the left-right asymmetry in involved and total neck lymph nodes distribution in forty-six patients with bilateral laryngeal cancer. The numbers of both involved and total neck lymph nodes were significantly higher on right side than on left side for all neck levels in laryngeal malignancies [16]. Left-right asymmetry was reported in pelvic lymph node

distribution in patients with gynecologic malignancies and right-side prevalence for the number of lymph nodes [17-19]. In another study, both the total number and the number of axillary lymph nodes involved by metastatic breast cancer cells was higher on right side in patients with breast cancer on the right side [14]. Stronger cell-mediated immune activity in the left side of humans [6, 7] may be associated with the blocking of metastatic invasion of cancer cells from gynecologic malignancies in the left side of the body.

A peripheral immune asymmetry may result in an asymmetry in skin temperature. No published study has specifically addressed the existence of a left-right asymmetry in skin temperature, thus, we aimed to examine left-right asymmetry in skin temperature, an important diagnostic and follow up method in nursing applications.

Methods

Four hundred sixty three healthy subjects (325 women, 138 men, mean age = 23.62, SD = 8.65) participated in this study. Exclusion criteria were health problems such as infectious, neurologic, psychiatric, respiratory, metabolic or autonomic nervous system diseases that might change the skin temperature. Also, the left-handed subjects were not included. There was no difference between men and women in age. The purpose of the study was explained to all students verbally and then a signed consent was obtained from each. All students had volunteered to participate in this study. The Ethical Committee of the Faculty of Medicine of the University of Turgut Ozal approved this study.

All skin temperature measurements were obtained by the same investigator and in morning 08.00-09.00 a.m. Skin temperature was assessed for three different points in skin: axillary, thumb and external auditory.

Measured values were given as means and standard deviations. Statistical analysis was performed using SPSS for Windows version 16.0 (SPSS, Inc., Chicago, IL). All variables were normally distributed. Paired *t* test was used to compare groups. A *p* value < 0.05 was considered significant.

Results

Skin temperature was statistically significantly higher in the right side of the body than on the left side when measured by axillary and thumb temperatures (see Table 1). There was no statistically significant difference in external auditory temperatures.

TABLE 1. Skin temperature (°C) in right and left sides of the body.

Skin Temperature	Right Side (Mean ± SD)	Left Side (Mean ± SD)	t	p
Axillary	35.78 ± 0.89	35.69 ± 0.99	2.62	0.01
Thumb	26.97 ± 4.74	26.77 ± 4.82	2.51	0.01
External Auditory	36.46 ± 1.12	36.44 ± 1.01	0.45	NS

Discussion

These results support the peripheral immune asymmetry hypothesis in terms of cell mediated immunity and lymph node distribution because immune system activity is strictly associated with the heat production.

Bacteria or breakdown products of bacteria are phagocytized by the blood leukocytes, by tissue macrophages, and by large granular killer lymphocytes. These cells digest bacterial products and then release the substance interleukin-1, also called leukocyte

pyrogen or endogenous pyrogen. The asymmetric function of the immune system may result in the lateralization of heat production or skin temperature.

Many types of segmental autonomic reflexes are integrated in the spinal cord; for example, changes in vascular tone resulting from changes in local skin heat and sweating resulting from localized heat on the surface of the body.

The lateralization of different paired organ cancers shown in some previous studies may be associated with the asymmetry of skin temperature in the present study. While the left-sided asymmetry for breast cancer was reported in females [11-13, 20, 21], the right-sided lateralization for the head-neck [15], lung [22], kidney [23] and testis [24] cancers were reported. Moreover, in a large study of a UK cohort, right-sided lateralization was reported for the lung, testis, ovarian and kidney cancers, except breast cancer in which there was a left-side lateralization [25]. In that study, the incidence ratio (left/right) were 0.88 for male lung cancer, 0.86 female lung cancers, 0.87 for testis cancer, 0.99 for ovarian cancer, 0.86 for ovarian germ cell cancer, 0.96 for male kidney cancer and 0.94 for female kidney cancer. The higher cancer risk on right side for the paired organ cancers may be associated with the higher temperatures found in the present study. The higher skin temperature on the right-side in the present study may be either result or cause of the higher risk of cancer in the right side. Also, the higher risk of the right-sided metastatic invasion of different paired organ cancers [14, 16-19] may result from the higher temperature in the right side of the body.

In a recent study, the possible asymmetry in palatine tonsil sizes by handedness was investigated. Right tonsil volume and weight were higher compared to left in right-handed patients with chronic tonsillitis and *vice versa* in left-handed patients [26]. A right-sided prevalence of the external and common iliac lymph nodes in 54% of cases in 152 autopsy examinations of individuals died from causes other than lymphatic organ disorders was found [27]. In addition, it has been performed a modified pelvic lymphadenectomy on 30 cadavers showing that both external iliac and obturator nodes were prevalent on the right side than on the left [28]. Moreover, a left-right asymmetry in nodal distribution with a lateral right prevalence has been reported in a variety of nodal groups [29]. In another study, the left-sided axillary lymph nodes were fewer in number but large in size than the right-sided ones in women with breast cancer [30].

The asymmetry of skin temperature may result from the peripheral immune asymmetry or asymmetric lymph node distribution. Some protocols in testing of skin temperature may be used for the true diagnosis and monitoring such as the assessing from the same side, for example right, for the same patient or all patients.

References

1. Guyton AC, Hall JE. *Textbook of Medical Physiology*. Saunders, Philadelphia 2006.
2. Gerendai I Halász B. Neuroendocrine asymmetry. *Frontiers in Neuroendocrinology* 1997; 18: 354-381.
3. Abramov VV, Karmatskikh OL, Kozlov VA, Os'kina IN. Functional asymmetry of adrenal glands in (CBA x C57BL/6), F1 mice. *Doklady Akademii Nauk* 1996; 347: 831-833.
4. Abramov VV, Konenkov VI, Gontova IA, Karmatskikh OL, Kashaba IV, Kozlov VA. Asymmetry of phenotypical and functional properties of lymphoid organ cells. *Doklady Akademii Nauk* 1992; 322: 802-805.
5. Abramov VV, Gontova IA, Kozlov VA. Functional asymmetry of thymus and the immune response in mice. *Neuroimmunomodulation* 2001; 9: 218-224.
6. Dane S, Erdem T, Gumustekin K. Cell-mediated immune hypersensitivity is stronger in the left side of the body than the right in healthy young subjects. *Perceptual and Motor Skills* 2001; 93: 329-332.
7. Gontova IA, Abramov VV, Kozlov VA. The role of asymmetry of nervous and immune systems in the formation of cellular immunity of (CBaxC57Bl/6), F1 mice. *Neuroimmunomodulation* 2004; 11: 385-391.
8. Erdem T, Dane S, Kadi M. Cell-mediated immune hypersensitivity is stronger on noninvolved side than involved side in patients with herpes zoster. *International Journal of Neuroscience* 2003; 113: 1081-1086.

9. Ertunc V, Dane S, Karakuzu A, Deniz O. Higher herpes zoster infection frequency in right handed patients and more frequent appearance in the left body side of females. *Acta Dermato-Venereologica* 1997; 77: 245.
10. Tan U. Left-sided lateralization of immune disorders in a left-handed female subject. *International Journal of Neuroscience* 1989; 48: 367.
11. Kramer MA, Albrecht S, Miller RA. Handedness and the laterality of breast cancer in women. *Nursing Research* 1985; 34: 333-337.
12. Kramer MA, Albrecht S, Miller RA. Higher frequency of left-breast cancer: a possible explanation. *Perceptual and Motor Skills* 1985; 61: 583-588.
13. McManus IC. Predominance of left-sided breast tumors. *Lancet* 1977; 2(8032): 297-298.
14. Dane S, Yildirim S, Koc M, Aktan M, Gundogdu C. Asymmetries in breast cancer lateralization and both axillary lymph node number and metastatic involvement. *Lymphology* 2008; 1: 75-79.
15. Dane S, Karasen M, Sahin O, Oztop E. Lateralization of squamous cell carcinomas in the head-neck region. *Perceptual and Motor Skills* 2005; 100: 258-262.
16. Yoruk O, Yuksel R, Yuksel Y, Dane S. Left-right asymmetry in neck lymph nodes distribution in patients with bilateral laryngeal cancer. *Surgical and Radiologic Anatomy* 2014; 36: 239-242.
17. Ghezzi F, Cromi A, Uccella S, Giudici S, Franchi M, Bolis P. Left-right asymmetry in pelvic lymph nodes distribution: Is there a right-side prevalence? *European Journal of Obstetrics & Gynecology and Reproductive Biology* 2006; 127: 236-239.
18. Borekci B, Dane S, Gundogdu C, Kadanali S. Asymmetries in pelvic lymph nodes and their metastatic involvement by gynecologic cancer cells. *Journal of Obstetrics and Gynaecology Research* 2007; 33(6): 829-833.
19. Dane S, Borekci B, Kadanali S. Right-sided lateralization of ovarian cancer and right bias asymmetry for involved pelvic lymph nodes by ovarian cancer cells. *Laterality* 2008; 13(5): 393-402.
20. Perkins CL, Hotes J, Kohler BA, Howe HL. Association between breast cancer laterality and tumor location, United States, 1994-1998. *Cancer Causes Control* 2004; 15: 637-645.
21. Weiss HA, Devesa SS, Brinton LA. Laterality of breast cancer in the United States. *Cancer Causes Control* 1996; 7: 539-543.
22. Parkash O. Lung cancer. A statistical study based on autopsy data from 1928 to 1972. *Respiration* 1977; 34: 295-304.
23. Delahunt B, Bethwaite P, Nacey JN. Renal cell carcinoma in New Zealand: A national survival study. *Urology* 1994; 43: 300-309.
24. Stone JM, Cruickshant DG, Sandeman TF, Matthews JP. Laterality, maldescent, trauma and other clinical factors in the epidemiology of testis cancer in Victoria, Australia. *British Journal of Cancer* 1991; 64: 132-138.
25. Roychoudhuri R, Putcha V, Moller H. Cancer and laterality: A study of the five major paired organs (UK). *Cancer Causes Control* 2006; 17: 655-662.
26. Fidan V, Fidan T, Yuksel Y, Yuksel R, Dane S. Morphological asymmetry in tonsilla palatina by handedness in patients with chronic tonsillitis. *Neurology, Psychiatry and Brain Research* 2012; 18: 19-21.
27. Shvetsov EV. Anatomy and topography of external iliac lymph nodes in adults. *Arkh Anat Gistol Embriol* 1991; 100(7-8): 50-57.
28. Weingartner K, Ramaswamy A, Bittinger A, Gerharz EW, Voge D, Riedmiller H. Anatomical basis for pelvic lymphadenectomy in prostate cancer: results of an autopsy study and implications for the clinic. *Journal of Urology* 1996; 156(6): 1969-1971.
29. Sapin MR. Human lymph node asymmetry and its applied importance. *Arkh Anat Gistol Embriol* 1980; 79(11): 58-63.
30. Cappello F, Bellafiore M, Palma A, Marciano V, Zummo G, Farina F, Bucchieri F. Study of axillary lymph node asymmetry in a female population. *Journal of Anatomy* 2001; 199: 617-620.