

Analysis of the autonomic supply of skin sympathetic reactions

I.V. Boitsov

(LLC "Spectral-dynamic systems", Minsk)

The analysis of vegetative provision of skin sympathetic responses

IV Boitsov

Spectral-dynamical systems ltd. (Minsk)

RESUME

The purpose of work was the analysis of vegetative provision of skin sympathetic responses in distal parts of the extremities. 67 healthy people (27 male and 40 female, aged from 14 to 29) were investigated by the method of dynamic segmentary diagnostics. The study identified the particular intensity changes of skin sympathetic responses in distal parts of the extremities of healthy people and factors of recalculation of the parameter of vegetative provision of activities have been offered for skin sympathetic responses in the field of skin segments vegetative provision.

Keywords: skin sympathetic responses, dynamic segmental diagnosis, autonomic nervous system.

SUMMARY

The aim of the study was to analyze the autonomic supply of sympathetic skin reactions in the distal extremities. To achieve this goal, a group of healthy people was examined, a total of 67 people - 27 men and 40 women aged 14 to 29 years. In the course of the study, the features of the change in the intensity of skin sympathetic reactions in the distal parts of the extremities in healthy people were revealed and the coefficients of recalculation of indicators of the vegetative support of the activity of skin sympathetic reactions in the area of skin segments of the vegetative support were proposed.

Key words: skin sympathetic reactions, dynamic segmental diagnostics, autonomic nervous system.

Introduction

It is impossible to imagine any disease without concomitant autonomic dysfunctions. So, for example, in modern pediatric practice, the diagnosis of somatoform autonomic dysfunction, which has the code F45.3 in the ICD-10, is exposed to almost every third child who consults a pediatrician with a non-infectious disease. Among the reasons for this, first of all, is called the restructuring of the body accompanying childhood, where special emphasis is placed on hormonal changes in adolescence. With autonomic dysfunction due to impaired autonomic regulation of the visceral systems of the body, various dyskinesias of the smooth muscle organs of the digestive tract and urinary system develop, as well as dysfunction of the heart and blood vessels. So, according to a number of authors, among schoolchildren who do not present "active" complaints, in 58.3-74, In 6% of cases, signs of an altered vegetative status are found (vegetative lability or vegetative dysfunction) [1]. Practice shows that the lack of effective treatment in childhood leads in the future to the development of such diseases as: gastric ulcer and duodenal ulcer, cholecystitis, cholelithiasis, arterial hyper- and hypotension, urolithiasis, etc. Hormonal changes in the adult body, in particular, the female, apparently, are explained by autonomic seizures, occurring mainly between the ages of 20 to 40 years [2]. In connection with such a wide spread of pathology of the autonomic nervous system, the development of new methods for assessing the autonomic status of an organism remains relevant. Dynamic segmental diagnostics as a method of testing sympathetic skin reactions, has fundamental features of calculating the indicator of the vegetative support of the activity of such reactions when assessing the vegetative balance of the body [3]. For these purposes, dynamic segmental diagnostics is carried out in the area of the so-called skin segments of autonomic support (KSVO). These skin segments are located on the distal extremities, and each such skin area

characterized by pronounced changes in autonomic regulation in the pathology of a specific internal organ or body system [4].

The purpose of this work is to analyze the autonomic supply of skin sympathetic reactions in the distal extremities.

The tasks of the study included: 1) determination of the patterns of distribution of the intensity of skin sympathetic reactions on the distal parts of the extremities in healthy people; 2) development of rules for calculating the indicator of vegetative support for the activity of skin sympathetic reactions during dynamic segmental diagnostics in order to assess the balance of vegetative support of various body systems.

Materials and methods

The work is based on the analysis of the results of dynamic segmental diagnostics of 67 people (40 women and 27 men) aged 14 to 29 years, who do not present complaints, clinically healthy, with normal indicators of general and biochemical blood tests, urinalysis, normal ECG, passed manual testing of the spine and those who do not have problems with the spinal motion segments.

Testing of skin sympathetic reactions was carried out by the method of dynamic segmental diagnostics developed by us (Permission for the use of new medical technology No. FS 2011/336. - Federal Service for Surveillance in Healthcare and Social Development of the Russian Federation). Each person was examined at least three times with an interval of 1-3 days. Testing was carried out on the device: "POST-12.2" (Registration certificate of the Ministry of Health and Social Development of the Russian Federation No. 29/23030700 / 2834-02).

During dynamic segmental diagnostics, the skin sympathetic reaction (CSR) occurs as a reflex response to low-intensity electrical stimulation of skin receptors with a constant electric current of 6–21 V and a current of 150–250 μ A [5]. Exposure to the skin of the testing current of the given parameters reflexively changes its sympathetic provision at the site of application of the active electrode. In this case, the skin sympathetic reaction goes through three stages: 1) the stage of increasing the vegetative supply of the skin; 2) the stage of stabilization of the vegetative supply of the skin or the stage of "plateau"; 3) the stage of inhibition of the vegetative supply of the skin.

Based on the test results, the following indicators are mainly evaluated:

1) "vegetative support of activity" (VOD) KSR - an indicator of the current strength at the "stage plateau", characterizing the vegetative supply of the skin-sympathetic reaction and reflecting the degree of vegetative supply of the tested skin area;

2) the vegetative reactivity of the first phase of the KCP - the ratio of the maximum current strength to the time of the onset of the "plateau stage", reflects the amplitude-temporal (dynamic) characteristic of the skin sympathetic reaction;

3) the duration of the second phase of the CSR ("plateau stage"). On the intensity of skin sympathetic reactions are judged by the VOD indicator, for the assessment of which testing is sufficient to carry out before the onset of the "plateau stage".

The active electrode was installed in the region of the distal extremities on the skin segments of the vegetative support. The following 6 segments are located on the hands: palmar-medial (RLMS), palmar-median (RLS), palmar-lateral (RLS), dorsal-medial (RTMS), dorsal-median (RTSS), dorsal-lateral (RTLS). On the lower extremities, there are 6 leg CSVOs: dorsal-medial (NTMS), dorsal-median (NTSS), dorsal-lateral (NTLS), medial (NMS), lateral (NLS), posterior (NZS) segments.

Research results

To assess the balance of autonomic regulation of the visceral systems of the body, first of all, the indicator of the initial autonomic tone is calculated. This indicator is a reflection of the general activity of the higher vegetative centers, which determine the intensity of segmental vegetative reactions. The indicator of the initial autonomic tone is the arithmetic mean of the indices of the autonomic support of the activity of skin-sympathetic reactions, calculated on the basis of testing all skin segments of the vegetative supply.

The balance of segmental skin sympathetic reactions, studied at different CSWS, is determined by comparing the indices of autonomic support of CSW activity. Normally, the VOD indicators of all reactions should be within their physiological corridors,

calculated taking into account the indicator of the initial vegetative tone (IWT). With an increase in the activity of higher vegetative centers and a parallel increase in the index of the initial vegetative tone, the limits of such corridors expand due to an increase in the spread of the absolute values of indicators reflecting the intensity of vegetative reactions.

Examination of a group of completely healthy people revealed the following regularities in the distribution of the intensity of skin sympathetic reactions on the skin of the distal extremities in the area of the skin segments of the autonomic supply (Tables 1, 2): firstly, during DSD testing, mainly significantly different ($p < 0,05$) in terms of intensity, skin sympathetic reactions in the area of different segments; secondly, for all the difference in the intensity of sympathetic skin reactions in healthy people on the distal extremities, the intensity on the same segments was at the same level; thirdly, the highest indices of autonomic support of the CSR activity were recorded on the dorsum of the hand on the skin area bounded by fingers II-IV and on the skin projections of the extensor tendons of the little finger and long muscle, the abductor thumb of the hand, which corresponds to the manual dorsal-medial and dorsal-lateral segments; fourthly, the smallest indicator of autonomic support for CSR activity was recorded on the dorsum of the foot on the skin area located from the first interdigital space in the direction of the anterior edge of the medial malleolus, and on the skin area located from the fourth interdigital space in the direction of the anterior edge of the lateral ankle, which corresponds to leg dorsal-medial and dorsal-lateral segments; fifth, the indicator of the initial autonomic tone was recorded in the range from 50 to 125 μA (mainly in 46 people, this indicator was in the range from 77 to 87 μA , 10 people had an IWT in the range of 50–76 μA , and 11 people - within 88–125 μA), which corresponds to the hand dorsal-medial and dorsal-lateral segments; fourthly, the smallest indicator of autonomic support for CSR activity was recorded on the dorsum of the foot on the skin area located from the first interdigital space in the direction of the anterior edge of the medial malleolus, and on the skin area located from the fourth interdigital space in the direction of the anterior edge of the lateral ankle, which corresponds to leg dorsal-medial and dorsal-lateral segments; fifth, the indicator of the initial autonomic tone was recorded in the range from 50 to 125 μA (mainly in 46 people, this indicator was in the range from 77 to 87 μA , 10 people had an IWT in the range of 50–76 μA , and 11 people - within 88–125 μA), which corresponds to the hand dorsal-medial and dorsal-lateral segments; fourthly, the smallest indicator of autonomic support for CSR activity was recorded on the dorsum of the foot on the skin area located from the first interdigital space in the direction of the anterior edge of the medial malleolus, and on the skin area located from the fourth interdigital space in the direction of the anterior edge of the lateral ankle, which corresponds to leg dorsal-medial and dorsal-lateral segments; fifth, the indicator of the initial autonomic tone was recorded in the range from 50 to 125 μA (mainly in 46 people, this indicator was in the range from 77 to 87 μA , 10 people had an IWT in the range of 50–76 μA , and 11 people - within 88–125 μA), the smallest indicator of autonomic support of the CSR activity was recorded on the dorsum of the foot on the skin area located from the first interdigital space in the direction of the anterior edge of the medial malleolus, and on the skin area located from the fourth interdigital space in the direction of the anterior edge of the lateral ankle, which corresponds to the leg dorsal-medial and dorsal-lateral segments; fifth, the indicator of the initial autonomic tone was recorded in the range from 50 to 125 μA (mainly in 46 people, this indicator was in the range from 77 to 87 μA , 10 people had an IWT in the range of 50–76 μA , and 11 people - within 88–125 μA), located from the first interdigital space in the direction of the anterior edge of the medial malleolus, and on the skin area located from the fourth interdigital space in the direction of the anterior edge of the lateral ankle, which corresponds to the leg dorsal-medial and dorsal-lateral segments; fifth, the indicator of the initial autonomic tone was recorded in the range from 50 to 125 μA (mainly in 46 people, this indicator was in the range from 77 to 87 μA , 10 people had an IWT in the range of 50–76 μA , and 11 people - within 88–125 μA).

Table 1

Indicators of vegetative support of activity on the tame skin segments of the vegetative provision in healthy people *

ИВТ	Показатели ВОД на ручных КСВО					
	Р.ИМС	Р.ЛСС	Р.ЛЛС	Р.ТМС	Р.ТСС	Р.ТЛС
7,9 ± 10,87 (n = 10)	56,8 ± 6,56	72,3 ± 7,62	78,7 ± 7,572	70,5 ± 7,06	82,2 ± 9,272	82,8 ± 9,162
2,07 ± 3,43 (n = 46)	73,07 ± 3,621	88,00 ± 3,261	95,57 ± 4,181	89,50 ± 4,151	102,1 ± 4,151	101,39 ± 3,311
9,1 ± 13,95 (n = 11)	101,9 ± 8,63	121,7 ± 12,522	125,3 ± 12,12	118,9 ± 12,12	141,3 ± 11,42	134,6 ± 12,992

* Data is presented as $M \pm s$, where M is the arithmetic mean; s - standard deviation; n is the number of patients in subgroups.

Approx. 1 Significance of differences in comparison with the IWT indicator by Student's t-test, $p < 0.05$;

Approx. 2 Significant differences in comparison with the IWT indicator according to the Mann-Whitney test, $p < 0.05$. Abbreviations: VOD, vegetative support of activity; KSVO - skin segments of the vegetative provision; IWT - initial vegetative tone; RLMS - manual palmar-medial segment; RLSS - manual palmar-medial segment; Radar - manual palmar-lateral segment; RTMS - manual dorsal-medial segment; PTCC - manual dorsal-medial segment; RTLS - manual dorsal-lateral segment.

table 2

Indicators of vegetative support of activity on the leg cutaneous segments vegetative support in healthy people *

Показатель ИВТ	Показатели ВОД на ножных КСВО					
	НТМС	НТСС	НТЛС	НМС	НЛС	НЗС
67,9 ± 10,87 (n = 10)	54,0 ± 5,4	54,6 ± 7,2	52,5 ± 6,26	68,1 ± 7,75	63,5 ± 8,26	66,9 ± 7,81
82,07 ± 3,43 (n = 46)	65,28 ± 2,461	69,52 ± 1,811	66,02 ± 2,471	82,76 ± 3,16	76,65 ± 2,961	81,11 ± 3,45
99,1 ± 13,95 (n = 11)	88,1 ± 8,092	89,4 ± 9,23	85,8 ± 7,632	109,4 ± 10,72	98,2 ± 9,42	105,9 ± 10,25

* Data are presented as $M \pm s$, where M is the arithmetic mean; s - standard deviation; n is the number of patients in subgroups.

Approx. 1 Significance of differences in comparison with the IWT indicator by Student's t-test, $p < 0.05$; Approx. 2 Significant differences in comparison with the IWT indicator according to the Mann-Whitney test, $p < 0.05$.

Abbreviations: VOD, vegetative support of activity; KSVO - skin segments of the vegetative

provision; IWT - initial vegetative tone; RLMS - manual palmar-medial segment; RLSS - manual palmar-medial segment; Radar - manual palmar-lateral segment; RTMS - manual dorsal-medial segment; PTCC - manual dorsal-medial segment; RTLS - manual dorsal-lateral segment.

In connection with the above, due to the difference in the indices of autonomic support for the activity of skin sympathetic reactions on various skin segments of autonomic support in completely healthy people, it seems necessary in the process of interpretation, in order to assess the balance of segmental skin sympathetic reactions when calculating these indicators, use correction factors.

According to the results of the study, it is proposed to use the recalculation coefficients obtained empirically and presented in table for the indicators of the vegetative support of the activity of the CSW on the skin segments of the vegetative supply. 3. The coefficients of recalculation for each KSVO decrease as the intensity of the sympathetic skin response increases. In the leftmost column of the table. 3 (VOD) shows the intervals of changes in the indicator of the vegetative support of the activity of the CCP, recorded by the device. When the VOD indicator obtained during testing falls into a certain interval, it is necessary to multiply such an indicator by the correction factor specified for this interval and the skin segment. The recalculation result is used to further assess the vegetative balance in the body.

Thus, for the final decision on the balance of the indices of autonomic support of the activity of skin sympathetic reactions during dynamic segmental diagnostics, it is necessary to take into account the VOD indices, recalculated taking into account the correction factors presented in Table. 3.

Table 3

Coefficients for recalculation of the VOD indicator for the CWS

ВОД	РЛМС	РЛСС	РЛЛС	РТМС	РТСС	РТЛС	НТМС	НТСС	НТЛС	НМС	НЛС	НЗС	НБТ
10-25	1,20	1,05	0,96	0,93	0,93	1,05	1,33	1,25	1,33	1,10	1,18	1,10	1,10
26-40	1,08	0,95	0,89	0,84	0,84	0,95	1,21	1,13	1,21	1,00	1,07	1,00	1,00
41-60	0,99	0,87	0,80	0,77	0,77	0,87	1,09	1,01	1,09	0,91	0,97	0,91	0,91
61-80	0,90	0,80	0,75	0,70	0,70	0,80	0,99	0,92	0,99	0,84	0,89	0,84	0,84
81-100	0,84	0,74	0,70	0,67	0,67	0,74	0,91	0,84	0,91	0,78	0,82	0,78	0,78
101-120	0,78	0,69	0,66	0,63	0,63	0,69	0,84	0,78	0,84	0,73	0,76	0,73	0,73
121-140	0,73	0,65	0,62	0,60	0,60	0,65	0,78	0,74	0,78	0,68	0,72	0,68	0,68
141-150	0,70	0,63	0,60	0,58	0,58	0,63	0,75	0,71	0,75	0,66	0,68	0,66	0,66
151-170	0,66	0,60	0,57	0,55	0,55	0,60	0,71	0,68	0,71	0,63	0,66	0,63	0,63

Abbreviations: VOD, vegetative support of activity; KSVO - skin segments of the vegetative provision; IWT - initial vegetative tone; RLMS - manual palmar-medial segment; RLSS - manual palmar-medial segment; Radar - manual palmar-lateral segment; RTMS - manual dorsal-medial segment; PTCC - manual dorsal-medial segment; RTLS - manual dorsal-lateral segment.

conclusions

1. The intensity of sympathetic skin reactions in healthy people in the distal regions limbs in the area of skin segments of the autonomic supply is different.
2. The maximum intensity of sympathetic skin reactions in these persons is recorded in the area the following manual cutaneous segments of the autonomic supply: dorsal-medial and dorsal-medial.
3. The minimum intensity of sympathetic skin reactions in healthy people is recorded in areas of the following leg cutaneous segments of autonomic support: dorsal-medial and dorsal-lateral.
4. When analyzing the balance of segmental skin sympathetic reactions to distal sections of the extremities, it is necessary to use correction factors for the indicators of autonomic support of the activity of the CSW.
5. In this work, based on more than 20 years of experience in research on balance segmental skin sympathetic reactions, it is proposed to calculate the indicators of their autonomic

to ensure the activity to use correction factors. These coefficients, in our opinion, allow obtaining a more accurate picture of the state of the vegetative status of the organism.

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Author's address

Ph.D. Boytsov I.V.
LLC "Spectral-dynamic systems" (Belarus, Minsk)
avicenna_h1@mail.ru

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