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## **DIAGNOSTICS AND TREATMENT OF AUTONOMIC NEUROPATHY OF THE VERTEBRAL COMPONENT OF SPINAL NERVES IN PATIENTS WITH DORSOPATHIES**

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**SUMMARY.** The medical rehabilitation carried out for 390 patients with dorsopathies. All patients on the nature of the autonomic manifestations of neuropathy at the level of spinal motion segments of the spine were divided into two groups: 1) 209 patients with increased sympathetic influence in the spine region; 2) 181 patients with low sympathetic provision of tissue in spine region. Patients of observation subgroups received an optimized interference (IFC) electrotherapy based on activity of skin sympathetic reactions in spine nerves skin areas. The results of medical rehabilitation were evaluated and effectiveness of rehabilitation was significantly higher in patients of observation subgroups that proves the need to use assessment methods of segmental sympathetic activity at the level of the spinal motion segments and optimize therapy based on the results of this assessment for improving adaptive-trophic regulation of all structural elements of the spinal column from the sympathetic nervous system.

**Key words:** dorsopathies; autonomic neuropathy; interference electrotherapy; dynamical segmental diagnostics.

### **Introduction**

An autonomic provision significantly affects any pathological process. The autonomic dysregulation of any organ or any structure of the body always causes pathological changes. This is also the cause of their progression [9]. The main manifestations of autonomic neuropathy are disorders of the processes of excitation of the autonomic neurons and the conduction of excitation along autonomic fibres. Therefore, the autonomic neuropathy of the vertebral component of the spinal nerves (SN), in fact, is the main cause of microcirculation disorders in the tissues of the spinal motion segment (SMS) - with spasms or dilatation of arterioles, which leads to the development of tissue hypoxia, metabolic disorders and, ultimately, dystrophic changes in structural elements of the spinal column, muscle and fibrous tissues [1]. In addition, the development of an atonic-congestive or spastic-congestive type of microcirculation disorders in the spinal motion segment is one of the main reasons for the low supply of drugs to the spinal tissues during drug therapy [7].

It should also be noted that the sympathetic dysregulation in the spinal column with impaired adaptive-trophic function of the sympathetic nervous system [10,11] in SMS tissues contributes to either maintaining musculo-tonic disorders at a particular segmental or regional level of the spine in cases of increased sympathetic influence due to increased diffusion of catecholamines from granular depots of presynaptic nerve endings of the sympathetic nervous system to myocytes, or, while reducing sympathetic, in general, low catecholamine

intake to myocytes leads to a weakening of the paravertebral tone of the striated muscle and a decrease in the ability of the latter to hold the spine when it is verticalized [5].

An assessment of the state of the autonomic nervous system and its segmental sympathetic link at the level of the vertebral motor segments is of crucial importance in the treatment of dorsopathies and is one of the priorities in the general spectrum of instrumental methods of research in this category of patients.

In this regard, **the goal of our study** was to optimize the effect of electro-physiotherapy in patients with dorsopathies, based on the segmental mechanisms of autonomic regulation.

### **Materials and methods.**

The study involved 390 patients with dorsopathies (152 men and 238 women) who underwent a comprehensive examination and medical rehabilitation in the neurological wards of city hospitals No. 3 and No. 7 in Dzerzhinsk (Nizhniy Novgorod Region, Russian Federation). The average age of patients was  $51.2 \pm 11.9$  years, and the duration of the disease was  $10.0 \pm 7.1$  years. Clinical diagnoses in the examined patients were mainly represented by vertebral reflex syndromes: at the cervical level - cervicobrachialgia (78 people), cervicalgia (19 people), cervicocranialgia (19 people); at the thoracic level - with thorakalgia (104 patients) and dorsalgia (26 people); at the lumbar level - lumboischalgia (68 people) and lumbalgia (3 people). Root-compression syndromes were diagnosed in the lumbar spine in 59 people with discogenic radiculopathy of the L4, L5, S1 roots, and at the cervical level in 14 people with discogenic radiculopathy of the C5, C6, C7 roots.

The study was conducted as an open comparative randomized controlled study. The criteria for the inclusion of patients in the study was the presence of verified neurological complications (reflex or radicular syndromes) of degenerative-dystrophic changes of the spinal column at the cervical, thoracic or lumbar level, confirmed by neuroimaging (CT scan, MRI, spondylography), with a disease duration of at least 2 years.

Exclusion criteria for patients from the study: under the age of 18 or over the age of 75, history of the spinal surgery, signs of damage of the brachycephalic zone vessels, marked congenital posture disorders, presence of clinically pronounced signs of lesions of the brain and spinal cord, signs of exacerbation of chronic somatic diseases and chronic intoxications, neoplasms of the spinal column or radiculoischemia.

The main methods for examining patients were as follows:

- 1) Assessment of their neurological status;
- 2) Manual diagnosis with a palpatory assessment of the function of the spinal motion segment;
- 3) Assessment of the overall dynamics of vertebral neurological symptoms on a five-point scale [3];
- 4) Assessment of the severity of musculo-tonic reactions in vertebral pathology by the muscle syndrome index (MSI) [12];
- 5) Assessment of the subjective component of the severity of pain using the Visual Analogue Scale (VAS) [3];
- 6) Assessment of the degree of quality of life impairment in patients with cervical dorsopathy based on the index of impairment of vital activity for neck pain [2,14], and for

patients with dorsopathy of the thoracic and lumbar levels - based on the Oswestry questionnaire [3,13].

The severity and nature of the manifestations of autonomic neuropathy at the level of the spinal motor segments was assessed by the results of the dynamic segmental diagnosis method (DSD testing) developed at the preliminary stage of our study (Permission to use new medical technology No. FS 2011/336. – Federal health and social development control agency of the Russian Federation) [6]. Testing and interference (IFC) therapy was carried out on the RADIUS apparatus (Reg. Certified by the Ministry of Health of the Russian Federation No. FSH 2012/12537)). The active electrode was sequentially installed paravertebrally on the skin in the projections of the posterior branches of the spinal nerves: in the cervical region from C3 to C8; in the chest - from Th1 to Th12; in the lumbosacral - from L1 to L5 and S1 [4,8]. We recorded the intensity of skin sympathetic reactions (an indicator of the autonomic(vegetative) support of activity — VSA SSR) on the skin in the projection of each CSN. The autonomic provision of spinal tissues at the regional level was assessed on the basis of regional indicators of VSA SSR (average value of all VSA SSR indicators in the particular region).

Statistical processing of the obtained digital data was performed using a personal computer, using the “Statistica 6.1” software package. If the statistical characteristics of the sample distributions (sample size, asymmetry and kurtosis coefficients) are such that they allow the use of parametric statistics methods, the *Student's t-test* was used. Otherwise, non-parametric criteria were used: for independent data - Wald–Wolfowitz runs test, and for dependent data - McNemar's test. Differences were considered statistically significant at  $p \leq 0.05$ . The correlation dependence was determined by the Spearman's rank correlation coefficient. The correlation was considered to be established with a coefficient equal to 0.51 and higher with  $p \leq 0.05$ .

We noted the exacerbation stage in 347 patients (89.0%) and 43 patients (11.0%) were in the stage of incomplete remission. The recurrent nature of the disease was in 326 patients (83.6%), chronically recurrent in 37 (9.5%), chronic in 27 patients (6.9%). The progression type of the course of the disease prevailed (227 people - 58.2%), a stable type was detected in 61 patients (15.6%), a progressive regression type in 67 (17.2%), the regredient type in 35 patients (9, 0%). We observed the progression of clinical manifestations in 284 cases (72.8%), 106 patients (27.2%) had a stationary stage of exacerbation. The severity of clinical manifestations: the ratio of moderately pronounced, pronounced and severely pronounced manifestations was respectively 1: 6.9: 6.6.

The pain in the particular area of the spine was the main complaint in the patients examined. Basically, the pain syndrome was moderately pronounced in 223 people (57.2%), pronounced pain syndrome in 162 people (41.5%) and severely pronounced in 5 people (1.3%). According to the assessment of the pain level according to the four-part 10-point VAS of pain, the pain level during the inspection was on average  $6.1 \pm 1.1$  points, the average pain level was  $6.0 \pm 1.0$  points, the pain level in the remission periods of the disease was  $4.9 \pm 0.9$  points, the level of pain in the exacerbation periods of the disease -  $6.9 \pm 1.2$  points.

Among the sensitivity disorders, 14.4% of patients noted the presence of paresthesias (tingling, burning, numbness) of varying severity in the upper or lower extremities.

The study of the neurological status revealed motor disorders in all patients, accompanied by smoothing of physiological cervical lordosis (92.3% of patients with dorsopathies at the cervical level), physiological thoracic kyphosis (42.3% of patients with dorsopathies at the chest level), physiological lumbar lordosis (60.8% of patients with dorsopathies at the lumbar level). In all patients, there were restrictions of varying degrees of severity of active and passive movements in the corresponding spinal region, and violations of general and regional statics were determined.

When evaluating the vertebral neurological symptoms on a five-point scale, a moderate severity of neurological symptoms was mainly detected (72.7% of patients), a mild degree was detected in 13.8% of patients and in 13.5% it was severe.

Spasms of varying severity of paravertebral muscles of the region concerned was noted. Assessment of muscle dysfunction by the "muscle syndrome index" showed the absence of mild muscle syndrome in the examined patients, the moderate degree was determined in 65.1% and severe - in 34.9% of patients.

It should be noted from the study, results where there is a positive correlation between the severity of pain syndrome (VAS) and muscular syndrome (MIS) at the level of the spinal segment concerned (Spearman's rank correlation coefficient:  $r = 0.58$ ,  $p < 0.05$ ).

A study of tendon and periosteal reflexes revealed a decrease in the latter only in 23.3% of patients with radicular syndromes. Increased reflexes were observed in 19 patients (4.9%) with severe pain syndrome. Varying degrees of reduction in superficial temperature, vibration and pain sensitivity in the segmental zones of the affected nerve roots were noted in patients with radicular syndromes (97 patients - 24.9%).

All patients were examined by one of the methods of neuroimaging, which revealed degenerative-dystrophic changes of varying severity in the affected spinal segment. The severity of degenerative-dystrophic manifestations in the affected spinal segment, defined in points, was as follows: 28.2% of patients had 1 point, 34.6% - 2 points, 14.1% - 3 points and 23.1% - 4 points.

A study of the degree of impairment in the activities as self-care, recreation, household and professional duty in patients with dorsopathies revealed that the relevant indicators characterizing the patient's quality of life varied from 45.0 to 94.3% (mean value  $61.1 \pm 9.8\%$ ).

A distinctive feature of this study was the assessment of the level of the sympathetic support in the spinal tissues at the level of specific vertebral motor segments. As shown by the results of such assessment, all the examined patients had impaired autonomic regulation at the level of the SMS in the affected spinal sections. Such disorders in 209 patients were characterized by an increase in sympathetic influence with an increase in the corresponding regional indicator of VSA SSR in the particular spinal column above the limit of physiological values, and in 181 patients - a decrease in sympathetic support of the tissues of the particular spinal section with a decrease in the corresponding regional indicator of VSA SSR disease below the physiological values limit. At the same time, in the first group, almost all patients had regional musculo-tonic manifestations alongside intervertebral disc protrusions and functional blockades, while the second group consisted mainly of patients with pronounced

degenerative-dystrophic changes in the affected spine region and patients with neurodystrophic manifestations.

The results of the study showed the presence of a correlation between the intensity of skin sympathetic reactions in the concerned spinal region (regional indicator of VSA SSR) and a number of indicators characterizing the clinical picture in patients with dorsopathies. So, the higher the index of muscle syndrome, the greater the value of the regional indicator of VSA SSR ( $r = 0.66$ ,  $p < 0.05$ ). The same pattern is observed when patients evaluate the severity of pain syndrome on the VAS scale ( $r = 0.51$ ,  $p < 0.05$ ). In addition, the following pattern is observed in the group of patients with decreased sympathetic support of the tissues of the affected spine, the more pronounced the vertebral neurological symptoms, assessed on a five-point scale, the lower the VSA SSR index (negative correlation with  $r = -0.63$ ;  $p < 0, 05$ ).

In fact, patients with increased sympathetic influence in the concerned spinal area and patients with reduced sympathetic support are two different categories of patients, differing in almost all the studied parameters and, above all, regional indicators of VSA SSR (reliability of differences in *Student's t-test*  $p < 0.000001$ ,  $t\text{-fact} = 26.3$ ). As noted above, in the first group compared to the second, we found more pronounced musculo-tonic manifestations (reliability of differences in IMS indices by the Wald-Wolfowitz series criterion  $p < 0.0001$ ,  $z\text{-fact} = 7.49$ ) with more pronounced impairments in the quality of life ( $p < 0.0001$ ,  $z\text{-fact} = 8.82$ ) and with a more intense pain syndrome ( $p < 0.0001$ ,  $z\text{-fact} = 6.98$ ). In addition, a group of patients with decreased sympathetic support is characterized by more pronounced vertebral neurological symptoms on a five-point assessment scale ( $p = 0.037$ ,  $z\text{-fact} = 2.09$ ) and more pronounced degenerative-dystrophic spinal injuries ( $p = 0.028$ ,  $z\text{-fact} = 2.19$ ).

Thus, based on the results of dynamic segmental diagnostics, patients with dorsopathies were divided into two groups according to the nature of the sympathetic support of the concerned spinal area: the first 209 patients with increased sympathetic influence at the level of the the concerned spinal column (code 1) and the second, 181 patients with decrease in sympathetic support of the tissues of the concerned spinal area (code "2"). Subsequently, in each of these groups, based on a complex of therapeutic measures used for medical rehabilitation, patients was divided randomly into three subgroups (6 in total): the 1-M comparison subgroups (69 patients) and 2 -M "(61 patients), consisting of patients who received basic medication monotherapy in the process of medical rehabilitation; comparison subgroups "1-SMC" (69 patients) and "2-SMC" (60 patients), consisting of patients who received standard medication therapy with amplipulse therapy (sinusoidal modulated currents - SMC) according to the standard method in the process of medical rehabilitation; the subgroups of observation "1-IFT" (71 patients) and "2-IFT" (60 patients), consisting of patients who received standard medication therapy with the course of interference therapy (IFT) during the process of medical rehabilitation, the parameters of which were determined according to the criteria developed by us based on of the intensity of skin sympathetic reactions in the paravertebral projections of the SMS.

The effectiveness of medical rehabilitation was compared separately between the three subgroups of the first group and between the three subgroups of the second group. Baseline values of clinical neurological and neurophysiological indicators were comparable for each of the three subgroups of the respective groups of patients (Table 1).

When assessing the effectiveness of rehabilitation measures, the initial values of the indicators characterizing the patient's condition before the start of the rehabilitation course were compared with those after the rehabilitation. In addition, in order to assess the dynamics of the studied indicators, the dynamics coefficient was calculated using the formula:  $KD = (C1 - C2) \times 100\% / C1$ , where KD is the dynamics coefficient (in%); C1 - the value of the studied index before treatment; C2 is the same indicator after the course of therapy. The dynamic factor shows how much the percentage has changed in comparison with the initial level after the treatment.

In order to create optimal treatment and medical rehabilitation programs for patients with dorsopathies, criteria were developed for assessing the intensity of segmental skin sympathetic reactions for diagnosing the vegetotrophic tissue supply at the level of specific vertebral motor segments. We have identified these criteria as follows: first, the level of pathology (cervical, thoracic, lumbar spine); secondly, the severity of pathology (regional, polysegmental or segmental); and, thirdly, the nature of the sympathetic support — an increase in the sympathetic influence on the tissues or a decrease in the sympathetic support of the structural elements of the spine. Based on the criteria developed, the parameters of interference therapy for patients of the observation subgroups were as follows: frequency range — 1-10Hz with a decrease in sympathetic support and 90-100Hz with an increase in sympathetic influence; current strength - 20mA for a segmental technique at the cervical level, 25mA for a regional technique at the cervical level, 30mA for a segmental method at the thoracic level, 35mA for regional and polysegmental methods at the thoracic level and for a segmental method at the lumbar level, 40mA for regional methods at the lumbar level; exposure time - with a decrease in sympathetic support of 5 minutes, with an increase in the sympathetic effect of 8-10 minutes for a segmental technique at the cervical level, or 9-10 minutes for a segmental and polysegmental technique at the chest level and a regional technique at the cervical level, or 10 minutes for a segmental techniques at the lumbar level and for regional methods at the thoracic and lumbar levels; the number of procedures per course of treatment — with an increase in the sympathetic effect of 10 procedures, with a decrease in the sympathetic provision of 5-10 procedures for the segmental technique at the cervical level, or 6-10 procedures for the segmental method at the thoracic level, or 7-10 procedures for the segmental method at the lumbar level, for regional techniques at the cervical level and for polysegmental techniques at the thoracic level, or 8-10 procedures for the regional methodology at the thoracic level, or 9-10 procedures for regional methods at the lumbar level; dimensions of medical electrodes -  $2 \times 2$ cm for a segmental technique at the cervical level,  $2 \times 3$ cm and  $2 \times 4$ cm for a regional technique at the cervical level and for a segmental method at the chest level,  $5 \times 5$ cm for regional and polysegmental methods at the chest level and for segmental techniques at the lumbar level,  $5 \times 10$ cm for regional techniques at the lumbar level.

Dynamic segmental diagnostics in paravertebral skin projections were performed to patients of comparison and observation subgroups before and after the course of appropriate therapy. In addition, in the observation subgroups, after 5 electrotreatment procedures, control DSD-tests were performed to correct the parameters of the IFT according to the developed criteria for estimating the intensity of the SSR.

### **The results of the study and discussion.**

The intensity of sympathetic skin reactions in individual paravertebral skin zones appeared to be rise against the background of pathology, accompanied by irritation of the nerve receptors in the wall of the fibrous ring of the intervertebral disk, in the capsules of the facet joints, in the periosteum of the vertebrae, in the walls of arterioles and veins, in tense, spasmodic ligaments SMS and muscles with increased tone.

The intensity of skin sympathetic reactions in individual paravertebral skin zones decreases during DSD testing against the background of the pathology of oppression or partial degeneration of the neural structures of this segment.

According to the results of dynamic segmental diagnostics in subgroups “1-M” and “2-M”, normalization of regional indicators of autonomic support of skin-sympathetic reactions were either practically not observed, or the dynamics towards the normalization of the autonomic support of tissues of the concerned spinal area was insignificant (Table 1).

In the “1-SMC” and “2-SMC” subgroups, the normalization of the autonomic maintenance of SMS tissues was not unambiguous. In patients with autonomic neuropathy, manifested by increased sympathetic effects in the tissues of the SMS (subgroup "1-SMC"), there was some improvement in the autonomic support of the particular vertebral motor segments (Table 1). At the same time, the values of regional indicators of VSA SSR, although in most cases did not reach physiological, but on average they became less than the initial ones. However, when comparing the dynamic coefficients for the subgroups “1-SMC” and “1-M”, they did not reveal statistically significant differences in contrast to the assessment of the effectiveness of the rehabilitation of patients in similar subgroups with initially low sympathetic tissue supply of the particular SMS (Table 2). So, after the rehabilitation course, it became slightly less, as evidenced by a slight decrease in the values of the regional indicators of the VSA SSR (Table 1). At the same time, the dynamics coefficients were negative in half of the patients in the “2-SMC” subgroup, which was interpreted by us as “deterioration of the sympathetic support of the tissues of the concerned spinal area”. Comparison of the dynamic coefficients for the subgroups "2-SMC" and "2-M" revealed the reliability of their differences according to the *Student's t-test* at the level of  $p = 0.001$ ,  $t\text{-fact} = 3.3$ . Apparently, the effect of amplipulse therapy on local sympathetic nervous activity leads to depression of the latter.

**Table 1**

**Dynamics of the clinical indicators in patients with dorsopathies after medical rehabilitation**

Subgroups		The indicators characterizing the clinical picture of patients <sup>1,2</sup>				
		VSA SSR	IMS	SNVS	VAS	QLP
Group 1 (n=209)	1-M, n=69	<u>151.6±10.2</u> 146.0±12.5 <sup>3</sup>	<u>11.5±2.0</u> 5.3±1.8 <sup>5,7</sup>	<u>6.6±1.6</u> 4.2±1.4 <sup>5</sup>	<u>6.7±0.9</u> 3.1±1.3 <sup>5,7</sup>	<u>61.9±10.3</u> 26.4±8.2 <sup>5,7</sup>
	1-SMC, n=69	<u>151.3±9.4</u> 142.0±13.5 <sup>3</sup>	<u>11.6±2.1</u> 4.3±1.9 <sup>5,8</sup>	<u>6.8±1.4</u> 3.6±1.4 <sup>5</sup>	<u>6.7±0.8</u> 2.2±1.2 <sup>5,8</sup>	<u>60.9±10.4</u> 20.1±7.2 <sup>5,8</sup>
	1-IFT, n=71	<u>152.6±10.4</u> 121.9±17.0 <sup>3,4</sup>	<u>11.8±1.9</u> 2.1±1.9 <sup>5</sup>	<u>6.9±1.6</u> 2.3±1.1 <sup>5,6</sup>	<u>6.7±0.9</u> 0.7±0.8 <sup>5</sup>	<u>63.4±10.3</u> 10.9±8.5 <sup>5</sup>
Group 2 (n=181)	2-M, n=61	<u>68.7±14.0</u> 78.5±17.7 <sup>3</sup>	<u>9.2±1.3</u> 4.7±0.9 <sup>5</sup>	<u>8.0±1.7</u> 4.7±1.0 <sup>5</sup>	<u>5.4±0.9</u> 2.3±0.7 <sup>5</sup>	<u>59.1±8.4</u> 24.3±5.6 <sup>5</sup>
	2-SMC, n=60	<u>69.2±12.6</u> 68.2±16.8	<u>9.2±1.3</u> 4.5±1.1 <sup>5</sup>	<u>8.0±1.8</u> 4.7±1.0 <sup>5</sup>	<u>5.4±1.0</u> 2.4±0.6 <sup>5</sup>	<u>60.5±9.2</u> 26.2±6.6 <sup>5</sup>
	2-IFT, n=60	<u>68.6±14.7</u> 97.5±24.7 <sup>3,4</sup>	<u>9.2±1.3</u> 1.0±1.3 <sup>5,6</sup>	<u>8.4±1.9</u> 2.7±1.5 <sup>5,6</sup>	<u>5.5±1.0</u> 0.6±0.7 <sup>5,6</sup>	<u>60.9±9.0</u> 7.1±7.7 <sup>5,6</sup>

**Note 1:** Data are presented in the format  $M \pm s$ , where  $M$  is the arithmetic average value,  $s$  is the standard deviation;  $n$  is the number of patients; **VSA SSR** – is an indicator of the autonomic support of the activity of skin sympathetic reactions; **IMS** is the index of muscle syndrome; **SNVS** - an indicator on a scale of vertebral neurological symptoms; **QLP** - the indicator according to the corresponding questionnaire of quality of life of patients;

**Note 2:** Above the line indicator before rehabilitation, below the line - after the course of medical rehabilitation;

**Note 3:** The significance of differences in *Student's t-test* versus the baseline of their subgroup,  $p < 0.0001$ ;

**Note 4:** Reliability of differences in *Student's t-test* versus VSA SSR indicators in the comparison subgroups of their group,  $p < 0.0001$ ;

**Note 5:** The significance of differences according to the criterion of *MacNymar test* in comparison with the initial indicator of its subgroup,  $p < 0.0001$ ;

**Note 6:** The significance of differences according to the criterion of the *Wald-Wolfowitz test* in comparison with the same indicators in the comparison subgroups of its group,  $p < 0.0001$ ;

**Note 7:** Reliability of differences according to the criterion of the *Wald-Wolfowitz test* in comparison with the same indicator of the observation subgroup,  $p < 0.0001$ ;

**Note 8:** Reliability of differences according to the criterion of the *Wald-Wolfowitz test* in comparison with the same indicator of the observation subgroup,  $p < 0.03$ .



**Table 2**

**Clinical characteristics of patients with dorsopathies in subgroups (dynamics coefficients calculated after medical rehabilitation)**

Sub-groups		The indicators characterizing the clinical picture of patients <sup>1</sup>				
		VSA SSR	IMS	SNVS	VAS	QLP
Group 1 (n=209)	1-M, n=69	3.7±3.5 <sup>2</sup>	53.8±12.0 <sup>5</sup>	36.0±16.4 <sup>5</sup>	53.1±17.7 <sup>5</sup>	56.8±12.5 <sup>5</sup>
	1-SMC, n=69	6.3±4.4 <sup>2</sup>	63.6±14.2 <sup>6</sup>	47.3±16.9 <sup>5</sup>	68.1±17.2 <sup>7</sup>	66.5±13.2 <sup>5</sup>
	1-IFT, n=71	20.3±8.2	82.9±15.5	67.4±12.3	89.8±11.7	82.9±13.3
Group 2 (n=181)	2-M, n=61	14.2±9.9 <sup>3,4</sup>	48.8±11.5 <sup>8</sup>	42.3±16.1 <sup>8</sup>	56.2±13.2 <sup>8</sup>	58.4±8.7 <sup>8</sup>
	2-SMC, n=60	-2.3±10.4 <sup>3</sup>	49.8±12.7 <sup>8</sup>	40.9±16.1 <sup>8</sup>	54.6±11.0 <sup>8</sup>	56.5±8.2 <sup>8</sup>
	2-IFT, n=60	41.6±17.8	89.9±13.0	65.5±21.0	89.4±14.2	88.7±11.8

**Note 1:** see Note 1 in Table 1  
**Note 2:** The significance of differences by t-criterion of the student in comparison with the indicator subgroup "1-IFT", p <0,0000001;  
**Note 3:** The significance of differences by t-criterion of the student in comparison with the indicator of subgroup "2-IFT", p <0.000005;  
**Note 4:** Reliability of differences by the student's t-criterion in comparison with the indicator of the subgroup "2-SMT", p = 0.001 [t-fact = 3.29];  
**Note 5:** Reliability of differences according to the criterion of the *Wald-Wolfowitz test* in comparison with the same indicator of the 1-IFT subgroup, p <0.000001;  
**Note 6:** Reliability of differences according to the criterion of the series in comparison with the analogous indicator of the subgroup "1-IFT", p = 0.027 [z = 2.20];  
**Note 7:** Reliability of differences according to the criterion of the series in comparison with the analogous indicator of the "1-IFT" subgroup, p = 0.004 [z = 2.88];  
**Note 8:** Reliability of differences according to the criterion of the series in comparison with the analogous indicator of the subgroup "2-IFT", p <0.0001.

In the subgroup of patients with an initially enhanced sympathetic influence in the region, where, along with standard drug therapy, the criteria is optimized for estimating the intensity of SSR interferences ("1-IFT") were used, the intensity of segmental skin sympathetic reactions was restored to physiological values in 78%.

In patients who initially had low sympathetic support in the region, in the observation subgroup ("2-IFT") normalization of the regional indices of VSA SSR also occurred, but to a much lesser extent in 37% of patients.

At the same time, the average values of the dynamic coefficients in the observation of the subgroups were significantly higher than in the respective comparison subgroups (Table 2).

When comparing the results of medical rehabilitation of patients of the observation subgroups and the corresponding subgroups, the following patterns were revealed by comparison of the main studied clinical parameters (Table 1.2):

Firstly, in the observation subgroup, patients who had an initial increase in sympathetic influence in the particular spinal column showed a decrease in the severity of musculo-tonic manifestations and relief of vertebral neurologic symptoms significantly more prominent than in the respective comparison subgroups, while the patient's assessment of the intensity of pain syndrome, the VAS scale also had significantly lower scores in the observed subgroups, which was ultimately accompanied by the normalization of the neurological status and improved quality of life for these patients;

Secondly, in the observed subgroup in patients who had initially low sympathetic support in the concerned spinal column, in comparison with the patients of the respective comparison subgroups, we observed a statistically significant decrease in musculo-tonic reactions, severity of vertebral neurological symptoms, pain intensity and improvement of indicators, characterizing the quality of life.

Analysing the correlation relationships between the indicators characterizing the intensity of skin sympathetic reactions in the particular spinal segment and the main indicators characterizing the clinical condition of the patients, it should be noted that after medical rehabilitation in the group of patients with initially sympathetic influence in the particular spine region, the indicator of VSA SSR had a positive correlation with an indicator of the scale of the vertebral neurological symptoms ( $r = 0.75$ ,  $p < 0.05$ ), with muscle syndrome index ( $r = 0.70$ ,  $p < 0.05$ ), with a VAS indicator ( $r = 0.62$ ,  $p < 0.05$ ) and a less pronounced correlation with the indicator of quality of life ( $r = 0.54$ ,  $p < 0.05$ ).

In the group with initially low sympathetic support, the VSA SSR indicator had a negative coefficient of correlation with the indicator of the scale of vertebral neurological symptoms ( $r = -0.62$ ,  $p < 0.05$ ) and with the indicator of quality of life ( $r = -0.61$ ,  $p < 0.05$ ), and low values of the correlation coefficient were noted with the index of muscle syndrome ( $r = -0.44$ ,  $p < 0.05$ ) and with the VAS index ( $r = -0.41$ ,  $p < 0.05$ ).

## **Conclusion**

According to the study, the inclusion of interference therapy into treatment and rehabilitation measures, the parameters of which we optimized according to DSD-testing data on the intensity of skin sympathetic reactions in the projections of the spinal nerves of the particular spinal section, made it possible in almost all patients with dorsopathies to improve the sympathetic provision of vertebral motor tissue segments and even restore their sympathetic regulation in an average of 77% of patients who had initially enhanced sympathetic influence at the level of the particular spine region, and in 37% of patients who had low sympathetic provision of PDS tissues.. Positive dynamics in the regulation of sympathetic support of the spinal column contributed to more effective relief of clinical manifestations of degenerative-dystrophic changes of the spine, such as a reduction of pain, severity of muscular-tonic syndrome, vertebral neurological symptoms, which affected the assessment of quality of life by patients with a statistically significant improvement in these indicators compared to the subgroups of patients where optimized electrophysiotherapy was not used.

The results of a clinical study comparing with the data of dynamic segmental diagnostics about the nature of sympathetic regulation of the tissues of the vertebral motor segments clearly indicates that the pathogenetic and sanogenetic mechanisms of the formation of

neurological manifestations caused by degenerative-dystrophic changes in the spinal column are related to the nature of the impaired sympathetic support of the spinal tissues, and the therapy of these manifestations should be optimized taking into account the segmented mechanisms of autonomic support.

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