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Assessment of autonomic nervous system function in a patient suffering from multiple sclerosis - a case study

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Abstract

Background: Multiple sclerosis (MS) is a chronic demyelinating disease of the nervous system. In its course, there are many motor and non-motor disorders, including the autonomic system disorders. They are characterized by an increase or decrease in the activity of the autonomic nervous system. The course of the disease is most often multi-phase, there are periods of remission and exacerbation. The aim of the study is to assess cardiovascular parameters and heart rate variability in response to orthostatic stimuli in a patient with multiple sclerosis.

Material and Method: A 48-year-old woman suffering from multiple sclerosis for 10 years (a form of secondary progressive disease) participated in the study. A study was carried out for cardiovascular response and heart rate variability in response to orthostatic stimuli. For this purpose, the Task Force Monitor system was used, which is a non-invasive method that allows the assessment of hemodynamic parameters such as heart rate, systolic blood pressure, diastolic blood pressure, and peripheral vascular resistance. Spectral heart rate variability (HRV) analysis was also used to assess the function of the autonomic nervous system. The

evaluated parameters were: low-frequency component (LF), high-frequency (HF) and sympathetic-parasympathetic balance factor (LF / HF).

Results: In the rest position, an autonomic balance shift was observed towards sympathetic domination. After performing the tilt test, the patient had an after pionization drop in blood pressure (orthostatic hypotension) as well as vascular resistance.

Conclusions: The analysis of the case study shows that in multiple sclerosis there may be disorders of the autonomic nervous system manifested by abnormal regulation of arterial pressure in a vertical position.

Key words: multiple sclerosis, autonomic dysfunction, dysautonomy

Introduction

Multiple sclerosis is a chronic inflammatory and demyelinating disease affecting the central nervous system (CNS). The disease has a different course depending on its form. The National Association of Multiple Sclerosis in the USA has distinguished four forms of MS [1]:

• Relapsing-remitting - the most common type of MS, characterized by the appearance of symptoms of exacerbations of so-called relapses. There are periods of remission between exacerbations.

• Secondary progressive - in 80% of cases it develops from relapsing-remitting form. In this type, the symptoms get worse.

• Primary progressive - similarly to the previous type, the symptoms intensify constantly. The difference is that the progression of symptoms occurs from the beginning of the disease.

• Progressive relapsing - this type is characterized by primary progression of symptoms with exacerbation episodes.

In the course of the disease, we distinguish between motor and non-motor symptoms. The latter include disorders of the autonomic nervous system (ANS). The autonomic system is responsible for maintaining the homeostasis of the body. For this purpose, it controls the work of such systems as: respiratory, cardiovascular, thermoregulatory and digestive. ANS dysfunction, or so-called dysautonomy, can lead to health risks and in extreme cases even life. Symptoms of dysautonomia include, but are not limited to, orthostatic disorders (dizziness), secretory disorders (excessive sweating or dry skin), vasomotor symptoms (changes in skin

warming and discoloration), sexual dysfunction, urinary tract disorders and disorders sleep [2].

Due to the fact that the symptoms of dysautonomy significantly affect the quality of life, it is important to diagnose them. One method of assessing autonomic nervous system function is to use the Task Force Monitor system. It is used for non-invasive assessment of cardiovascular function and for functional assessment of AUN. The system consists from: electrocardiograph (ECG), devices for continuous blood pressure measurement, pulse oximeter, impedance cardiograph (IKG) and devices for oscillometric blood pressure measurement [3].

Material and method

A 48-year-old woman with multiple sclerosis took part in the study. The condition of joining the study was giving voluntary consent to participate in the study and diagnosed multiple sclerosis, as well as no medical contraindications to participate in the vertical test. The patient who participated in the study for 10 years had MS, a secondary progressive form. Prior to the study, the patient's degree of disability was assessed using the Expanded Disability Status Scale (EDSS). The obtained result was 4.5. This means that the patient is able to move independently without the help of about 300 meters. It is capable of functioning independently, however, it may require assistance in carrying out some everyday activities.

The next step was to conduct a study for cardiovascular response and heart rate variability in response to orthostatic stimuli. For this purpose, the TaskForce Monitor system was used, which is a tool for non-invasive assessment of the circulatory system and functional assessment of the autonomic nervous system. The parameters evaluated were:

- HR - heart rate, which is the number of heartbeats per 1 minute
- sBP - systolic blood pressure
- dBP - diastolic blood pressure
- LFnu - normalized low frequency spectrum power component
- HFnu - normalized high frequency spectrum power component
- LF / HF - ratio of low frequency spectrum power to high frequency spectrum power

The first stage of the study consisted of assessing parameters during the patient's rest in a horizontal position. The rest lasted 10 minutes. Then a quick passive upright positioning was performed using a tilt table. The standing time lasted 5 minutes 20 seconds, a standing angle of 70 degrees was obtained. After the verticalisation, the above parameters were again evaluated.

Results

A change in the assessed parameters was observed in the patient after the verticalization test. These changes are presented in Table 1 (Tab.1).

Table 1. Change in cardiovascular parameters in response to orthostatic stimuli.

Rest in a horizontal position for 10 minutes.					
HR	sBP	dBP	LF	HF	LF/HF
77.03	111.93	68.67	85.82	14.18	2.88
Verticality up to 70 degrees. Duration 5 minutes 20 seconds.					
Δ 10.7	Δ - 36.96	Δ - 25.73	Δ 9.39	Δ - 9.39	Δ 10.02

Δ - vertical - horizontal difference

From the analysis of the change in parameters observed, a decrease in systolic pressure by more than 20 mmHg and a decrease in diastolic pressure of more than 10 mmHg which testifies on orthostatic hypotension. As a result of the change in vertical position, there was a decrease in parasympathetic (HF) activity and an increase in sympathetic (LF) activity, which is a physiological response to decompression of arterial baroreceptors as a result of a change in body position from lying to standing. As a result of stimulation of the sympathetic part of the autonomic nervous system, after the upright position the heart rate (HR) increased. In addition, in the upright position we observe a shift in resting autonomous balance towards sympathetic dominance. This manifests by increasing the ratio of low and high frequency spectrum (LF / HF), or sympathetic-parasympathetic imbalance.

Discussion

Diagnosing disorders of the autonomic nervous system is a topic undertaken by many authors. In their research, they use various methods of assessing the ANS. Damla et al. [4] conducted an analysis of heart rate variability using 24-hour Holter monitoring. The study compared the

results of 51 patients with multiple sclerosis diagnosed with relapsing-remitting form and 44 healthy people. The study showed that heart rate variability values were significantly lower in patients with multiple sclerosis compared to the control group. In another study, Studer [5] analyzed heart rate variability during rest and during the tilt test. 120 people with multiple sclerosis were examined, including 84 people with relapsing-progressive disease. The remaining 36 people were diagnosed with progressive multiple sclerosis. The control group consisted of 60 healthy people. Sympathetic dysfunction was closely related to the progression of disability in multiple sclerosis. The form of the disease significantly affected the sympathetic-parasympathetic balance. Autonomic imbalances were found in patients suffering from progressive MS, showing a predominance of sympathetic activity at rest. Flachenecker [6] conducted a study of 40 MS patients for cardiovascular disorders and orthostatic intolerance. The study used methods to assess the parasympathetic part (pulse response to the Valsalva maneuver, deep breathing test and active change in posture), as well as sympathetic function tests (blood pressure responses to active posture change), and spectral analysis of heart rate variability during rest and upright position. The obtained results were compared with the results obtained in a healthy control group. Abnormal cardiovascular responses in at least one of the tests were observed in 40% of patients with multiple sclerosis, compared with 17% of the control group. Orthostatic intolerance was reported in 50% of patients, while only 14% of healthy subjects reported symptoms of orthostatic intolerance [4, 5, 6].

Conclusion

The studies shows that multiple sclerosis is a condition in which autonomic imbalances may occur. In a patient they manifest themselves as abnormal blood pressure regulation during uprighting position. This necessitates further research in this direction involving a broader research group. In addition, the analysis is important from the point of view of rehabilitation, because autonomic imbalances can affect the functioning of patients.

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