

Functional disorders of autonomic nervous system in Parkinson's disease – relevant or irrelevant to the diagnosis?

Zaburzenia czynności autonomicznego układu nerwowego w chorobie Parkinsona – ważne czy nieważne w diagnostyce schorzenia?

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Choroba Parkinsona to postępujące schorzenie neurodegeneracyjne ośrodkowego układu nerwowego występujące najczęściej u pacjentów powyżej 50 roku życia. Ze względu na brak konkretnego, ostatecznego testu na obecność choroby Parkinsona, rozpoznanie stawia się na podstawie objawów klinicznych. Zazwyczaj jest to jednak bardzo trudne.

Literatura przedmiotu podaje, że zaburzenia autonomicznego układu nerwowego mogą występować już we wczesnym stadium choroby, co potwierdzają badania patomorfologiczne mózgu osób z chorobą Parkinsona. Szczegółowe poznanie dysfunkcji autonomicznego układu nerwowego w chorobie Parkinsona może być zatem istotne we wczesnej diagnostyce.

Słowa kluczowe: *choroba Parkinsona, autonomiczny układ nerwowy, Task Force Monitor, wczesna diagnostyka*

Parkinson's disease is a progressive neurodegenerative disorder of the central nervous system, most frequently observed in patients older than 50 years. Due to the lack of independent and reliable test for Parkinson's disease, the diagnosis is based on clinical symptoms. However, establishing diagnosis is difficult in most cases.

According to literature, the disorders of autonomic nervous system can be observed already at an early stage of the disease, as confirmed by the pathomorphological examination of brain specimens from the Parkinson's disease patients. Comprehensive understanding of autonomic dysfunction associated with Parkinson's disease can be important for early detection of this condition.

Key words: *Parkinson's disease, Autonomic Nervous System, Task Force Monitor, early detection*

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Introduction

Parkinson's disease (PD) is a progressive neurodegenerative disorder of the central nervous system (CNS), most frequently observed in patients older than 50 years. According to the World Health Organization (WHO), the number of Parkinson's disease patients amounts to 5 million worldwide. In Europe, the prevalence of this condition in individuals over 60 years of age is estimated at approximately 1.6% [1].

Age and gender represent principal risk factors of Parkinson's disease. Males are affected more frequently than females, usually after 60 years of age. According to some authors, familial occurrence of

the disease can influence its incidence in future generations. Moreover, an increased risk of Parkinson's disease was observed as a result of continuous exposure to herbicides and pesticides, as well as to copper and lead [2].

Due to the lack of independent and reliable test for Parkinson's disease, the diagnosis is based on clinical symptoms. However, establishing diagnosis is difficult in most cases. For instance, the symptoms of the disease can be misdiagnosed as a consequence of aging process, since the condition typically occurs in individuals older than 60 years [3-5].

Functional disorders of autonomic nervous system in Parkinson's disease

Functional disorders of the autonomic nervous system represent frequent clinical manifestation of Parkinson's disease. Although dysautonomia can be asymptomatic in some patients, quite frequently it can cause life-threatening states, and significantly diminishes the quality of life in a vast majority of asymptomatic cases. Unfortunately, the available reports on Parkinson's disease-associated dysautonomia do not cover the whole spectrum of the problem in question. According to literature, the disorders of autonomic nervous system can be observed already at an early stage of the disease, as confirmed by the pathomorphological examination of brain specimens from the Parkinson's disease patients. The disorders of autonomic nervous system were observed even during the preclinical stage of the disease, and initial neurodegenerative symptoms involve such CNS structures as the intermediate zone of the reticular formation and dorsal nucleus of the vagus nerve. The autonomic symptoms of Parkinson's disease occur independently from the motor symptoms, suggesting the neurodegeneration of both central and peripheral autonomic nervous system. Comprehensive understanding of autonomic dysfunction associated with Parkinson's disease can be important for early detection of this condition.

Principal signs of autonomic nervous system disorders can be observed within urogenital system, cardiovascular system, alimentary tract, thermoregulation system [6-9].

Gastroenterological disorders

The most frequent alimentary disorders observed in Parkinson's disease include dysphagia and dribbling of saliva, probably associated with dysphagia, reduced activity of esophageal muscles or enhanced cholinergic stimulation. According to literature, dysphagia occurs in most Parkinson's disease patients, and leads to nausea, lack of appetite, heartburn associated with gastroesophageal reflux, and early postprandial satiety. The presence of Parkinson's disease-associated gastroenterological disorders is explained by the progressive degeneration of the autonomic nervous system.

Additionally, impaired gastrointestinal motility and constipation are reported; they can result from the injury of intermediolateral sacral nucleus, pelvic plexus, Auerbach's myenteric plexus, and Meissner's submucosal plexus [10].

Disorders of cardiovascular system

Orthostatic hypotension is the most frequent cardiovascular manifestation of Parkinson's disease.

The orthostatic hypotension is diagnosed based on the drop off in systolic and diastolic pressure by at least 20 mm Hg and 10 mm Hg, respectively, observed three minutes after passive tilting. It is associated with tachycardia and the release of renin.

Additionally, abnormalities in 24-hour profile of arterial blood pressure (decrease in the morning hours along with nocturnal increase) were observed in most Parkinson's disease patients. Moreover, one of the principal regulators of arterial pressure, the baroreceptor reflex, is impaired, as reflected by the lower pressure values observed in the Parkinson's disease patients as compared to healthy individuals [11-16].

The patients with Parkinson's disease frequently develop postprandial hypotension resulting from the dilatation of alimentary tract vessels and simultaneous drop off in the peripheral pressure. These changes result from insufficient release of catecholamines and renin, enhanced intestinal secretion of vasodilating peptides, and impaired baroreceptor reflex.

The lack of respiratory variability in RR interval was reported in some patients with Parkinson's disease due to the injury of parasympathetic part of autonomic nervous system; this resulted in the "rigid heart rhythm" [11-16].

Disorders of urogenital system

The most frequent urinary abnormalities associated with Parkinson's disease include frequent urination (even every 2 hours), urgency, and nocturia. Other, less frequently reported symptoms include urinary retention, incomplete voiding of bladder, and narrowed urine stream.

Previous studies revealed that Parkinson's disease can be associated with such sexual disorders as erectile problems in men and decreased libido in women. Principal reasons behind those disorders include: injury of autonomic centers, complications of antidepressant therapy, complications of therapy with diuretics, anxiolytics, adrenergic blockers, and diuretics, depression [17].

Thermoregulation disorders

Patients with Parkinson's disease can suffer from impaired thermoregulation processes. They are characterized by poor tolerance to low temperatures and can even develop hypothermia. Most commonly, the disorders of thermoregulation are manifested by hyperhidrosis and acne (oily skin symptom). Postulated reasons behind those dysfunctions include the injuries of hypothalamus, sympathetic ganglia, and intermediolateral sympathetic nucleus [18].

Standard functional examination of autonomic nervous system

The assessment of autonomic nervous system is based on several reproducible tests. The methods of vegetative system assessment include the following tests of the parasympathetic function: analysis of heart rhythm variability during the Valsalva maneuver, analysis of heart rhythm variability during deep breathing, analysis of heart rhythm variability during active tilting, 30/15 test, ocular compression maneuver, carotid artery compression test, face immersion test. The methods of sympathetic function assessment include: minor's starch-iodine test, ninhydrin test, Schellong test, Valsalva maneuver, isometric muscular stretching test, ice-water test, active and passive tilting test.

Example of excellent tool for the examination of the autonomic nervous system is a Task Force® Monitor [19].

Task Force Monitor

Task Force® Monitor (TFM) is a specialist device for non-invasive examination of cardiovascular system and functional assessment of autonomic nervous system. The system includes the following components: device for the continuous measurement of blood pressure, electrocardiograph (ECG), impedance cardiograph (ICG), device for the oscillometric measurement of blood pressure, pulse oximeter.

The device for the continuous measurement of blood pressure determines the pressure of perivascular environment in the distal part of upper limb. In the case of TFM, the measurements are obtained with controlled pressure air cuff and plethysmograph, placed on the middle and index fingers.

Electrocardiograph (ECG) registers the electrical activity of the myocardium detected as the voltage difference between two electrodes at the surface of the chest, and presents it graphically as the electrocardiographic curve.

Impedance cardiograph (ICG) analyzes the components of impedance signal registered in the chest during one cardiac cycle.

The device for the oscillometric measurement of blood pressure senses the magnitude of oscillations caused by blood flowing into the arm compressed with

occluding cuff. The last component of the TFM system is pulse oximeter, monitoring the oxygen saturation of patient's blood.

Due to the presence of internal calibration generators, the TFM system can be calibrated automatically. As a result, measurements that exceed biological norms are identified automatically and not recorded by the Task Force® Monitor system.

TFM obtains biological signals non-invasively and thus all the procedures are safe for the participants of the study.

The "beat to beat" measurements enable determination of arterial blood pressure, stroke volume, minute volume, peripheral resistance, heart rate variability (HRV), blood pressure variability (BPV), and spontaneous baroreceptor sensitivity.

The autonomic function (HRV and BPV) will be assessed by means of spectral analysis, while baroreceptor sensitivity (BR) will be analyzed with the sequential method [20].

Conclusion

The disorders of autonomic nervous system gain increasing importance in neurological practice; despite extensive clinical neurophysiological research, however, practical application of the autonomic evaluation is still insufficient. The disorders of autonomic nervous system in Parkinson's disease can be observed already at early stage of the disease. The Task Force Monitor has a role to play in the objective diagnosis of autonomic nervous system abnormalities in Parkinson's disease. Further research explaining autonomic disorders in PD is necessary to improve early detection of this condition. Probably, the findings of this study will play an important role in the future, facilitating early diagnosis of the disease in question at a stage when the neurodegenerative process is still not advanced. Early detection of dysautonomia is also important in the differential diagnosis of other extrapyramidal disorders; moreover, it should facilitate early implementation of pharmacotherapy and rehabilitation, consequently prolonging the period of patient's functional capacity.

Conflict of interest statement: Authors state no conflict of interests.

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