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Rehabilitation management in Parkinson's disease - review of the variety of forms

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Abstract:

Introduction: Parkinson's disease is one of the most common central nervous system diseases. Despite many studies and the use of many different forms of drug treatment, it is still not possible to completely regress the disease. Drug treatment can effectively reduce the severity of stiffness, slow motion or tremor, but does not affect non-dopaminergic symptoms such as postural and gait stability disorders which can result in numerous falls.

Materials and methods: Analysis of selected and available literature and scientific articles available in the Google Scholar and Pubmed search engine database. Keywords were used for this purpose: Parkinson's disease, Rehabilitation, and Therapy

Results: The most common symptoms of a neurodegenerative disease, which is Parkinson's disease, include slow motion, increased muscle tone, resting tremor, and balance disorders. The etiopathogenesis of Parkinson's disease is still not fully understood, and for this reason a simple algorithm was still created for the diagnosis of the disease and possible further treatment.

Kinesitherapy, which is individually tailored to the patient's needs, is the basic form of rehabilitation in Parkinson's disease. For this purpose, muscle stretching exercises, autogenic training, exercises improving efficiency, respiratory therapy or progressive muscle relaxation by the Jacobson method are used. In the case of physical therapy, which is complementary to rehabilitation, hydrotherapy, magnetotherapy and iontophoresis are used. In addition to the above-mentioned forms of rehabilitation, deep therapeutic stimulation of the brain, subcutaneous administration of apomorphine, basic forms of occupational therapy and speech therapy exercises are also used for therapeutic purposes.

Conclusions: Despite the large amount of research and published results, there is still a great need for further work on the problems of people with Parkinson's disease.

Keywords: Parkinson's disease, Rehabilitation, Therapy

Admission

Resting tremors, slow motion, increased muscle tone or balance problems are one of the symptoms of Parkinson's, a neurodegenerative disease that leads to temporary or permanent cognitive impairment, preventing you from participating in everyday activities. Proper selection of appropriate and continuous rehabilitation, which should include both the physical and mental sphere, is necessary to achieve an improvement in the quality of life. An indispensable complementary therapy to pharmacological treatment is exercise therapy, which plays a special role in maintaining the physical fitness and functional independence of patients. Properly selected, systematic physical exercises have a beneficial effect on the health of patients, both in the early and advanced stages. Unfortunately, so far, no drug for Parkinson has been invented, so the only role of rehabilitation is to slow down the development of the disease, delay the onset of troublesome symptoms or reduce the intensity of those already formed. [1]

Parkinson's disease (definition, symptoms)

Parkinson's disease was first described in 1817 as a tremor. The essence of the disease is based on the slowly progressive, spontaneous degeneration of the central nervous system, otherwise it is called neurodegenerative disease. [2]

Symptoms of Parkinson's disease relate to the most characteristic motor problems, but non-motor symptoms appearing before classic motor symptoms are also known. [2]

Motor problems belong to the so-called the classic triad, defined as parkinsonism. These include bradykinesia, characterized by reduced amplitude of movements, affects 80% -90% of patients with the disease. Muscle stiffness regarding relaxed flexors and extensors is also observed - the problem affects 80% -90% of patients. The classic triad also includes resting tremors, in 70-90% of patients this is one of the first symptoms, the problem mainly affects the hands, but it can involve the jaw, tongue, mouth, chin and lower limbs. In the later stages of the disease, apart from the classical triad, postural instability is also characteristic, as it predisposes to frequent falls and injuries. [2]

Often overlooked, but equally characteristic of Parkinson's disease are autonomic dysfunction (constipation, sexual dysfunction, hyperhidrosis, urinary output problems), neuropsychiatric symptoms (anxiety, dementia, depression, anxiety disorders and psychoses) and sleep disorders (insomnia, daytime sleepiness) restless legs syndrome, sleep apnea). Other characteristic symptoms are olfactory dysfunction, drooling and weight loss. [2]

Epidemiology, etiopathogenesis

Epidemiology deals with the study and determination of the incidence of diseases in specific human populations. Thanks to it, one can quite accurately find out the incidence of parkinsonism in a given country, where it is determined in a given general population of 100-200 cases per 100,000 people. Of these, around 85% are people with Parkinson's disease, while around 15% are other Parkinson's syndromes.

There are about 50-60 thousand people suffering from parkinsonism in Poland. It is estimated that 10-20 people per 100,000 people in the general population get sick annually, which gives about 4-6 thousand new cases of parkinsonism [3].

Exposure to toxic substances is important in etiopathogenesis. However, no specific substances have been identified so far, and attention is paid to the pyridine group, which includes MPTP. The compounds that make up this group are widespread in everyday life and belong to the natural environment, including food. Research on Parkinson's disease is ongoing all the time, thanks to which further important aspects of the disease are learned for practice [4].

The etiology of Parkinson's disease, despite continuous research, is not fully explained due to its complex background. This disease belongs to the degenerative diseases of the central nervous system, where motor disorders - arising from the degeneration of dopaminergic neurons of the nigrostriatal tract, constitute its basic symptom [4, 5].

Parkinson's disease is thought to be progressive and affects movement symptoms as well as non-movement symptoms. Diagnosis is currently based on the presence of only the

identification of the basic signs of movement associated with dopamine deficiency in the nigrostriatic system.

Parkinson's disease is currently considered a generalized synucleinopathy with a wide range of clinical symptoms [6].

The factor initiating the accumulation of α -synuclein in astrocytes is not yet known [7]. Thanks to the discovery of Lewy's pathology in embryonic neurons implanted in sick patients, a new prion concept emerged. This concept presents:

- long period of Parkinson's disease development - long-term accumulation of α -synuclein,
- mutation of the α -synuclein gene causing family disease,
- change in α -synuclein configuration in β in the pathogenesis of the disease,
- possibility of migration of α -synuclein through the olfactory system or gastrointestinal tract,
- genetic studies supporting the concept: increasing protein synthesis (α -synuclein, LRRK2), protein removal disorders (parkin, UCH-L1) [8].

The most important for researchers of Parkinson's disease is to find out the causes initiating the process of neuronal damage, determining markers of the early period of the disease and creating a process of effective treatment [9].

Diagnostics

Despite many studies conducted for Parkinson's disease, it has still not been possible to create a simple algorithm for direct diagnosis and possible further treatment. The most important aspect of diagnostics is the exclusion of symptomatic parkinsonism, observed after carbon monoxide poisoning or taking neuroleptics. The diagnosis of Parkinson's disease is based on clinical criteria, however, despite quite characteristic symptoms, the disease is diagnosed in 75-85% of people. [10]

It has been proved that many patients have symptoms preceding motor disorders, it is assumed that the preclinical duration of the disease is quite long, so the so-called "Diagnostic tests for preclinical and early disease". Basic tests include neuropsychological tests that diagnose visual-spatial orientation disorders, problems with planning and implementation of given activities, mood disorders and depression. In preclinical diagnostics, the olfactory examination is used due to olfactory problems in 90% of patients diagnosed with the disease. Studies have shown that the detection of smell problems in first-degree relatives without motor symptoms gives a high probability of developing the disease. Early diagnostic tests also include neuroimaging of the dopaminergic system, thanks to which it is possible to demonstrate dopaminergic system disorders before motor problems occur, thus allowing to assess the progress of the

neurodegenerative process. From the point of view of typical pre-clinical diagnostics, genetic tests have a high diagnostic value. Detection of genetic mutations predisposing to the disease is particularly important in families where Parkinson's disease is already present. Studies to date have shown the existence of 11 genetic loci designated PARK1-PARK11. [11]

Nowadays, a special role of diagnostic tests is pointed out as a treatment perspective, where in the future neuroprotective treatment slowing or stopping the progression of the disease will be directed at people with a diagnosis. [11]

The diagnosis of Parkinson's disease is of interest to many scientists. The latest report comes from 2017, where Australian scientists have created a diagnostic test that will determine whether there is a risk of future disease. A system was created that analyzes the connection of individual points arranged in a spiral-shaped snail shell. The analysis concerns pressure force, micro-vibrations, the rate of connection of individual points and other characteristic features. Scientists argue that the new system allows you to assess the likelihood of getting sick even in middle-aged people, while pointing to efficacy oscillating around 93%. [12]

Kinesitherapy

Physical activity affects all systems in the human body, well-being and is necessary for the proper functioning of the muscles, which disappear as a result of inactivity. Maintaining normal physical activity is very important for people with Parkinson's disease.

The disease discourages patients from physical effort, performing work, meeting friends and withdraws them from social and family life. Therefore, people with Parkinson's disease should be motivated to be physically active, which is individually tailored to the patient's preferences, capabilities and needs [3].

Rehabilitation is carried out depending on the symptoms and stage of the disease according to the Hoehn-Yahr scale.

I. In the first stage of the disease - unilateral symptoms with minimal or no functional impairment - the patient's general fitness, muscular strength and tissue stretch are strived to be maintained. Patient and caregiver education as well as performing exercises are also important here. For the form of exercise, walking at least 3 times a week for 40 minutes with step length control and using various obstacles such as stairs, uneven ground is recommended. The patient should control the maintenance of an upright posture and practice getting up, sitting down, turning and walking.

II. In stage II - bilateral or axial symptoms, but without imbalance. Rehabilitation is carried out as needed, taking into account hypokinesia, bradykinesia, akinesia and dyskinesias

in relation to daily activities. Patients and their carers should also be educated at this stage. Kinesitherapy is used here in the form of active regular physical activity in the form of a 40-minute walk, 3 times a week. Keeping posture as well as exercise, as in Stage I, and performing muscle stretching exercises.

III. III. Stage III of the disease relates to patients in whom instability can be observed when turning around or when the patient in a standing position with his feet together and eyes closed by pushing is thrown out of balance. Objectives of physiotherapy as in Stage II in addition with fall prevention. Rehabilitation for walking, at this stage is at least 100 meters a day, where the foot-ground distance should be kept more than 1.5 cm. A fall notebook should be kept with an annotation of the day, time, place and activity during which the event occurred. Exercises are conducted to overcome the slowdown and instability of posture during everyday activities. The patient should control body posture and have a muscle stretching exercise program.

IV. IV. Fully developed disease that causes disability applies to stage IV, in which the patient has problems standing and walking. Physiotherapy mainly concerns the education of the caregiver, as well as both the sick person in order to prevent falls, take medication regularly and maintain walking distance, fitness, endurance and stretchiness of soft tissues. Exercises include a walk with a caregiver at least 100 meters a day, and exercises as in Stage III.

V. V. The last, fifth stage of the disease is the stage of "bed attachment or wheelchair" in the absence of help. It is recommended that the patient, if possible, walk daily with help or stand up with supervision. When the conditions are favorable, it is recommended that the patient lie 15 minutes twice a day back (on the back) or on the side with the torso, hips and knees in a neutral position [3, 13].

Disorders of the musculoskeletal system, also called hypokinesia, are further exacerbated by stiffness that arises from the degeneration of dopaminergic cells. When the disease begins, the ability to learn new movement patterns is impaired, and in its further management it becomes impossible to create new pathways, which is associated with the inability to learn new movements. To maintain acquired, automated motion processes, frequent repetition of motion is necessary, including repetition at varying frequencies and combining movements with an acoustic motion initiator. Stiffness treatment consists in reducing its negative impact on the body. Rehabilitations are performed to reduce muscle tension, reduce their soreness, improve joint mobility and improve patients' mobility in everyday life. Kinesitherapy uses muscle stretching exercises, passive movements at a variable pace, autogenic training, respiratory therapy and Jacobson's progressive muscle relaxation. The rehabilitation can also be supplemented with swimming pool classes [4].

A sign of Parkinson's disease is also tremor, which does not reduce rehabilitation, but a strategy is being developed to reduce its frequency. Patients are advised to try to overcome tremor with intentional movements. In the case of unilateral tremor, you can try to immobilize your trembling hand with a healthy hand, and in the case of lower limbs with the other limb [4].

Hypokinesia, tremor and stiffness also cause precision and writing disorders. When conducting rehabilitation to improve precise movements, maintain dexterity and slow down disease progression, one should pay attention to the patient's willingness. The rehabilitation program includes stretching, loosening, dexterity exercises and exercises to improve alternating movements.

Facial muscle exercises to reduce facial and mouth muscle stiffness should also be added to rehabilitation. When exercising facial mimic muscles, it is recommended that the patient have a mirror in front of him [3].

Every patient (except for the fifth stage of the disease according to the Hoehn-Yahr classification) is preferred to walk, because it is one of the easiest methods of movement. For people with imbalances, it is recommended to use a walking stick, tripod or walking frame or with an accompanying person [3, 13].

In addition to walking, cycling and swimming are also preferred. An important activity to start the day is morning gymnastics, lasting about 10-15 minutes a day, not forgetting about breathing exercises.

To improve the form and increase muscle strength, you can do stretching exercises with low weight. It is thanks to these exercises that adequate muscle mobility is maintained.

While exercising, you should maintain a proper rhythm of effort and remember to rest. It is necessary to properly match the physical effort to the patient's health expenditure of energy [13].

Physical therapy in Parkinson's disease

Physical therapy in the fight against Parkinson's disease should not be the only method of therapy used, but only to complement and complete the rehabilitation process. [14]

One of the most popular forms of physical impact on patients with Parkinson's disease is hydrotherapy (hydrotherapy, aqua-therapy). The treatments used in this form of rehabilitation are based on the therapeutic use of water in the form of baths, water massages and other treatments. The term hydrotherapy is also understood as exercises that are performed by patients in water. The basis for therapeutic action is appropriate water pressure and its temperature used for a given therapy. [15]

In rehabilitation practice in the treatment of patients with disorders associated with Parkinson's disease, exercises in warm water are used, which can significantly contribute to improving the patient's condition. The effects that are planned to be achieved during this therapy include: muscle relaxation, improvement of general efficiency by increasing lung function, improvement of general body posture. In some cases, there is a reduction in stress, anxiety disorders and tension, as well as an improvement in the quality and length of sleep of patients. At the same time, the basic properties of water are used, such as the resistance it puts to patients and buoyancy. [14]

This therapy, like many others, also finds new possibilities that try to increase the effectiveness and diversify the stay of patients. In this case, special foam costumes have become increasingly popular, whose main goal is to reduce the patient's heat loss and are a safety measure. [13,14]

As a supplement to movement therapy in patients with Parkinson's disease, physical treatments in the form of magnetotherapy and magnetostimulation can also be used. After using these treatments, there may be a reduction in clumsiness of movements and dyskinesias. Like hydrotherapy, they can also have a beneficial effect on patients' sleep, autonomic function, cognitive functions and mood. As for the parameters regarding the use of magnetic fields in the form of magnetotherapy, in the literature you can find, for example (40 Hz, 10 mT, 12 min, field course - sinusoidal, coil location - head) and in magnetostimulation - magnetic field intensity - 6/7, applicator location ring - head or large applicator - mat). [15,16]

It is also worth noting that the technological progress in the use of physical therapy has expanded the possibilities of magnetotherapy. It is the combined effect of alternating magnetic field and optical radiation. Positive effects include an improvement in interneuronal conductivity and modulation of neuronal activity [17,18]

Among other physiotherapeutic procedures, the authors emphasize the effectiveness of using xylocaine and hydrocortisone ionophoresis, which aim to reduce patient pain, and exposure to the Sollux lamp, which are designed to warm up patients with diagnosed Parkinson's disease. [13]

Other forms of rehabilitation

In the course of rapid development of Parkinson's disease, the functioning of the whole organism is weakened. The selection of an appropriate method of treating patients should take into account the age, occupation, stage of the disease, existing disorders and individual needs of the patient. [1]

Muscle dysfunction leads to rapid fatigue, hindering functioning in everyday life and performing basic social roles. Multidirectional rehabilitation is carried out in order to reduce bothersome symptoms and improve the quality of life. [1]

In order to increase the range of treatment, in addition to basic physiotherapy, additional forms of rehabilitation are introduced, such as: pharmacological treatment, therapeutic massage, aqua aerobics, Nordic Walking and music therapy. [1,19]

In Parkinson's disease, the balance between the cholinergic system and the dopaminergic system is disturbed. Drug treatment includes stimulation of the dopaminergic system. The most effective drug used to treat the disease is levodopa, which, after passing through the blood-brain barrier, is transformed into dopamine and replenishes its deficiency in the brain. It is necessary to take the drug several times a day, due to its short half-life. As the disease progresses, the dosage of the drug should be increased. The best therapeutic effects are visible in the area of stiffness and slow motion. During the use of levodopa, undesirable effects may occur, such as chorea, dystonic dyskinesia and motor fluctuations, as well as urination disorders, decreased libido, constipation, depression and memory impairment. [1]

Other drugs that have also found application in the fight against PD include: COMT inhibitor (increasing the transport of levodopa to the brain) and rasagiline and selegiline, which block the breakdown of dopamine, leading to an increase in its concentration. [1]

One of the additional forms of rehabilitation for people with PD is aqua aerobics. The aquatic environment has a positive effect on both the physical and mental state of man. Due to the buoyancy of water, partial relief of the body can be achieved, which enables the support of weakened muscle parts in moving the limbs. At the same time, water resistance makes it possible to conduct strengthening exercises. Classes conducted in swimming pools are a combination of exercise therapy with good fun, which is of great interest among people with PD. [19]

The introduction of Nordic Walking to PD therapy has a beneficial effect on improving the functioning of the whole body. Research shows that regular outdoor walks have a beneficial effect on motor coordination and balance, involving the work of all body muscle parts. The walking time should be increased in stages, striving for 30-45 min effort. The use of poles, in addition to stimulating the correct posture, allows you to ensure safety when walking on uneven surfaces, which helps to reduce the risk of falls and injuries. Systematic walks have a soothing effect on the nervous system and thus lead to improved sleep quality in patients. [20]

Regular therapeutic massage in PD has a positive effect on the functioning of the entire patient's body. The main goals of the massage are to achieve muscle relaxation and improve circulation.

In order to obtain positive effects, it is recommended to carry out massages about 2-3 times a week, after 45 minutes. The massage uses cardiac stroking, gentle rubbing, slow longitudinal kneading and simultaneous pressure. Particular attention should be paid to back and neck massage. Myofascial (stretching) techniques also give positive effects of compensating for disturbed balance. [21]

Many people with Parkinson's disease suffer from speech disorders. At the earliest, the patient's voice becomes weak, monotonous with imprecise articulation, slow or fast speech. People with PD may have difficulty starting speech, disturbed accentuation or rhythm, or stuttering. This disability worsens as the disease progresses and can lead to serious communication difficulties. [22]

The goal of speech therapy is to maintain maximum performance of the speech apparatus in the course of Parkinson's disease. In order for speech therapy exercises to bring results, they should be conducted systematically over a long period, it is important to introduce them at an early stage of the disease. It is also important to include swallowing problems in therapy. [22]

Speech therapy should primarily concern:

- articulation improvement exercises,
- proper voice modulation,
- improving phonation,
- reduction of mouth and face muscles stiffness,
- breath regulation. [22]

Music therapy may be another form of rehabilitation for people with PD. Rhythmic music allows you to adjust the gait, its stride length, elasticity, strength, smoothness and makes it easier to change the direction of the march. The use of auditory stimuli has both a stimulating effect on physical effort and a calming effect, through the use of relaxing music. [23]

Deep brain stimulation (DBS)

DBS is a therapy in which, during surgery, electrodes are placed in the brain connected by a wire under the skin on the chest. Strength and frequency are selected individually for each patient. DBS low-hypothalamic (DBS STN) and inner pale knob (DBS GPi) treatments are considered one of the greatest achievements in the treatment of Parkinson's disease. The effectiveness of the method has been proven by many clinical studies, and the possibility of side effects associated with bleeding or infection after surgery is negligible.

The method has significant limitations. Contraindications are, among others: age above 70 years, dementia or vascular changes in the brain. These restrictions mean that half of the patients in advanced stage are disqualified.

For some patients, the operation itself may be very difficult to accept, during which the patient is aware in a significant part of the operation and placing a foreign body in the brain. is another contraindication to use the method. [24]

Indications for DBS:

- Diagnosis of Parkinson's disease based on United Kingdom Parkinson's Disease Society Brain Bank criteria;
- Five-year duration of the disease;
- Patient's age <70 years old;
- Exhausting the possibilities of pharmacological therapy;
- No signs of dementia;
- Positive response to levodopa;
- No depression;
- No psychotic symptoms;
- No contraindications for implantation of a pacemaker resulting from comorbidities [24]

Duodopa system

The method involves placing a tube through the abdominal skin directly into the small intestine, through which the programmed pump administers levodopa in the form of a special gel. The slow release of the drug directly into the intestine allows it to reach a constant concentration in the blood, and thus - in the brain. This makes the method clearly more effective than oral levodopa and better alleviates the symptoms. The drug is administered at a constant speed by the pump, at a dose determined by the doctor or nurse. The patient has the option of modifying this dose to a small extent, as well as giving a specific number of additional doses. The total daily dose consists of: a morning dose administered to quickly obtain the "on" state after a night break, a dose of the drug given by continuous infusion, and single booster doses administered by the patient himself [25].

Operating the entire system is not easy, which is why the patient requires daily caregiver assistance. In the case of intestinal levodopa, no other agents are used.

A new route of administration for levodopa is underway. For example, an inhalation system has already been established. It works in a similar way to asthma inhalers. Just as an asthma patient at the time of an attack reaches, for example, a disk and inhales a dose of medicine, so the

patient with parkinson uses the inhaler when he is in the "off" phase. The method is already passing the last stages of research. [25]

Indications for duodopa:

- Correctly diagnosed Parkinson's disease lasting a minimum of five years;
- Exhausting the possibilities of optimal pharmacological therapy conducted with oral drugs;
- No contraindications for establishing PEG;
- No severe dementia;
- Daily presence and assistance of the guardian. [25]

Subcutaneous administration of apomorphine

Apomorphine (has nothing to do with morphine) is a dopamine agonist, it stimulates the same receptors as dopamine. Its action does not depend on how many dopamine-producing cells are left undamaged by the disease. Apomorphine in the form of subcutaneous injections can be used to terminate "off" conditions. Due to the relatively short duration of action, this is not an optimal treatment. A constant blood drug concentration and a constant level of dopamine receptor stimulation can only be obtained by continuous infusion of apomorphine.

Due to the fact that apomorphine is administered subcutaneously, it is the least invasive method. Usually the medicine is given only during the day. Every morning, the patient has a thin needle inserted under the skin connected to the drug delivery pump. In the evening the whole system is disconnected. Treatment with subcutaneous infusions of apomorphine requires daily caregiver assistance in preparing the infusion and connecting the pump. [26]

Indications for apomorphine:

- Correctly diagnosed Parkinson's disease lasting at least five years;
- Exhausting the possibilities of pharmacological therapy conducted with oral drugs;
- No psychotic disorders;
- No deep dementia;
- Absence of skin lesions constituting a contraindication to subcutaneous infusions of the drug;
- Daily presence and assistance of the guardian. [26]

Summary

In the treatment of symptoms and effects of Parkinson's disease we can distinguish pharmacological and non-pharmacological treatment, which in the vast majority is based on

physical rehabilitation. Its goals include increasing mobility and muscular strength, as well as reducing postural and gait stability disorders, which results in a decrease in the number of falls for those struggling with Parkinson's disease. [27]

The use of various therapeutic options and methods allows for successive implementation of the goals set by the therapist and the patient himself. Early rehabilitation significantly delays the progressive phase of disability.

Properly programmed and individually matched to the needs and stage of the disease, the exercises can also act neuroprotectively, reducing the disease's progression or its occurrence. Further development of research on physical activity is necessary to understand the mechanisms of neuroplasticity in Parkinson's disease associated with neurotransmission. [28]

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