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Assessing the risk of falls of older people using specialized diagnostic tests

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Abstract:

Background: The phenomenon of population aging, resulting in an increase in the number of elderly people in need of medical assistance, necessitated the development of geriatric medicine. Its key assumption is to improve the quality of life of older people through early recognition, prevention and treatment of diseases of old age.

Material and methods: Analysis of available literature, articles in the Google Scholar and PubMed database using keywords: geriatrics, aging process, falls

Results: The fall belongs to a group of great geriatric problems contributing to the phenomenon of senile disability. The result of disturbances in the balance and problems associated with the weakening of the musculoskeletal system is a fall, which has very serious consequences for the health and functioning of an older person. The most important diagnostic tests related to falls of older people include: Timed Up & Go Test (TUG), Dynamic Gait Index (DGI), The Step Test, Stop Walking When Talking (SWWT), Four Square Step Test (FSST)

Conclusions: Falling older people is statistically one of the biggest problems of this age group, and at the same time causing a huge number of complications in the lives of geriatric

patients, which is why their prevention is so important. There is a further need for research and discussion on the effectiveness of forms of diagnostic to prevent the falls of older people.

Key words: geriatrics, aging process, falls

Admission

The phenomenon of population aging, resulting in an increase in the number of elderly people in need of medical assistance, necessitated the development of geriatric medicine. Its key assumption is to improve the quality of life of older people through early recognition, prevention and treatment of diseases of old age. Contemporary Polish society is characterized by the phenomenon of aging of an unprecedented scale. The development of technology, improvement of medical care and progress in the treatment of diseases have contributed to extending the life span. In 2014, according to the data of the Central Statistical Office (GUS), the Polish population was 38.5 million, of which 8.5 million were people aged 60 and over (over 22%). Since 1989, the number of young people in the pre-working age has drastically decreased, while the number of people aged 50-70 has grown rapidly. There is also an increase in the number of the oldest age groups called "double aging". Available forecasts indicate an increasing scale of aging of the entire Polish society. According to a study by the Central Statistical Office in 2020, the percentage share of people over 60 in the total population should amount to 18.4%, while in 2035 - 23.2%. One of the main problems of the elderly, which should be detected during the tests are balance disorders and posture stability increasing the risk of falling. As part of aging, irreversible organ changes cause a reduction in the efficiency of their functioning, which affects many spheres of senior life. This results in a decrease in physical and mental fitness of older people, which is often associated with a decrease in participation in social life, disability and addiction to help others. The result of disturbances in the balance and problems associated with the weakening of the musculoskeletal system is a fall, which has very serious consequences for the health and functioning of an older person. This creates the necessity of early detection of postural instability, thanks to the use of specialized diagnostic tests.

Falls among the elderly

Falls of older people are one of the great geriatric problems contributing to the phenomenon of senile disability. According to surveys within the PolSenior [1] project, on average, 23% of people aged 65 and over living in their own households experience at least one fall during the year. The risk of falls increases with age and affects more nursing home residents and people staying in hospital facilities [1, 2, 3].

The collapse - according to the WHO [3] definition - is an event in which a person, unintentionally, found himself on the ground, floor or other lower level. Most of the falls in the elderly occur during the journey. Predominant falls are 60% of all falls, most often causing injuries to upper limbs. The likelihood of falling from side to side is similar and is around 20% for each direction. In men, there is a tendency to fall aside as a result of slipping, while older women, as a result of stumbling, mostly fall forward. Falls that result in more serious injuries account for only 5-15% of the total number of falls, but about 87% of fractures in older people are caused by a fall. The fractures mainly affect the upper limbs, hip joint, spine and ribs. The result of a fall can be not only physical injury but also fear of another fall, causing limitation of activity, unwillingness to actively spend free time and weakening of self-confidence, leading to social isolation. Early diagnosis of postural instability combined with appropriate rehabilitation is crucial in reducing the negative effects of falls and is able to significantly improve the quality of life of elderly people [3, 4, 5].

In developing a fall prevention strategy, a thorough analysis of their causes is needed. Some cases of falling are caused by a single cause, but most of them are conditioned by many factors. As the number of risk factors increases, the risk of falling increases. Risk factors can be divided into internal - related to the reduction of the body's efficiency and external - independent of involutory changes associated with aging. Among the internal factors can be distinguished physiological, related to the aging and pathological processes related to chronic and acute chronic lesions [3, 4, 6]. The physiological involution processes occurring in the organs and tissues of the elderly contribute to a greater extent to the risk of falling. There is a weakening of perception of sense organs responsible for stability of posture. During aging in the vestibular apparatus there are numerous structural changes, which reduces the number of sensory epithelial cells and vestibular nerve fibers. This weakens excitability and transmits nerve impulses. Sight defects deepen, resulting in reduced visual acuity, adaptation to the dark and color sensitivity. The visual field is reduced and the visual and spatial functions are disturbed. Muscle mass decreases, resulting in lowering muscle strength and efficiency. This process affects in particular the muscles of the lower limbs as a result of the restriction of locomotion. Degenerative changes arising in the musculoskeletal system cause a change in the walking pattern by the appearance of compensation mechanisms. The step slows down and shortens, the phase of the double supports is extended, the compensating shift of the center of gravity forward by the inclination of the silhouette takes place. These phenomena make it difficult to react to suddenly appearing obstacles, creating a high risk of falling. In addition, changes in the muscular system negatively affect the functioning of deep sensory receptors located in muscle tendons and spindles. Nerve conduction is also slowed down, resulting in a longer reaction time and disturbed integration of sensory and motor reactions. All of the above factors make it difficult to maintain balance as one of the key reasons for limiting physical activity of elderly people [2, 3, 4, 5, 7, 8].

Disease processes and related organ dysfunctions are internal risk factors for falls. Orthostatic decreases in blood pressure are a very important risk factor. It is noted that they accompany as many as 16 percent of the elderly and the treatment of hypertension may double the incidence of hypertension. Kario et al. In their studies [9] found that falls occurred 2.8 times more often in people with less than 140 mmHg pressure compared to people with a pressure greater than or equal to 140 mmHg. Among the diseases of old age there are numerous neurological disorders. These include stroke, transient ischemic attack, myelopathy, basilar artery and vertebral arteries, peripheral neuropathies. Especially often the Parkinson syndrome contributes to the fall. It increases the risk of falling by a factor of 10 by disturbing gait and balance. Staining is another factor that predisposes to falls. Behavioral disorders in the elderly in the form of agitation, wandering and psychotic symptoms combined with disturbances in the balance increase the risk of falling three times. Other diseases affecting, in particular, the elderly are cardiovascular diseases (myocardial infarction, arrhythmias), musculoskeletal diseases in the form of osteoarthritis limiting the scope of their mobility and pain. In addition, there are diseases of the genitourinary system manifested by urinary incontinence, which often cause social isolation of the elderly and overactive bladder syndrome. In this case, often on the way to the toilet accompanied by haste and inattention, which combined with disturbances of stability may result in a fall. The diseases that contribute to an increased risk of falls include metabolic, gastrointestinal and mental diseases [2, 3, 4, 8, 9, 10].

Pharmaceutical therapy plays a key role in the treatment of older people's diseases. A multitude of diseases is conducive to taking many preparations saved by a doctor, including those issued without a prescription. At the same time, along with the number of medicines taken, the risk of side effects increases, which are often closely related to the deterioration of

the balance system. It has been proven that taking more than 4 drugs significantly increases the probability of an elderly person falling down. Drugs whose use contributes to the increased risk of falls are: diuretics, anti-drugs, anti-diabetic and central nervous system such as phenothiazines, benzodiazepines and antidepressants. The mechanism of their action may impair the cognitive functions of older people, as well as lead to longer reaction time, disturbances of consciousness, increased orthostatic decreases in blood pressure or arrhythmias. The group of drugs which, according to research, have strong association with the occurrence of falls are psychotropic drugs. According to research carried out by Thapa and colleagues [11], falls in patients receiving antidepressants from the tricyclic group and serotonin reuptake were significantly more frequent than in the group of patients not taking psychotropic drugs. There was also a particular increase in the risk of falls in patients receiving antidepressants from the tricyclic group together with cardiac drugs. In addition, in studies carried out by Haney et al. [12], it was proved that the use of antidepressants from the tricyclic group is associated with a decrease in bone mineral density and a twofold increase in the risk of bone fracture during a fall. During the research on the risk of hip fracture during the use of benzodiazepines, a significant increase in the percentage of patients with fractures in the first two weeks of taking the drug and in treatments lasting over a month was noted. Obtained results may be the result of undesirable effects of benzodiazepines in the form of cognitive impairment [2, 3, 4, 11, 12, 13, 14].

External factors that increase the risk of falling are called all potential causes of falls, not related to the processes of invasive and invasive aging. External factors responsible for 30-50% of falls [15] include: poor lighting, improper footwear, time of day, slippery or uneven ground. According to research, the places where falls most often occur, is the flat and its immediate surroundings. The key factor is the lack of proper adaptation of the apartment to the needs of the elderly. This is often due to the reluctance to change the immediate surroundings to which the older person is accustomed. The reasons for the fall are often carpets, thresholds or stairs that the older person stumbles while walking. Other causes of falls include changing positions, such as getting up or sitting down and doing minor housework. Most often, falls happen while practicing sports and performing dangerous activities. This is due to avoiding physical activity and potentially dangerous situations as a result of inferior health and fear of injuries. According to a study conducted by Tinetti et al. [16] in people over 75 living in their own environment, the risk of falls increases linearly, along with the number of risk factors from 8% in people without factors to 78% in those who have 4 and more factors [1, 2, 3, 3, 13, 14, 15].

The consequences of falls

The importance of falls is closely related to their dangerous consequences. Falls in the elderly population are the main cause of injuries and associated disease states and mortality. Frequent injuries associated with falls are caused by slowing down defensive reactions and osteoporosis. The result is that even a minor fall can have serious consequences for an elderly person. The result of 10% falls are serious injuries to soft tissues in the form of wounds, concussions or intracranial hematomas. Often as a result of a fall, the elderly person does not suffer serious complications and damage, but is unable to lift himself from the floor, thus being exposed to long immobilization until he gets help from another person. This situation applies in particular to people living alone, who can only count on help if they notify their family or emergency services. Falling actions [1] Prolonged immobilization leads to pressure ulcers and hypothermia, which can result in death. About 5% of falls result in bone fractures, the most serious of which are fractures of the proximal femur, which are 90% the result of falls. Such fractures significantly reduce the quality of life of an elderly person, increase morbidity and mortality. In 50%, they lead to immobilization and reduction of physical

activity to a minimum. This predisposes to complications, eg contractures in the joints, pressure ulcers, pulmonary embolism, deep vein thrombosis or infection. The elderly person becomes dependent on the help of others and is unable to function independently in society. This creates a huge burden for the elderly person as well as the family and public health care. Another important consequence is the feeling of fear of another fall, which results in almost complete avoidance of physical activity.

The poupad syndrome affects 21-65% of people [16] who have suffered a fall, but it also occurs in people who have witnessed or got to know the effects of someone else. As a result of anxiety, the elderly person ceases to perform activities in which there is a risk of falling and limits physical activity to a minimum. The first symptom of an anticipatory anxiety is to stop leaving the house. A person who has experienced a fall takes a sedentary lifestyle, avoids walking and going shopping, becoming dependent and dependent on other people. Limiting physical activity leads to weakening of muscular strength, deterioration of posture control and drastically accelerates the process of physical weakness, which negatively affects psychological aspects. This results in an intensification of already existing anxiety and, in many cases, the first symptoms of depression. The predisposing factors for a poupadical syndrome are: female gender, visual and gait disturbances, deterioration of cognitive functions, perceiving oneself as ill and physically weak, sedentary lifestyle, low economic status and lack of emotional support. It can be concluded that the lack of implementation of an appropriate diagnosis, prevention and treatment program for the effects of falls deepens anxiety and is a predicator of subsequent falls [1, 2, 3, 16].

Risk assessment for falls based on individual diagnostic tests

The easiest way to assess the risk of falling is a medical history of past falls and the accompanying circumstances. According to the National Institutes for Clinical Excellence (NICE) in the United Kingdom, each patient reporting at least one fall over the past year, 43 should have a gait and balance test. This is helpful in selecting people and activities that are at risk of being able to fall in the future. In addition, the physical examination should include the assessment of the functioning of the nervous system, musculoskeletal system, the occurrence of orthostatic decreases in blood pressure, heart problems, characteristics of infection and visual disturbances. In addition to the physical state examination, the assessment of the mental state of the patient - cognitive function, fear of falling and depression is also crucial. An important issue is the choice of gait and balance assessment, which will allow you to reliably determine the risk of falling, with the greatest possible accuracy. Functional tests, combining physiological elements and functional requirements, which are a reflection of everyday activities of most people, are very popular. Their main advantages are the ability to use in all conditions, without the need for expensive equipment and a short time of carrying them out. This makes them a very practical and much cheaper method of gait and balance assessment than complicated technological measurements [17, 18,].

Timed Up & Go Test (TUG)

It is a modification of the Get-Up & Go test introduced in 1986 by Mathias et al. [19]. The modification carried out by Podsiadło and Richardson [20] is based on the replacement of the five-point scoring with the measurement of the test execution time. The task of the subject is to perform a few simple steps in the form of: getting up from the chair (seat located at a height of 46cm) from a sitting position with leaning backs, crossing a flat area of 3 meters, crossing the line ending the designated section, performing a rotation of 180 degrees, the next passage of the section 3 meters and return to a sitting position. The test begins with the command "start" to the person sitting on the chair and ends with the re-adoption of a stable sitting posture. The respondent tries to do the above tasks as quickly as possible but at the same time

safe for him. The time in which the subject performs the task is the basic parameter on the basis of which the risk of falling is assessed. It is assumed that a healthy young person is able to complete all tasks within 5 seconds. For people over 60, the average was 8 seconds to increase to 10-11 seconds in people over 80 years of age. The cut-off time, which differentiates persons with risk and without the risk of falling, is the time of completing tasks of 13 seconds. In Dite and Temple [21], there was a 89 percent fall-arrest probability in the fall reporting group and 93 percent prediction specificity in the no-fall group. In people with atrial organ damage 44, the test should be performed twice, recommending rotation to the left and in the next series to the right, in order to compare the symmetry [3, 21, 22].

Dynamic Gait Index (DGI)

It is a test evaluating gait and balance on the basis of 8 tasks to which the subject is subjected. These include: walking at different speeds, walking with the simultaneous turning of the head from side to side, walking with overcoming obstacles, turning while walking, ascent and descent from the stairs. Tasks are assessed on a four-level scale, where 0 means the inability to perform the task, 1 - moderate difficulty in completing the task, 2- minimal difficulty, 3 - correct task performance. During the test it is possible to obtain a maximum of 24 points. According to the research, getting 19 points and less confirms the existence of a fall risk with 69% sensitivity and 64% specificity. Normative values for healthy people were set at 23-24 points to 40 years of age, 22-24 points at the age of 40-60, 21-24 for people aged 70-80. In addition, the DGI test is used to assess the progress in gait rehabilitation accompanying multiple sclerosis, Parkinson's disease or stroke [3.21].

The Step Test

It allows you to evaluate the ability to maintain balance during dynamic activities typical for walking with overcoming obstacles. The test consists in measuring the number of zones of one limb per degree, 7 and a half centimeters in 15 seconds. The subject performs the task without any help, at the fastest possible rate, with a still second lower limb being in constant contact with the ground. The test is performed for both lower limbs. Healthy older people who are in good condition achieve results from 16.1 to 17.5 entries for 15 seconds. According to the study, in people over 65, the score below 11 is classified as an increased risk of falling in the future. While performing the test, the patient's belaying is important. The activity requires a lot of physical effort, so that the elderly person is exposed to sudden loss of balance resulting in a fall [21].

Stop Walking When Talking (SWWT)

It is a simple test that allows you to assess the severity of attention during a walk. It consists in checking if the subject is able to continue the walk at the same time when the conversation starts unexpectedly. Retention of the subject may indicate a risk of falling as a result of a decrease in the efficiency of cognitive functions being one of the components of motor control. In their research, Andersson et al. [46] showed a 15% sensitivity and 97% specificity of the SWWT test in detecting the risk of falls of older people [22, 23].

Four Square Step Test (FSST)

allows you to test the ability to move the subject in all directions while overcoming the obstacle. To perform the test, it is necessary to use four sticks with a diameter of 2.5 cm and a length of 90 cm placed on the floor in the shape of a plus sign (+). The canes define four fields (Fig.13), which are marked with numbers 1, 2, 3 and 4. The task is to pass in the shortest possible time successively through the fields in the designated order (2, 3, 4, 1, 4, 3, 2

and 1). When passing through sticks, the examined person must be facing in one direction, thus moving in different directions (forward, backwards, sideways). The task execution time is the result of a test based on which the risk of falling is assessed. Studies have shown that performing a task in 15 seconds or more indicates an increased risk of falling and requires further tests to confirm the occurrence of a fall hazard. The FSST test is characterized by 89% sensitivity and 85% specificity in the differentiation of people who have experienced 2 or more falls with persons falling less frequently in the last 6 months [24]. Functional tests, used in assessing the risk of falls in the elderly, are characterized by a large variety of forms. During the determination of the risk of falling, the researcher should base his assumptions on the results of several tests assessing various activities accompanying the performance of daily activities by the elderly. This reduces the risk of misinterpretation of the tests, resulting from the inability to objectively evaluate the test [2].

Prevention of falls of older people

According to studies by Tinetti et al. [25] preventive activities should be multi-directional and refer in particular to: patient education, improvement of muscle strength and balance, reduction of medication, elimination of household risks and avoidance of orthostatic hypotension. Exercise exercises - kinesiotherapy are aimed at strengthening the muscles of the lower limbs, improving the balance and stability of the body. Physical exercises supported additionally by physiotherapy in the form of treatments with the use of heat, ultrasounds, etc. can have analgesic and anti-inflammatory effects. It is recommended that kinesiotherapy be performed systematically and also include elements of teaching safe change of patient's position and proper post-fall behavior. The broadly understood patient education also plays a key role. The elderly should be informed about the risk factors of falls and how they can be prevented. Drops often occur as a result of a sudden drop in pressure. The elderly should learn the correct technique of getting up - first sit on the bed and then get up. Additionally, she should be informed about the necessity of easy access to the telephone in order to call for assistance in the event of loss of stability and fall [26, 27].

Another element of fall prevention is proper adaptation of the environment in which an elderly person lives. This is possible, among other things, by fitting appropriate handrails to facilitate getting up and moving around. Particular places are stairs and toilet. Pay attention to the placement of furniture that can not hinder the free movement of an elderly person after the apartment. The cabinets should be of adequate height, so that the elderly person does not have to stand on his toes, bend down or use a chair to reach things.

The most necessary items should be placed in easily accessible places. The room in which the elderly person is staying should be properly lit with additional lamps. It is also important to have the right height of the bed, which should be 50 cm high, which will allow an older person to get up more easily. Chairs and armchairs should be equipped with high backrest and handrails, also facilitating getting up. The floor surface should be smooth, with a limited number of rugs, which can easily be caught while walking. In addition, the thresholds between rooms, which also pose a threat to the elderly, should be removed. In the bathroom, one should remember about the right number of handles, handrails and non-slip mats. Instead of a bathtub, mount a shower with a folding chair that facilitates washing [3, 26].

In the prevention of falls, if necessary, provide an elderly person with auxiliary equipment. The walking stick, the walking frame and other equipment support the stability while walking and can protect the patient from falling. Additionally, it is necessary to educate the correct use of help during the walk. The elderly person may, if necessary, wear glasses or a hearing aid. It helps to control gait by means of the senses: hearing and walking. An important element is the selection of the correct footwear, which should be light and easy to put on [3, 4, 26, 28]. According to the National Institute for Health and Clinical Excellence (NICE) from the

United Kingdom, there are as many as 400 risk factors for falls. In order to improve the process of preventing the falls of older people, the processes of educating the public should be developed in order to increase the awareness of threats and the scale of their elimination from the living environment of older people. In addition, patients of geriatric wards should have standard examinations to determine functional fitness and fall risk based on appropriate scales and tests. This will allow you to enter an individual exercise program to improve your balance and gait. This is a priority issue because it provides the elderly person with the opportunity to move independently, which determines the independence and the possibility of a satisfying senior's existence. This indicates the need to develop geriatric rehabilitation, including daily departments, which should translate into a reduction in disability and reduced costs of care [2, 26, 28].

Summary

The phenomenon of aging of society has caused the emergence of new challenges before the modern health service. In order to ensure the best quality of life for the elderly, diagnose existing diseases and introduce programs preventing the development of diseases of old age should be diagnosed as soon as possible. This is one of the tasks of the Geriatric Comprehensive Assessment, in which a team of specialists, composed of a physiotherapist, is tasked with assessing the state of health and planning individualized therapy, aimed at improving the quality of life and functioning of the elderly person. Any undetected disturbances in the movement system and balance lead to an increased risk of falling. Fall and its consequences, lead to a decrease in the quality of life and disability of a senior. In order to prevent the consequences of falls, it is necessary to implement specialized diagnostic tests in the form of Tinetti and Berg tests for every elderly person reporting a fall in the past.

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