

# Rehabilitation in elderly patients with dizziness and balance unsteadiness

**Authors' Contribution:**

A – Study Design  
B – Data Collection  
C – Statistical Analysis  
D – Data Interpretation  
E – Manuscript Preparation  
F – Literature Search  
G – Funds Collection

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**ABSTRACT:**

**Introduction:** In elderly patients the dizziness and balance disorders may be elicited by the central nervous system dysfunction on various levels, caused by aging process and the coexisting diseases. The aim of the study was to assess the efficiency of rehabilitation in elderly patients with dizziness and balance unsteadiness.

**Material and methods:** Out of the 84 patients over 65 years, with central vestibular impairment diagnosed in videonystagmography VNG, 31 with dizziness and balance unsteadiness, were enrolled to the study. Otolaryngological examination, Tinetti test, Time and Go test (TUG) and Functional Reach (FR) tests were conducted in all patients. They were assessed twice before and after 2 weeks of vestibular rehabilitation (VR). Training sessions took place five times a week.

**Results:** Statistically significant improvement in total DHI and 3 subscale were observed after therapy. As many as 70% of patients presented better outcome in the gait and stability tests - in Time and Go test (TUG) an average score of 15.3 seconds, in Tinetti test an average of 22 points (low chance to fall) and in the FR test 27 cm were observed.

**Conclusion:** In elderly patients, vestibular rehabilitation is a method that significantly improves posture and gait stability. In ageing patients with dizziness and unsteadiness clinical, functional and objective tests could confirm diagnosis and monitor VR therapy.

**KEYWORDS:**

unsteadiness, dizziness, aging

Dizziness can be caused by disorders of the central part of the vestibular system on various levels. They may be elicited by the process of aging as well as coexisting systemic diseases such as cardiovascular diseases, hypertension, osteoporosis, depression and anxiety, sleep disorders, nicotine use, motor function impairment and use of many drugs e.g. antidepressants, anti-anxiety medications, diuretics, antibiotics such as aminoglycosides [4,14].

According to literature, the noted frequency of central vestibular disorders is that of 7 to 45%, with higher prevalence among women [16,25,27]. While describing their symptoms, patients usually report disorientation, light-headedness, notion of movement inside their heads, disequilibrium, rocking, shoving, flowing, and blurred vision. These symptoms can last a few seconds and can also be absent during the examination. In currently being prepared ICD-11 classification World Health Organization describes dizziness as PPPD – Persistent Postural Perceptual Dizziness [26].

Cognitive disorders and spatial orientation disturbances often coexist with dizziness in elderly patients which may contribute to falls and causes fear and panic in these patients [13]. The consequences may include contusions, fractures or immobilization. Those significantly worsen the patients' quality of life, are causes of depression, limitation of physical fitness and permanent disability with significant worsening of the quality of life [20].

In the central balance system dysfunction a mechanism of compensation is activated, but comparison with symptom withdrawing after peripheral injury, is a slower and less permanent process [8,11,18,21]. Advanced age, internal diseases, used medications, lack of physical activity can all negatively influence symptom remission as well as cause temporary decompensation. Vestibular rehabilitation (VR) is based on the mechanism of central nervous

system neuroplasticity due to the processes of adaptation, habituation and substitution [10]. The aim of VR exercises is to improve the visual-vestibular interaction during head movements and to stimulate the proprioceptive functions which translates into reduction of dizziness and disequilibrium [1]. VR is indicated in patients in whom the process of compensation is insufficient. The success of the therapy depends on its systematic and continues performed individually design exercises [1]. The use of rehabilitation as a form of treatment leads to improvement of stability and has a positive effect on the mechanisms involved in the process of compensation [19].

The aim of the study is to assess the efficiency of rehabilitation in elderly patients with dizziness and balance unsteadiness.

## MATERIAL AND METHODS

Out of the group of 84 patients aged over 65 years with dizziness, balance unsteadiness and central vestibular system impairment diagnosed in videonystagmography (VNG). The patients were diagnosed in Balance Unit of the I Department of Laryngology of the Medical University in Lodz in years 2015-2016, a group of 31 patients was analyzed, mean age  $71.8 \pm 5.7$  years, median age 71 years, who have completed rehabilitation in the Rehabilitation Unit of the Medical University in Lodz University Teaching Clinical Hospital no. I.

All the patients were examined twice – before enrollment to the study and after completed rehabilitation. They filled a survey concerning their symptoms, conditions and coexisting diseases as well as the DHI (Dizziness Handicap Inventory) questionnaire which is a self-report questionnaire of physical state comprising 25 questions (max 100 points) in three categories: functional (F – 36 points), emotional (E – 36 points) and physical (P – 28 points). Scores in the range of 100-70 indicate severe handicap, 69-40 points – moderate, and 39-0 points – a mild form of handicap. Otoneurological examination was conducted in all of the patients, with Romberg's test, evaluation of gait and balance according to Tinetti score, evaluation of stability limitations in Functional Reach (FR) test and Timed Up and Go (TUG) test.

Tinetti score is a score in which maximal number of points is 16 points for balance assessment and 12 points for gait assessment. A patient with a sum of under 19 points is among the group of patients with high risk of falling, a score of 19-24 means that the patient has tendency to fall, and 24 points indicate low risk or lack of fall risk.

FR test serves as a balance and fall risk evaluation tool in the population of elderly patients. While performing the test the ex-

amined person is sitting with one side near the wall, the upper extremity that is closer to the wall being flexed to  $90^\circ$  at the glenohumeral joint. The patient's task is to lean forward in the way that the feet stay immobilized and in contact with the ground and the pelvis remains in its place. The leaning distance from the vertical position is measured in centimetres. Dite and Temple assume. A result of  $> 25$  cm for distinguishing patients affected by multiple falls from those falling occasionally [6]. Many studies show dissonant values for abovementioned test. On average, assumed values are below 18.5 – 25.4 cm [6,7].

Timed Up and Go test assesses the risk of falling. Patient is sitting on the chair and on the command of "stand up and go" the patient is getting up from the chair, walking for 3 metres, turning around, walking back and returning to sitting position. Time needed by the patient to accomplish the task is measured (in seconds) and the processes of getting up, walking and stability are analyzed. The result of  $< 10$  seconds did not indicate risk of falling, 10-19 seconds indicated low risk of falling, and  $> 19$  seconds - high risk of falling.

VNG examination (Ulmer SYNOPSIS 2008) was performed in all subjects. VNG examination consisted of registration of spontaneous nystagmus with eyes open and closed, registration of positional nystagmus, rotatory chair test, Fitzgerald-Hallpike caloric test, smooth pursuit test, optokinetic test and saccades test. Each examination underwent individual qualitative interpretation. Central vestibular system disorder was diagnosed when at least three results were abnormal: saccades test, smooth pursuit or optokinetic test, qualitative changes in caloric test, prevalence of direction or irregular recordings in rotatory chair test, presence of Nylen type I or type III nystagmus in positional test.

The process of rehabilitation involved a set of exercises individually chosen for the patient, done for the period of 2 weeks, five times per week for 45 minutes. Patients were assessed twice, before enrollment to the study and after finishing treatment. The conducted study was approved by the Bioethics Committee of the Medical University in Lodz (approval no. RNN/232/16/KE).

The statistical analysis was carried out using STATISTICA 13.0 software. Mean values were calculated together with standard deviations and medians. The normality of distribution was checked with the Kolmogorov-Smirnov test and Shapiro-Wilk test. Comparisons of the dependent variables which distributions did not differ significantly from normal distribution with assumed level of significance of  $p = 0.05$  were performed using Student's t test for dependent variables and in case of rejection of the hypothesis about the normality of distributions Wilcoxon signed-rank test was used.

## CONCLUSIONS

In the group of 31 patients with dizziness and balance disorders central vestibular disorder was diagnosed in VNG examination in 17 patients (54.5%). Peripheral vestibular disorder coexisted in 14 subjects (45.1%). Central disorder was diagnosed more often than coexisting central and vestibular disorder which was statistically significant ( $p < 0.05$ ). 11 examined patients (35%) presented with tinnitus, hearing deficit and transient neurological disorders in the form of vision disorders, diplopia and cognitive disorders. 19 patients (61%) were being treated for arterial hypertension, 7 (25%) for ischemic heart disease, and type II diabetes was present in 2 subjects (6%). History of head injury was reported by 4 subjects (13%).

Comparing the results DHI questionnaire before before enrollment to the study and after finishing treatment the greatest difference was found in general scoring i.e. 7.2 points ( $p < 0.005$ ). A lesser difference was found in physical (2.6 pts), emotional (2.1 pts) and functional subscales (2.5 pts) (Table 1). Taking into account scoring change after treatment, scoring reduction from the “severe” type of handicap (70-100 pts) to “moderate” (40-69 pts) type was observed in 6 subjects, and from “moderate” (40-69 pts) to “mild” (0-39 pts) - in 5 subjects.

After analysis of the results obtained in functional tests after rehabilitation an improvement of 4 seconds was seen in Timed Up and Go test, with mean result of 15.3 seconds, and the differences were statistically significant ( $p < 0.000034$ ) (Figure 1).

In Tinetti test on patients patients after rehabilitation scored 22 points, averagely, which is an improvement of 3 points (Figure 2). These differences were statistically significant in comparison with the results obtained before treatment ( $p < 0.000029$ ).

In reaching test mean result was 27 cm. Regarding the result of reaching test before rehabilitation an improvement of 1.9 cm was noted. This result was statistically significant ( $p < 0.001$ ) (Figure 3).

22 patients (70%) improved after treatment. The greatest improvement applied to the Time Up & Go test – 22%, in Tinetti score it was 18%, and in Functional Reach test 8% of patients improved after rehabilitation (Figure 4).

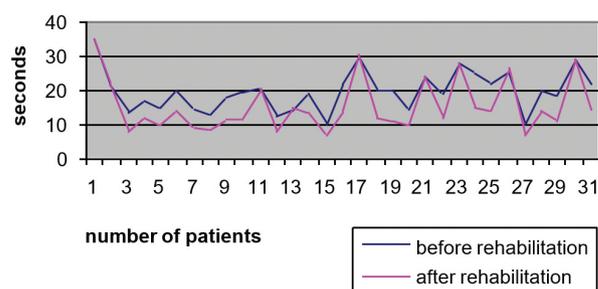
## DISCUSSION

In the study we made an attempt to evaluate the efficiency of rehabilitation in elderly patients with dizziness and balance disorders. The examined group were subjects of mean age of above 71 years, all were retired. The most frequent coexisting disease was arterial

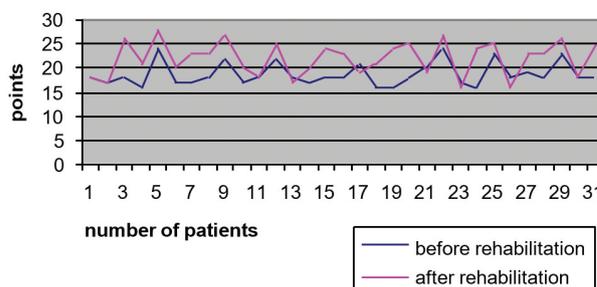
**Tab. 1.** Results of the DHI questionnaire in points at patients before and after treatment (n = 31).

	BEFORE TREATMENT	AFTER TREATMENT	DIFFERENCES
Overall scoring	55.7 ± 19.66	48.5 ± 17.84*	7.2
P subscale – physical	17.6 ± 4.60	15.0 ± 4.15*	2.6
E subscale – emotional	17.6 ± 8.75	15.5 ± 7.53*	2.1
F subscale – functional	20.5 ± 9.97	18 ± 9.59*	2.5

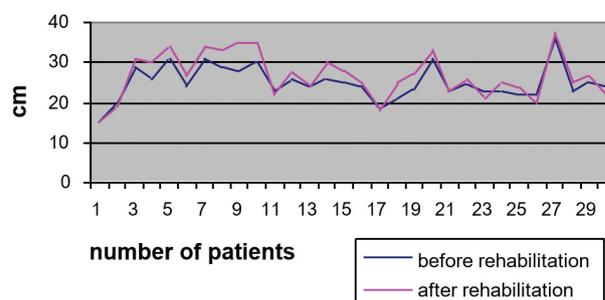
\*  $p < 0.005$



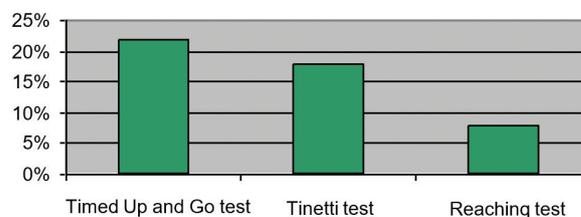
**Fig. 1.** Time & Go Test results before and after rehabilitation in the group of 31 patients.



**Fig. 2.** Tinetti test results before and after rehabilitation in the group of 31 patients.



**Fig. 3.** Functional Reach test results before and after rehabilitation in the group of 31 patients.



**Fig. 4.** Improvement in functional tests after the rehabilitation in the group of 31 patients.

hypertension (61%) in more than half of the cases. After two-week physiotherapy within clinical study significant improvement was observed in 70% of subjects in functional tests, Timed Up and Go test, reaching test, and Tinetti score of gait and balance, which indicates efficiency of the used treatment. Initially, vestibular rehabilitation was used in patients with peripheral vestibular system disorders, yet many authors underline its efficiency in elderly patients with symptoms of dizziness [8,11,18,21]. Thompson et al. [22] evaluated the efficiency of vestibular rehabilitation in 26 patients with PPPD. They observed an improvement in 14 subjects. Tsukamoto et al. [23] carried out studies in 20 subjects aged above 60 years with chronic dizziness lasting from 3 to 36 years. They noted a decrease of frequency and intensity of dizziness and balance disorders in almost all patients (90%). Brown et al. [3] also found improvement after the use of kinesiotherapy in 48 elderly patients with central vestibular system disorder.

In authors' own research statistically significant decrease of total scoring and of scores of all subscales of DHI questionnaire was found after treatment. Similar results were shown e.g. by Meli et al. [15] who examined patients of approximately 50 years of age presenting with dizziness and confirmed high efficiency of VR in the vast majority of the patients. Romero et al. [17] also observed a decrease of scoring value of this questionnaire after treatment. Many authors confirmed the usefulness of DHI questionnaire in the evaluation of physical, just as functional and emotional state in patients with balance disorders [3,15,17,23]. Vereeck et al. [24] found that in 214 patients with dizziness and instability of different origin clinical functional tests, e.g. those which we were conducted in the above described group of patients, correlate best with the results of DHI questionnaire. Brown et al. [3] noted an improvement in patients undergoing VR with evaluation of DHI score and Timed Up and Go test. They observed a decrease in general scoring of DHI and shortening of time needed to perform the Timed Up and Go test, similarly as it was in the presented study.

In described patients the improvement of results was observed in TUG and FR tests. This is similar to the results obtained by

Tsukamoto et al. [23] who evaluated patients using DHI questionnaire, TUG and FR tests. These authors observed an improvement both in clinical tests and in self-reported evaluation in DHI questionnaire, similarly as it was in our study. We also found the increase of 3 points in general scoring in Tinetti balance and gait test. Kao et al. [12] also observed an improvement of results while evaluating patients in Tinetti test and TUG test. They carried out the study in the group of 41 patients who were undergoing rehabilitation at home or under the supervision of physiotherapist. In both variants of treatment they observed an increase of scoring in Tinetti test and a decrease of time needed for performing TUG test of approximately 2 seconds.

Both own research and the results reported by other authors show that vestibular rehabilitation is an effective treatment of balance disorders and not only vertigo, but also dizziness [15]. Using the set of e.g. Cawthorne-Cooksey exercises, which involve movements of the head, eyes and whole body, favors induction of central compensation of these disorders [5,23]. Primary and secondary symptoms appearing in vestibular apparatus disorders are being suppressed by rehabilitation [9]. These proceedings play significant role especially in elderly patients as they allow these patients for an independent existence and improvement of the quality of life [25]. This situation applies to even bigger group of patients because of the aging of population. Treatment and care of the elderly patient with dizziness and balance disorders is thus both a clinical and a social problem.

## CONCLUSIONS

Vestibular rehabilitation is a method which is positively assessed by the patients and which significantly improves posture and gait stability in elderly patients.

In aging patients with dizziness and balance disorders clinical, functional and objective tests could both confirm diagnosis and monitor VR therapy.

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