The Analysis of Postural Stability and the Risk of Falls After the Ischemic Stroke of the Brain - the Preliminary Report

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Abstract: The aim of the work is the analysis of postural stability and the risk of falls at persons after ischemic stroke of brain in reference to persons with the disease of the intervertebral disc.

Thirty persons were studied (15 - after ischemic stroke, 8 women and 7 men, and 15 - with disease of intervertebral disc in the lumbar section of the spine, 6 women and 9 men) in the sharp period of the disease. The investigation consisted in execution of tests on postural stability and the risk of falls with using of the dynamic platform (Biodeks SD) on the beginning and on the end three weeks lasting the therapy. Results of Postural Stability like the risk of falls while duration of the therapy, in both studied groups, were changed. Group of patients after the ischemic stroke of the brain showed higher values in the test of postural stability and the risk of fall than the patients with the degenerative changes lumbar section of the spine. Persons with the disorders of the central nervous arrangement manifest the larger risk of the fall than the orthopedic patients. The larger quantity of inclination noted down in the arrow and frontal plane during the test of postural stability at patients with neurological disorders.

Keywords: Postural control, Stroke, Intervertebral disc disease, Risk of falls.

INTRODUCTION

Balance reactions are highly developed form of automatic motion patterns. These processes take place dependently to level of maturity of structures of central nervous system and lead to increased level of cerebral cortex control over lower centers [1-3]. Neurological system and muscle systems and especially mechanism of posture reflex are of fundamental importance in body posture forming. Mechanism of posture reflex actively works against gravity and controls posture when in action (postural control). The result is harmonious, smooth and economical human activeness [4]. Mechanism of posture reflex consists of: postural tension, reciprocal innervation and correct postural and motion patterns. Postural tension should not be mistaken with individual muscle tension nor functional group tension. It is distributed all over motion patterns. Its size and distribution depend on reflex activeness, body position and emotional conditions. Basic postural tension develops gradually from peripheral stabilization and central hypotonic into central stabilization and peripheral mobility. Centre of gravity moves as a result of the development of postural tension [5]. Correct postural tension is high enough to work against gravity and low enough to keep ability to move in controlled order [6]. Another component of posture reflex is reciprocal innervation which is defined as follows, basis for structural and functional organization of individual muscle groups in respect to mutual activeness of agonists, antagonists, synergists and stabilizing muscles [3]. Set and balance standards are too components of posture reflex. As a result of correct balance and extension reactions, an individual body posture is formed. All anomalies in any of the above mentioned elements of antigravity mechanism cause disturbances in function and structure of the others. In consequence, psychomotor development may be disturbed and skeleton and muscle system deformed [6]. Incorrect posture may be the cause of abnormal distribution of muscle tension and often pain and overload not just in motion system but other organs as well. Balance is certain definite condition of postural system, characterized by vertical orientation of body achieved thanks to counteraction to forces and their momentums acting on body. Stability means ability to regain state of balance. In case of human posture, stability is defined as the ability to regain typical body position in space, lost as a result of action of destabilizing factors [7]. Posture stability is not just effect of correctly developed motion system, well-functioning nervous system and labyrinth, organs of deep sense and sight. Postural stability is much wider issue, for more complex and related to possible dynamic properties and characteristics of all systems engaged in holding balance. This relates largely to efficiency of motion organs, promptness of reaction and decision making and ability to analysis contradictory information about present body condition, including position of all body parts, their speed and acceleration. Postural stability is both biomechanical and

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physiological issue [7]. The aim of the work is the analysis of postural stability and the risk of falls at persons after crossed ischemic stroke in reference to orthopedic patients.

MATERIALS AND METHODS

Thirty persons were involved in the study, in acute and under acute period of the disease (15 - after ischemic stroke, 8 women and 7 men, 15 - with the disease of intervertebral disc in the lumbar section of the spine - 6 women and 9 men), from 45 to 60 years old. The investigation consisted of patients balance condition check as a postural stability and the risk of falls, on Biodeks SD dynamic platform, before and after six weeks therapy. Biodeks SD dynamic platform examination performed on the first day of the therapy involved precise evaluation of centre of gravity distribution, projected on the surface of support. Afterwards postural stability static test and the test of the risk of falls was performed. The test on postural stability was executed on the stiff platform, however the test of the risk of falls on changing every several seconds, automatically, the angle of the inclination of the plane. Patient stands freely on the platform, facing to the monitor and tries to keep cursor in the middle of rings shown on the monitor. The lesser deviation from the middle was the better test result. Test lasts 20 seconds. It was performed three times during each examination. The device gather all the records and sends them on to computer. Every each test is safe to patients and performed in the presence of physiotherapist and under doctor's supervision. Patients after ischemic stroke and patients suffering from motion organ ailments (degenerative spine disease) were included in the research. Excluded were patients suffering from balance disturbances related to labyrinth and sight (failing eyesight) diseases, as well as patient in pain disabling walking and standing functions. I used some methods of the statistical analysis like: the calculation of the basic parameters of the schedule of studied features, the investigations of the schedule of parameters using the Shapiro-Wolf, for dependent tests to the investigation of the significance of differences were used t-student test and for the non-parametric, test U Manna – Whitneya.

RESULTS

Results were obtained in calculation of basic parameters of researched features distribution and on the basis of parameters distribution examination using Shapiro-Wilk test. In most of the cases distribution was significantly different than normal. It was used for dependent tests to the investigation of the significance of differences t-student test, for the remaining steams of cases the non-parametric test U Manna-Whitneya. Significance level a=0.05; Statistic 10.

In the postural stability test the opinion was subjected the patients inclination in the arrow plane (anterior and posterior) and in front plane (medial and lateral) (Table **2**). It was checked also the % time of sojourn the canter of the body mass (bmc) in individual quarters appointed on monitor (Table **3**).

At 0.05 significance level a statistically significant difference is found between the results obtained before and after the therapy in the following parameters: Medial (p=0,037) and LatL (p=0,033) among the orthopedic and the neurological patients. There is no significant difference in Anterior (p=0,233) and PostL (p=0,202) (Table **2**).

There is no significant difference between parameters Quads1, Quads2 and Quads3 among orthopedic and neurological patient (Table **3**).

Table 1: Descriptive Statistics

Descriptive statistics	N	Mean	Median	Minimum	Maximum	Deviation
Anterior Orthopedic	15	0,371	0,286	0,184	1,158	0,237
PostL Orthopedic	15	0,341	0,297	0,189	0,879	0,164
Medial Orthopedic	15	0,292	0,172	0,084	1,767	0,415
LatL Orthopedic	15	0,268	0,208	0,112	1,009	0,215
Anterior Neurological	15	0,565	0,456	0,107	1,424	0,422
PostL Neurological	15	0,506	0,335	0,139	1,268	0,334
Medial Neurological	15	0,794	0,341	0,077	4,256	1,053
LatL Neurological	15	0,651	0,344	0,103	2,960	0,732

Table 2: Comparison of Two Groups Significance Differences of Results in Anterior, PostL, Medial, LatL Before and After Therapy

U-Mann-Whitney	Sum. ranks Orthopedic	Sum. Ranks Neurological	U	N Orthopedic	N Neurological	p
Anterior	203,0	262,0	83,0	15	15	0,233
PostL	201,0	264,0	81,0	15	15	0,202
Medial	182,0	283,0	62,0	15	15	0,037
LatL	181,0	284,0	61,0	15	15	0,033

Table 3: Inclination of Body Mass Centre in Individual Quarters

U Mann- Whitney	Sums of ranks	Sums of ranks	U	N	N	p
Quads1	255,0	210,0	90,0	15	15	0,367
Quads2	221,0	244,0	101,0	15	15	0,653
Quads3	213,5	251,5	93,5	15	15	0,436

There is also no significant difference between parameters Quads4 among orthopedic and neurological patient (p=0,842) (Table **4**).

The average time of inclination body mass centre was subjected in test on the risk of falls in a period of duration the whole test (unstable plane) (Table **6**).

At 0.05 significance level there is no statistically significant difference between the average time of inclination body mass centre in test on the risk of falls among orthopedic and neurological patient (p>0,05).

DISCUSSION

There are reports on balance disturbances, their mechanisms and causes in neurological patients [8, 9, 10, 11]. Postural Control significantly affects coordination, manual efficiency, muscle tension in limbs and limbs' optional functions [12, 10]. Balance is certain definite condition of postural system, characterized by vertical orientation of body achieved thanks to counteraction to forces and their momentums acting on body [13, 14]. Balance is maintained by nervous system through reflex tension of muscle

Table 4: Inclination of Body Mass Centre in Individual Quarters

t-Studenta test	Mean Neurol.	Mean Ortoped.	p	N Neurol.	N Orthoped.	Deviation neurol.	Deviation ortoped.
Quads4 Neurological vs. Quads4 Orthopedic	41,600	43,267	0,842	15	15	22,557	22,874

Table 5: Descriptive Statistics for the Risk of Falls Test

Descriptive statistics	N	Mean	Median	Minimum	Maximum	Deviation
OverallL1Ortopedyczni	15	2,100	1,900	1,000	4,100	0,838
OverallL2Orthopedc	15	1,604	1,375	0,663	3,401	0,862
Difference OverallL Orthopedc	15	-0,496	-0,667	-1,614	0,685	0,580
OverallL1Neurological	15	3,020	2,200	0,400	11,400	2,807
OverallL2Neurological	15	2,072	1,104	0,205	6,000	1,808
Difference OverallL Neurological	15	-0,948	-0,546	-5,400	-0,164	1,299

Table 6: Comparison of Significance of Difference Results of Inclination of Body Mass Centre Before and After Therapy in Both Groups

U-Mann-Whitney	Sum. ranks Orthopedic	Sum. ranks Neurological	U	N Orthopedic	N Neurological	p
OverallL1	225,0	240,0	105,0	15	15	0,775
OverallL2	232,0	233,0	112,0	15	15	1,000
Difference OverallL	249,0	216,0	96,0	15	15	0,512

groups called postural muscles or antigravity muscles [13, 15, 16]. The above definition refers to motion organ condition in static circumstances – static balance [7, 17, 18]. Balance may be investigated, in dynamic circumstances, as ability to maintain straight up position linked with deviations and motion without falling – dynamic balance [7, 1719]. Body balance may be investigated in frontal and sagittal planes. In frontal plane investigated is the shift of weight onto both lower limbs. In sagittal plane body deviations were described by Nasher as three fundamental strategies ensuring regaining lost balance in a given plane: feet, hips and steps strategy. These strategies show close cooperation of nervous and motion systems. Feet strategy is active when standing on firm ground and ensures little torso deviation in reaction to balance loss. Horak and Nasher first reported about this phenomenon in 1986. Feet strategy enables deviation of torso without engaging other balance strategies (hips and steps) in 8° frontal deviation and 4° back deviation. It constitutes a very important strategy for it is active first when balance is lost. Hips strategy is mostly employed after action of a fast stimulus which is more posture disturbing. Balance maintenance in sagittal and frontal planes requires intensive work from limbs and torso muscles. In our own research significant results were related to body deviation in sagittal plane, which proves Horak and Nasher's (1986) observations (test in static conditions activates feet strategy first). Following the dynamic platform test results and thorough patients examination (in respect to physiotherapy according to ICF) may well enable a closer look at mechanisms of disturbed balance reactions in the group of patients after the stroke and suffering from motion organ diseases (degenerative spine disease).

The conclusions is that the assessment of postural stability showed the larger quantity statistically essential inclination in the front plane at patients with neurological disorder. Patients group after the ischemic stroke of the brain showed higher values in the test of the risk of the fall than the patients group with degenerative changes of the section of the lumbar spine. Patients group after the ischemic stroke of the brain showed higher values in the test of the risk of the fall than the patients group with the degenerative changes of the section of the lumbar spine.

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