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Original Article

Comparison of motor functions according to stroke type in hemiplegic patients with a specific level of disability

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Abstract

Aim: Stroke is basically classified as hemorrhagic and ischemic etiologically. Stroke type can be a factor influencing recovery and evidence is insufficient on this issue. Therefore, the purpose of study is to compare motor and functional recovery in terms of stroke type.

Material and Methods: 20 patients with stroke between 30 and 65 years of age participated in the study voluntarily. The volunteers were grouped according to the stroke type as ischemic (n=10) or hemorrhagic (n=10). Disability levels of patients determined using Functional Independence Measure (FIM). The patients were compared with isokinetic knee strength, static-dynamic balance test, and 6-minutes walking test according to stroke type.

Results: According to isokinetic strength test results, no statistically significant difference was found between groups in the parameters of hemiplegic side knee extension peak torque, knee flexion peak torque, values obtained in the flexion and extension phases of the average power, total work in the flexion phase and extension phase of the movement and hamstring/quadriceps (H/Q) muscle groups strength ratio ($p>0.05$). According to the data of balance test and 6-minute walk test, no statistically significant difference was found between groups in the parameters of balance indexes and test completion time and 6 minute-long walk distance ($p>0.05$).

Conclusion: It was concluded that a stroke's being ischemic or hemorrhagic did not create a difference in the recovery of motor function such as strength, balance, and walking. The fact that there are contradictory results and that there is no consensus shows that more studies are required in literature.

Keywords: Hemiplegia; Stroke type; Motor function; Disability.

INTRODUCTION

According to the World Health Organization data, cerebrovascular disease-related stroke is the third reason of mortality following cardiac diseases and cancer (1). It is also the most common reason for injury/disability (2). Paralysis, focal or global cognitive function disorders, balance problems and in addition to these sensory perception motor association disorders are seen in the opposite body half of cerebral lesion area (3). Etiologically, a stroke occurs as a result of ischemic hemorrhage with a rate of 75-80% and as a result of subarachnoid or intracerebral hemorrhage with a rate of 20-25% and it is most basically classified like this (4). In addition to the type of stroke, the rate of mortality and morbidity depends on age and comorbid diseases such as hypertension, cardiac disease or diabetes in stroke (5).

In cases that have developed hemiplegia, motor disorders which cause morbidity are seen following ischemic or hemorrhagic stroke. These are muscle paralysis, motor control, and coordination disorders, muscle tone and balance disorders (6). One of the most important results which cause morbidity following stroke is the complete or partial loss of walking function. Regaining walking function is one of the most important functional goals and it has been reported that only 60-70% of patients can reach this goal (7). There are many tests to assess walking function. Of these, 6-minute walk test is a practical and objective test that can be used in patients with stroke who can walk independently or with a walking aid (8). Another most frequent significant symptom of a stroke is muscle paralysis (9). Paralysis occurs as weakness, weak control and with recovery, movements are first

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seen as a synergy pattern and later isolated movements independent of synergy may occur (10). Although there are a great number of strength assessment methods in stroke patients, the isokinetic system (11) is accepted as the golden standard in muscle strength assessment (12). In a stroke, improvement in motor functions is assessed with Brunnstrom staging system, while tonus increase is assessed with the Modified Ashworth Scale (MAS). Both methods are frequently used in stroke patients in clinic and researches (13). Finding out the level of disability is important in stroke in terms of the course of recovery. FIM is a commonly used scoring in finding out the level of disability-specific for stroke (14).

It is known that following the cerebrovascular event, a limited neuroplasticity window opens in time in living beings and meanwhile the greatest attainments occur in recovery. That is, a certain amount of motor and functional recovery is seen following stroke (15). In a stroke, plasticity and the development of compensatory mechanisms are extremely important for motor and functional recovery (16). Regaining motor functions and increasing the individual's quality of life is one of the most important rehabilitation goals. Type of stroke is an important factor in shaping the lesion and mechanisms. When literature is reviewed, it was found that the topics of the effect of stroke type on quality of life, mortality-morbidity, disease prognosis and frequency (17-19) were researched, while the evidence to show the effect of ischemic or hemorrhagic stroke type on the motor and functional recovery was not sufficient. For this reason, the purpose of this study was to examine the effects of different dynamics occurring as a result of stroke type on the recovery of functional skills such as walking, balance, and strength and to contribute to the literature.

MATERIAL and METHODS

Study Groups

Local Clinical Researches Ethical Board approval was taken for the study (2018/95). Of the stroke patients between the ages of 30 and 65 who referred to Physical Medicine and Rehabilitation polyclinic, 20 patients voluntarily participated in the study. Power analyses was made for determination of sample size. According to isokinetic strength test at least 9 patients in each group were determined to be. The volunteers were informed about the study and they signed consent forms. The volunteers were grouped in two as ischemic stroke group (ISG) (n=10) and hemorrhagic stroke group (HSG) (n=10) according to the type of stroke. In ISG, 4 of the patients were female and 6 were male, while the number of male and female patients was equal in HSG.

Inclusion-Exclusion Criteria

Patients who had a stroke for more than a year and less than two years and who had not received physiotherapy-rehabilitation therapy for the past 6 months were included in the study. Patients with cerebellar stroke, patients who had a tonus increase of 3 and higher in muscle groups assessed in the lower extremity according to MAS, patients whose lower extremity motor level was less than stage 4 according to Brunnstrom staging system, patients who had an FIM score less than 65 and a cognitive area score less than 25 and patients who had a chronic disease comorbid of stroke were excluded. These measurements were made to determine the level of disability of patients. Patients with a specific level of disability were included in the study.

Data Collection Process

The volunteers were informed about the study and they signed consent forms. The participants' socio-demographic information was recorded in the patient information form.

Age-Height-Weight and BMI Measurement

Age was calculated in (years). Height (centimeter-cm) was measured by using steel stadiometer, with bare feet and a precision of 0.1 cm. Weight (kilogram-kg) was measured by using Tanita BC-418 Segmental Body Analysis System (Tanita Corporation, Tokyo, Japan) with bare feet and with no metals on (20). Body Mass Index (BMI) was found by using the weight (kg)/height (m2) formula (21).

Assessment of the level of disability, motor function, and spasticity

Disability level of the patients was assessed by using FIM, lower extremity motor function level was assessed by using the Brunnstrom staging system and the tonus increase in lower extremity muscles (hip flexor/extensor and abductor/adductor, knee flexor/extensor and ankle dorsiflexor/plantar flexor muscles) were assessed by using MAS (13,14). FIM scoring is an 18-item scale with 6 sub-divisions assessing 4 motor and 2 cognitive areas and each question was asked to patients and scored between 1 and 7 (1: Total assistance, 7: Complete independence) (14). Motor and cognitive area scores were recorded separately. The patients' motor function levels were found and recorded according to Brunnstrom staging system which examines lower extremity motor recovery progressing from flask period in stage 1 where no movement is observed to stage 6 gaining lower extremity normal motor functioning (14). Tonus presence was recorded according to MAS which scores and assesses muscle tonus increase in the areas affected in patients between the values of 0 and 5. While 0 means no tonus increase, 5 means that the affected area is rigid in flexion or extension (13).

Strength Assessment

Isokinetic knee strength test was conducted by using Biodex System-3 (BS-3) (Biodex Medical Systems, Shirley, 2000, New York). Before the isokinetic test, 10-minute long warm-up was performed with Fitron (Lumex Corp., Ronkonkoma, NY) lower extremity bike. For strength measurement, the subjects were made to sit and then fixed by using the leg, femoral, pelvic and body upper diagonal stabilization straps according to Standard Biodex procedure. Before the measurement, the patient watched the demo video of the test and exercise phase with 3 repetitions was performed. The test was performed after a 15-minute rest following the exercise phase. The hemiplegic side was assessed with knee extension (0°) and flexion (100°) by using concentric/concentric mode at 90°/sec angular speed. The test procedure was conducted according to the Biodex application guide (22). The parameters of Peak torque (Newton meter-Nm), average power (Watt), total work (Joule), and H/Q peak torque ratio were analyzed from the automatic printout taken from the device. Since 90°/sec angular speed is a optimal speed option, it can be used for both strength and power assessment (23). Considering the tolerance level of patients, only one angular speed was preferred to avoid fatigue.

Balance Assessment

Biodex Balance System (BBS) (Biodex Medical Systems, Shirley, 2000, New York) was used to measure balance in the study. Antero-posterior (AP), medial-lateral (ML) and overall (OA) balance indexes and total time (TT) time were tested with eyes open by an expert. The measurement was made on the balance platform, with bare feet, feet open at the width of shoulder, knees 15° twisted and hand combined on the chest. The test started at level 8 and ended at level 3 (24).

6-Minute Walk Test

6 minute (min) walk test was performed at physiotherapy rehabilitation hall on 20 m long marked flat surface by using chronometer. Shoes the patients used in their daily lives were preferred. The patients were asked to determine their own walking pace and walk the longest distance they could walk in 6 minutes. They were told that they could slow down or give a break to the test if they needed. The patients who used walking aids (walking stick, walker, etc.) were supervised by a physiotherapist (sometimes with minimal contact). The patients were reminded of the remaining time at the fourth and fifth minutes of the test. At the end of 6 minutes, walking distance covered was calculated by using the bands fixed to the test track every 2.5 meters. The result was recorded in meter (m) (7).

Statistical Analysis

The data were given with (mean minimal value-maximum value) (median min-max). Mann Whitney U test was used in statistical analyzes. The significance level was taken as $p<0.05$. Analyzes were made with IBM SPSS Statistics 22.0 program.

RESULTS

No statistically significant difference was found between the age, height, weight and BMI data of the patients in terms of their stroke type ($p>0.05$) (Table 1).

Table 2 shows the data obtained as a result of isokinetic knee strength test. According to the results, no statistically significant difference was found between ischemic and HSG in the parameters of hemiplegic side knee extension peak torque (peak ext.), knee flexion peak torque (peak flex.), values obtained in the flexion (avg. pow. flex) and extension (avg. pow. ext.) phases of the average power value, total work in the flexion phase (total work flex.) and extension phase (total work ext.) of the movement and H/Q muscle groups strength ratio ($p>0.05$).

According to the balance test and 6-minute walk test data in Table 3, no statistically significant difference was found between ISG and HSG in terms of the parameters of A/P, M/L and OA balance indexes and TT period and 6-minute walk distance ($p>0.05$).

Table 1. Descriptive data of the patients

Parameters	ISG (median-min-max)	HSG (median-min-max)	p
Age (years)	45 (32-61)	52.5 (31-62)	0.820
Height (cm)	164.5 (160-185)	170.5 (160-180)	0.819
Weight (kg)	72.5 (65-80)	73 (55-90)	0.909
BMI	25.7 (20.5-29.2)	25 (20.1-29.1)	0.426

ISG: Ischemic Stroke Group, HSG: Hemorrhagic Stroke Group, BMI: Body Mass Index

Table 2. Isokinetic knee strength test results

Parameters	ISG (median-min-max)	HSG (median-min-max)	p
Peak Ext.	43.4 (17.2-132.8)	58.5 (23.4-157.5)	0.19
Peak Flex.	15.6 (6.5-47.6)	20.8 (13.4-55.4)	0. 89
Avg. Pow. Ext.	34 (5.3-107.2)	46.5 (9.4-133.1)	0. 25
Avg. Pow. Flex.	15.8 (44.1-10.0)	35.6 (0.5-36.1)	0. 27
Total Work Ext.	168.4 (50.7-609.9)	246.1 (35.8-756.2)	0. 96
Total Work Flex.	84.1 (1.9-223.7)	36.5 (2.6-217.7)	0. 25
H/Q ratio	42.7 (14.5-70.9)	36.0 (17.4-122.9)	0. 97

Ext: Extension, Flex: Flexion, Avg: Average, H/Q: Hamstring/Quadriceps Ratio, ISG: Ischemic Stroke Group, HSG: Hemorrhagic Stroke Group

Table 3. Balance and 6 min walk tests results

Parameters	ISG (median-min-max)	HSG (median-min-max)	p
A/P	4.55 (2.2-6.7)	3.60 (2.2-5.7)	0.543
M/L	4.25 (0.9-7.6)	3.25 (0.9-4.7)	0.150
OA	5.5 (3.4-6.7)	4.75 (2.4-7.2)	0.198
TT	75.5 (39-170)	84 (37-114)	0.290
Walking distance	383.5 (176-543)	417.5 (158-487)	0.650

A/P: Anterior/Posterior. M/L: Medial/Lateral. OA: Overall. TT: Total Time. ISG: Ischemic Stroke Group. HSG: Hemorrhagic Stroke Group

DISCUSSION

The purpose of our study was to examine the effect of stroke type on muscle strength, balance and walking functions. There is information in the literature about the effects of stroke type on quality of life, the frequency and prognosis of stroke and on mortality and morbidity (17-19). However, the evidence on the effects of stroke type on motor functions such as strength, balance, and walking seems to be insufficient. The results of our study pointed out that stroke type does not have an influence on regaining these functions. These results provide a significant contribution in terms of making up the deficiency in literature.

In their study Wityk et al. conducted with acute ischemic stroke patients classified according to sub-type. They assessed the effect of conventional therapy with The National Institutes of Health (NIH) scale and reported significant recovery in patients with moderate cerebral artery embolism, and no significant recovery in patients with lacunar infarct (17). According to these results, it is possible to say that lacunar infarct is more disadvantageous in terms of recovery. In Wityk et al.'s study, only patients with ischemic stroke were assessed according to sub-types (17). In our study, we assessed patients with ischemic and hemorrhagic stroke without grouping them in sub-types. Our purpose was to research whether there were differences between strength, balance and walking functions caused by ischemia and hemorrhage. However, we concluded that there were no significant differences between ischemic stroke and hemorrhagic stroke in all parameters in terms of the assessment conducted according to stroke type ($p>0.05$).

In their study, Limburg et al. (18) classified stroke patients as lesion localization and supra-infratentorial stroke type as a right-left side and assessed quality of life with Sickness impact profile. As a conclusion, they found that lesion location and stroke type did not create a difference in emotional distress. In addition, they stated that the patients who survived hemorrhagic stroke did not have more quality of life defects when compared with ischemic stroke patients. Although the supra-infratentorial classification conducted in this study is not used frequently in literature, it represents a wider area. Limburg et al. also used ischemic-hemorrhagic stroke classification in the assessment of the quality of life (18). Quality of life was not assessed in our study, however, when the motor-functional results of stroke which directly influence the quality of life such as strength, walking and balance and which can be measured more objectively were assessed, no significant difference was found between the two groups.

Lefkovitz et al. (19) classified acute stroke patients as large subcortical infarct, vertebro-basilar infarct, lacunar infarct, intracerebral hemorrhage, and subarachnoid hemorrhage. They reported that hypertension, diabetes mellitus, and cardiac disease prevalence increased with age in all stroke types, while the frequency of smoking decreased with age and the highest rate of mortality was in intracerebral hemorrhage (34%), while the lowest rate of mortality was in lacunar infarct (1%). According to these results, in hemorrhagic stroke, advanced age, comorbid cardiac disease, and diabetes worsens prognosis-recovery independent from acute stroke result (19). Another study compared hemorrhagic and infarct strokes in terms of stroke frequency, risk factors and prognosis (25). As a conclusion, it was reported that intracerebral hemorrhage frequency was proportional to stroke severity, stroke type did not have an influence on mortality, neurological results, functional result or the time course of recovery; initial stroke severity was the most important factor determining prognosis; gender, age, smoking factors and stroke type were not related and stroke type did not have an influence on stroke prognosis in general (25). The results of these two studies seem to be contradictive. While Lefkovits et al. (19) associated hemorrhagic stroke with mortality, Jorgensen et al. (25) argued that the primary determinant of prognosis in stroke was the initial stroke severity and stroke type did not influence the neurological and functional result. In our study, we concluded that stroke type does not have an influence on motor function result. However, it can be seen that there is still no consensus on stroke type and its effect on functional recovery. For this reason, the results of the study will contribute to this point.

According to the results obtained from objective tests conducted, it can be said that ischemic or hemorrhagic stroke does not cause a difference in the recovery of motor functions such as strength, balance and walking. Contradictory results and absence of consensus in the literature on the subject shows that more future studies are required.

CONCLUSION

Limitations of study are; since the number of patients that could be reached was limited within the period of time the study was conducted, we assessed without making sub-types of stroke. This is one of the limitations of our study. While two or three different angular speeds can be preferred in strength assessment, considering that our study analyzed a disadvantageous group, one angular speed was preferred to prevent fatigue. This is another limitation of our study.

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