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Case report

REHABILITATION OF A STROKE PATIENT WITH THE METHODS OF ACTIVE KINESIOTHERAPY AFTER BOTOX INJECTION IN SPASTIC MUSCLES

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ABSTRACT

It is presented in this study a case of 54 years old man with stroke and chronic right hemiparesis and Wernicke-Mann gait hospitalized in the medical center for rehabilitation with kinesiotherapy and botulinum toxin injection. Six months ago, he got an acute headache, tingling in the right hand, inability to move the right lower and upper limb, as well as inability to walk independently. Hospitalized in the Neurology department, where an MRI of the brain was conducted and exhibited hemorrhagic stroke. The patient complained about instability of the right leg and difficulty in daily activities. Observational gait analysis showed violations in flexion of the right knee due to spasticity of m.quadriceps femoris dextra during the stance phase of the gate. Dynamic smart insoles recordings showed increasing in knee flexion and gait velocity after botulinum toxin injection in parallel with systematic kinesiotherapy, which lasted 1 month. The results exhibited that spastic gate disorders can improve with systemic kinesiotherapy and spasticity-reducing agents such as botulinum toxin A.

Keywords: botulinum toxin, stroke, hemiplegic, gate, spasticity,

INTRODUCTION

Balance is the ability to move without falling down or maintain posture, and includes the static stability to maintain a given position with minimum fluctuation and the dynamic stability to move from a given position without a loss of balance [1]. A stroke is defined as a blood vessel disorder. It leads to an acute loss of the brain's function for more than 24 hours. According to the World Health Organization, about 15 million people have a stroke each year, and 5 million will be permanently disabled by it [3, 4]. Among the serious neurological deficits caused by a stroke, the most significant is the loss of motor functions, as well as induced paralysis, pathological reflexes, and spasticity, which interfere with a person's independent mobility [4, 5]. One main reasons of disability to walk is hemiparetic gait, which is characterized by spatial-temporal parameters' asymmetry, simultaneously with reversal of stance phase and step length. In addition to that, it is observed an amplitude reduction of hip and knee flexion, but an increase in plantar flexion or loss of dorsal flexion at the ankle's level [6, 7]. Reduced peak knee flexion in the swing phase of gait, known as Wernicke-Mann gait, is a common abnormality in patients after stroke. Impaired activity of lower limb muscles, in particular, m. quadriceps femoris, due to spasticity, has been widely reported as a cause of that paretic gait. Because stroke patients have difficulty controlling their movements due to muscle weakness, abnormal muscle tone and abnormal movement patterns, their movement amounts are reduced [2]. The simultaneous application of the methods of kinesiotherapy and botulinum toxin are mutually related and help to improve the quality of life of stroke patients, reducing spasticity of the affected muscles and improving gait [3]. The specific characteristics of water impact muscle spasticity and motor activity, providing the patient a motivating environment [4]. Rehabilitation with

BoNTA has been shown to be effective in patients with hemiparesis with lower limb spasticity [7]. This study aims to evaluate the improvement of gate velocity and step's length of the gate of patient with stroke hemiparesis Wernicke-Mann typeth after botulinum toxin injections in spastic muscles and 1 month of kinesiotherapy.

MATERIALS AND METHODS

1. Participants. One male person with stroke and chronic right hemiparesis and Wernicke-Mann gait was admitted to the medical center for rehabilitation with kinesiotherapy and BTI. Time since stroke 6 months, weight 74kg, height 170cm. The inclusion of the patient was based on clinical examination and observation of gait, lack of knee flexion during the swing phase of gait and the ability to walk independently only by using an assistive device.

2. Clinical and functional examination. Neurologic impairments were assessed using the NIHSS National Institute of Health Stroke Scale. Spasticity of m. quadriceps femoris and m. rectus femoris were evaluated using the modified Ashworth Scale. Functional ability was assessed using the Timed Up and Go Test (TUG), 10m Walk test and the time taken to ascend and then descend a flight of 10 stairs and walk on sloped terrain. The patient was asked to rate the perception of improvement or worsening of his gate using a visual analogue scale. As a balance test, the 360° turn test was used.

3. Intervention. BoNTA was injected into the spastic RF muscle on the hemiparetic side of the patient. Botox, 200U in 2ml physiologic solution, was injected through 3 punctures in the rectus femoris. The used dose was the same as that in other studies evaluating the impact of BoNTA injection in the spastic muscles on peak knee flexion in the swing phase.

4. Gate analysis. It captures data while walking. Insoles are connected to a mobile application and easy-to-use software. Walking steps and foot orientations in space are measured by an inertial platform located in the insoles. Each insole has an inertial platform that records the movements and orientations of each foot in space. At the end of each acquisition, data from insoles is transferred to a wireless connection box to be dissected.

5. Protocol. Data on the spatial and temporal gait parameters were recorded. Two assessments were carried out: before injection and kinesiotherapy (PRE) and one month after the injection and kinesiotherapy (POST). Clinical assessment and gait analysis were carried out at each period. Insoles were installed inside the participant's shoes. Participants were requested to walk on a 2-m walkway located within our clinic for rehabilitation. The patient performed two walking trials at his preferred walking speed.

RESULTS

1. Results of clinical examination

Evaluated spasticity of m. quadriceps femoris and m. rectus femoris before and after the intervention using the modified Ashworth Scale showed its significant reduction in relation to m.rectus femoris of the patient from 3 to 1 post-intervention, and not significant in relation to m.quadriceps femoris – it ranged from 0 to 1 and was not modified post-intervention.

2. Results of functional examination

The results of the patient's functional tests are shown in Table 1. All scores tended to improve after the intervention: 10MWT (PRE= 0.74+0.4m, POST=0.85+0.25m); TUG test (PRE=14.2+3.1, POST=15.2+4.1); TAD10 time taken to ascend and then descend 10 stairs was reduced and took less time for the patient. WST test - walking on sloped terrain (PRE= 23.8+6.4s, POST=26.8+8.4). No correlation was found between the percentage change in peak knee flection and the percentage of subjective improvement (PRE r=0.55, POST r=0.65). The rating of perception of improvement or worsening of the patient's gait using a visual analogue scale was also improved from 8 before to 5 after the intervention. The balance 360° turn test showed decreasing in making a 360° turn while standing in place. The time taken to perform this action was decreased from 9s PRE to 6s POST. SLSB test - Single leg stance balance test showed no significant differences before and after the intervention (PRE left leg=5s, right leg 1s, POST left leg=5s, right leg=1s)

Table 1. Assessment of functional examination using the specific tests. Data are presented PRE (at the hospitalization before the treatment) and POST (one month after the treatment)

Test	PRE	POST
10MWT (m)	0.74	0.85
TUG (s)	14.2	15.2
TAD10 (s)	25	21
WST	23.8	26.8
Visual analogue scale	8	5
The balance 360° turn test (s)	9	6
SLSB left/right leg (s)	5/1	5/1

3. Results of gait analysis

The gate parameters evaluated in this study are presented in Table 2. The patient's maximal gait speed increased between the two assessments (PRE 76/4 steps/min to 78/16 steps/min after the injection) mostly because of an increase in step length (PRE 0.73m, POST 1.02m). The spasticity of rectus femoris was rated 3 by the Ashworth scale before the injection and kinesiotherapy and 1 after one month after the kinesiotherapy and injection. Knee flexion angle in degrees increased from 65 PRE to 85 POST, which is correlated with a significant increase in peak knee flexion at the moment of maximal peak of gait velocity.

Table 2. Data are presented for patient's right spastic lower limb - gate analysis is done using spatiotemporal parameters of his gate at maximal speed with a cane. Row data are shown as the changes related to PRE-injection and POST-injection and assessments.

PARAMETER	PRE	POST
Gait velocity (m/s)	0.46	0.65
Step frequency (steps/min)	76/4	78/16
Spasticity (Ashworth scale)	3	1
Knee flexion angle (deg.)	65°	85°
Gate speed (m/s)	0.63	0.48
Step length (m)	0.73	1.02

DISCUSSION

The study shows the benefits of kinesiotherapy, including BoNTA injection in spastic muscles on the hemiparetic lower limb of a patient after stroke. This combined treatment of methods of kinesiotherapy and decreasing spasticity injection in the most affected muscles indisputably improve angular speed, power and knee joint displacement as well as gate speed and activities of daily living. The volume of BTX-A to decrease muscle tone in spastic patients has been proven by several RCTs, but the effect of the decreased spastic muscles' tone after BTX-A injection at the same time with kinesiotherapy on hemiparetic gait was unknown and not much researched. Several researchers wrote that observational studies are useful as preliminary studies. If this preliminary study shows a positive effect of this new therapy, this effectiveness should then be confirmed by an RCT [9. 10]

Concerning the gender of the patient participating in this study, the patient was a man. To our knowledge, there is no data in the literature suggesting that the gait pattern of men differs from those of women either in healthy subjects or in hemiplegic patients [11]. It seems, therefore, unlikely that difference in gender could constitute a limitation in the interpretation of the results.

CONCLUSION

To conclude, the results of this study indicate that the parallel treatment of hemiparetic gate after stroke with kinesiotherapy and injection of botulinum toxin increase knee flexion by 20° and a present tendency of functional improvement. The specific kinesiotherapy given during the month after injection showed that the combination of botulinum toxin injection and kinesiotherapy would have yielded more significant results regarding the functional benefit of the treatment and good results in improving the daily activities of the patients.

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