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Effect of anodal and sham transcranial direct current stimulation on balance and stroke specific quality of life in stroke patients.

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INTRODUCTION: Stroke is the leading cause of disability which requires rehabilitation. It is defined as obstruction or restriction of blood supply to the brain, usually because a blood vessel supplying brain is burst or blocked by a clot; causing damage to the cells of brain. This in turn may result in physical and/or mental disabilities. Lower limb functions are most commonly impaired following stroke; which also deteriorates activities of daily living. TDCS is a novice approach which can improve lower limb function by modulating cortical neuronal excitability.

MATERIALS AND METHOD: 30 stroke patients above 18 years meeting inclusion criteria were randomly allocated into two groups. They were divided into two groups a anodal tDCS and group B sham tDCS respectively. Each group had 15 participant. The intensity of the current was 2mA given for 20 minutes along with conventional physiotherapy exercises of lower limb. It was given for 12 sessions in 3 weeks. Berg Balance Scale and stroke specific Quality of Life Questionnaire was taken to assess lower limb function for balance and Quality of Life. It was taken before and after the 3 weeks.

RESULT: Wilcoxin signed Rank test showed that the lower limb function on balance improved before and after treatment with anodal (0.000) and sham (0.917) tDCS which showed balance improved in anodal tDCS than sham tDCS. In stroke specific quality of life there was no improvement before and after treatment with anodal and sham (0.214) which showed no improvement in anodal tDCS and sham tDCS.

CONCLUSION: There was improvement of balance with anodal tDCS than sham tDCS while in quality of life there was no significant difference seen in anodal and sham tDCS

KEY WORDS: tDCS, lower limb function, stroke, Berg Balance scale, stroke specific Quality of Life Questionnaire

I. INTRODUCTION

Stroke is the leading cause of disability which requires rehabilitation. It is defined as obstruction or restriction of blood supply to the brain, usually because a blood vessel supplying brain is burst or blocked by a clot; causing damage to the cells of brain. This in turn may result in physical and/or mental disabilities. Lower limb functions are most commonly impaired following stroke; which also deteriorates activities of daily living. In acute stroke, that is early stages show motor disabilities in about two-thirds of patients. However few weeks after stroke there are some changes seen in the brain. As brain has to deal with motor and cognitive problems the patients do not respond to the medications faster. There are increased pathologic alterations seen in healthy as well as affected hemisphere(2) of brain. Due to increasing changes cerebral blood flow acts as an autoregulatory mechanism which helps to maintain the flow of blood throughout the brain. Stroke causes many impairments, which include motor deficits, loss of voluntary movement changes in muscle tone which reduces balance and also alters the gait. Even postural symmetry is altered due to which the centre of pressure (COP) alters and there is more weight bearing on the unaffected side the affected side and so te individual is not able to balance properly. Due to impaired balance, gait parameters alter. Patient having stroke typically have (1) altered kinematics including reduced hip flexion, knee flexion, hip extension, increase knee extension during stance and reduced ankle dorsiflexion during swing, (2) spatiotemporal changes such as asymmetry in the duration of support and swing phases between the two legs, reduced gait speed, stride length and cadence. These disorders are mainly due to paresis and spasticity. The primary motor cortex (M1) and the corticospinal tract play a greater role in the control of locomotion in humans(4) tDCS is a novice approach which can improve lower limb function by modulating cortical neuronal excitability. Transcranial direct current stimulation (tDCS) is a form neurostimulation that uses constant, low frequency current delivered via electrodes on the head. It was originally developed to help patients with brain injuries or psychiatric conditions. It is a contemporary, portable, non invasive, neuromodulatory techniques that delivers a low electric current to the scalp.

A fixed current between 1 and 2 mA is typically applied. Parts include two electrodes and a battery powered device that delivers constant current. There are three various stimulation: anodal, cathodal and sham. The anodal is positive (+ve) stimulation which shoots up the neuronal excitability of the area being stimulated. Cathodal (-ve) stimulation brings down the neuronal excitability of the area being stimulated[9].

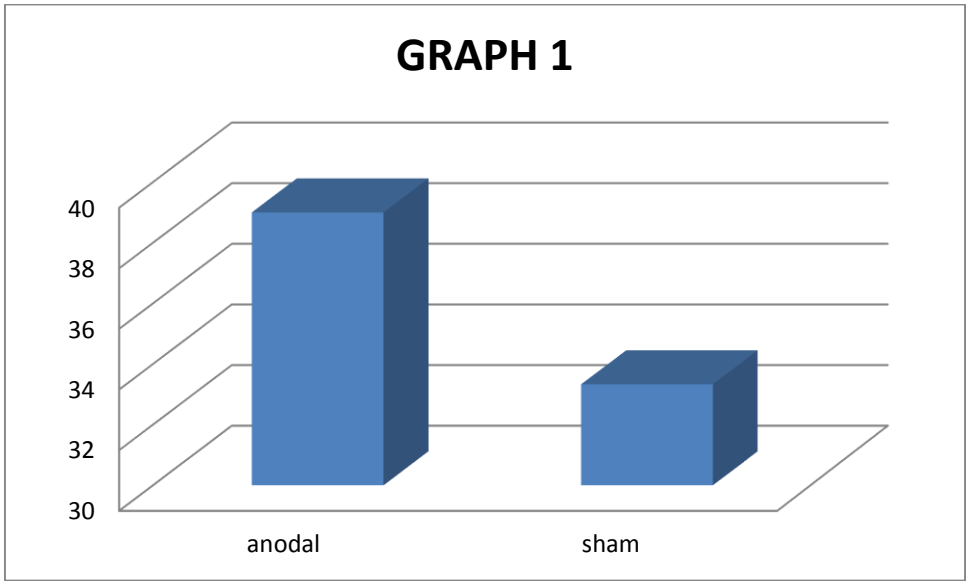
II. METHOD

30 Stroke patients were selected whose inclusion criteria was of one time stroke, above 18 years of age, MMSE score ≥ 24 and BBS score between 21-40 that is medium risk of fall. Patients with Traumatic brain injury or any injury to the brain, Impaired skin over the placement of electrode which includes eczema, rashes, blisters, open wounds, burns and cuts, Functional limitations due to musculoskeletal injuries ,Cognitive impairment, Pacemaker, Epileptic fit less than 1 year, Intercerebral metal clip were excluded.[8]There were divided into two Groups with 10 patients in each Group. Treatment procedure was explained and a written informed consent was taken from each of them, Group A received anodal tDCS and Group B received sham stimulation all along with conventional physiotherapy exercises. TDCS dosage was intensity for 2mA for 20 minutes with electrodes of area 25 cm^2. Lower limb exercises along with stimulation were hip, knee, ankle physiological movements. Conventional physiotherapy exercises included for reducing the spasticity of the muscles spastic muscles icing and stretching, mat exercises such as rolling, quadruped, kneeling, half kneeling along with reach outs and perturbations, balance and gait training. Treatment was given for 20 minutes, 4 days per week for 3 weeks.

III. DATA ANALYSIS AND INTERPRETATION

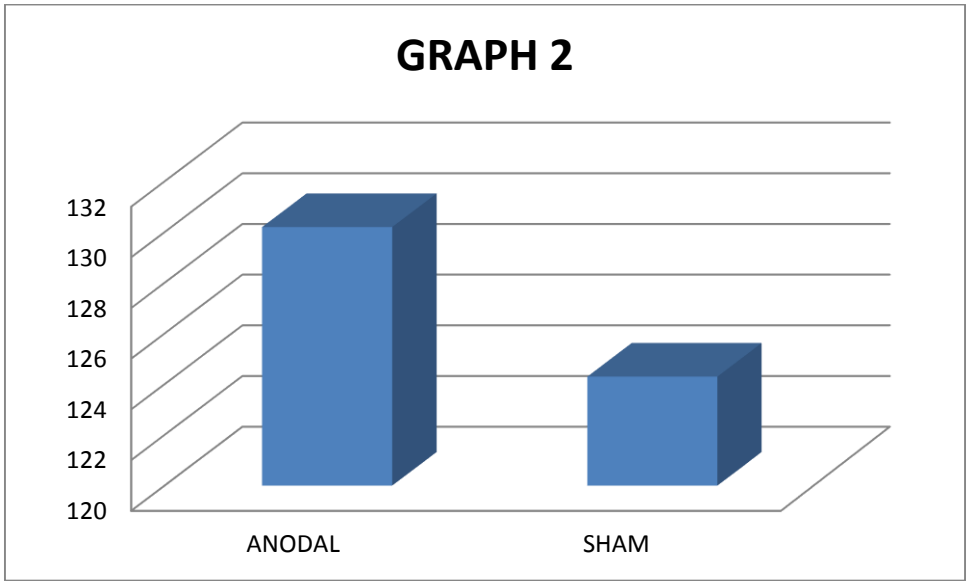
Statistical analysis was done using Paired t test for berg balance scale and stroke specific quality of life score within the group. Kruskal wallis test for berg balance and stroke specific quality of life between the groups.

Graph 1: Comparison of mean difference of Balance in Group A and B



Interpretation: This shows that there is statistically significant difference in balance in both the groups; p value (0.015) < 0.05. The mean difference is highest in Group B; followed by Group A. This suggests that anodal tDCS is more effective than tDCS along with conventional exercise.

Graph 2: Comparison of mean difference of stroke specific quality of life in Group A and B



Interpretation: This shows that there is no statistically significant difference in quality of life in both the groups; p value (0.214) > 0.05. This suggest that both treatment can be used to improve quality of life.

IV. RESULTS

In this study 30 stroke patients were taken and analyzed. The group A and B each had 15 patients respectively in each group. The group A and B were given anodal and sham tDCS respectively with conventional physiotherapy exercises. All the patients were assessed for balance and quality of life by berg balance scale and stroke specific quality of life respectively. They were assessed first and after 3 weeks after 12 sessions. The normality of data was checked using Shapiro-Wilk Test.By applying Wilcoxin Signed Rank Test and mean shows statistical significance in balance in Group A and B. The p value 0.015> 0.05 for Wilcoxin signed rank test for Group A (0.000) and B (0.917) which means that anodal is effective in improving balance than sham tDCS. The stroke specific quality of life is not statistically significant in improving quality of life. The p value 0.214 > 0.05 for Wilcoxin signed Rank test for Group A (0.034) and B (0.012) which means that anodal tDCS is more effective than sham tDCS in improving quality of life. This states that there is significant improvement in balance but no such improvement in quality of life.

V. DISCUSSION

The present study compared the effects anodal and sham transcranial direct current stimulation along with conventional exercises. There was significant improvement in balance with anodal tDCS and sham tDCS along with conventional physiotherapy. While no significant improvement was seen in quality of life with anodal and sham tDCS along with conventional physiotherapy. The treatment was given for 12 sessions in 3 weeks. There was significant improvement in balance with anodal tDCS followed by sham tDCS. There was significant improvement in quality of life with anodal tDCS but no improvement was seen in sham tDCS. The balance and quality of life was checked by berg balance scale and stroke specific quality of life before and after 3 weeks.

It is established that sensory and motor processing is that body parts are controlled by neurons in the cerebral hemisphere on the opposite side of the body but ipsilateral pathways are also present. The affected hemisphere is inhibited by contralesional hemisphere which leads to reduced neuronal activation on the affected side. Therefore the use of these contralesional regions in recovery reduces lateralized activation. The consensus from studies proved that recovery is most efficient when lateralization pattern is normal. TDCS has evidence that it reduces lateralization pattern by inhibiting the contralesional hemisphere. Hyu-Kyu Cha (2014) said that it is difficult for patients to recover after stroke. Stimulation by tDCS which is a non-invasive technique controls the function of non-specific neural structures and makes the cortical excitability and motor function better. He also reported that tDCS could improve the function of lower limb and ADL which has been damaged. In this study limb motor function and ADL assessment significantly improved in the experimental group. Together these study results suggested that tDCS along with conventional physiotherapy exercises provide non-specific input to the motor cortex, facilitating alterations in neural activation and synaptinc plasticity which promote functional recovery, and enhance voluntary activities such as ADL by increasing the activity of cerebral cortex in the damaged brain area. Therefore, while applying tDCS there could be facilitation of cortical repair by brain reorganization, which had great clinical benefits through improvements.

Wanalee Klomjai et al investigated whether a single session of dual tDCS before physiotherapy could immediately benefit lower limb function. They compared tDCS and sham tDCS on the MVC of knee extensors and TUG and FISST scores in the same participants. While comparing before and after no significant difference was found for sham group while for the real tDCS group showed significantly greater performance in TUG and FISST. Hence they said that for first session, with no involvement of recovery and or testing effect, real tDCS could increase functional performance. Carry over effect was tested and for FISST significant difference was found but for TUG no difference was seen. It was observed that participants with subcortical lesions showed a greater change in TUG than did the other participants. Though TUG performance was improved there was no significant difference between the real and sham stimulation. Multiple sessions of anodal tDCS with training did not produce significantly greater increase in knee extensors MVC as compared with training alone. TDCS is probably of more benefit to motor performance modulation in people with severe motor impairment.

This study shows that there was significant improvement in balance with anodal tDCS and cathodal tDCS than sham stimulation in stroke patients similar results were found in other studies. Eman Khedr in his study of effect of anodal and cathodal stimulation suggested that there was no difference between the effects of anodal and cathodal stimulation on clinical scores, and both improved more than sham in clinical measures of functional ability. These effects were due to increased cortical excitability and marginal increased muscle strength in all 3 groups, improvement was seen also in lower limb function of the affected side. Jeffery found in a preliminary study that anodal stimulation delivered at the intensity of 1 mA failed to affect lower limb MEPs. This finding was likely due to the fact that the leg area of primary motor cortex is located further inside the motor cortex than arm area. Any anodal stimulation administered at the level of 2mA improves the amplitude of leg EPs which is similar to 40% increase in the improvement achieved in amplitude of hand MEPs at level of 1mA. This study also administered anodal stimulation at intensity of 2mA to accelerate the stimulation to the leg area of the primary motor cortex. However in this study only stroke patients were included. Moreover the effect of dominance cannot be conclusive because of relatively small sample size within the group. Dominance plays important role in recovery of stroke and so should be studied separately.

VI. CONCLUSION

This study concludes that improvement of balance was better with anodal than sham transcranial direct current stimulation (tDCS) There was as such no significant improvement in stroke specific quality of life with anodal and sham stimulation.

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CONFLICT OF INTEREST: There was no conflict of interest in this study.

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