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Effectiveness of Standardized Rehabilitation on Upper Limb Recovery in Different Types of Stroke Among Young Stroke Subjects

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Abstract

Introduction: According to the World Health Organization (WHO), Cerebrovascular Accident (CVA) is the second leading cause of death and disability all over the world. A stroke can be defined as a rupture or blockage of an artery of the brain parenchyma or in decreased blood supply. There are two types of strokes: Ischemic (lack of blood flow) and Hemorrhagic (blood leakage). Each year, Ischemic strokes affect more than two million young adults worldwide. Stroke caused by ischemia occurs 68% of the time worldwide, while Hemorrhagic stroke occurs 32% of the time. 10-15% of all first-ever strokes in India happen to adults between the ages of 18 and 50. It is particularly important to actively seek treatment options to promote the recovery of upper limb function in stroke patients because hand

function recovery is slow during the process of upper limb disfunction recovery after stroke, and this directly affects subjects' ability to lead a normal daily life and their quality of life. The standardized treatment protocol was given to the patient to provide upper limb rehabilitation. When it was required to address these limitations in order to complete the active tasks, the therapy plan also included some sensory training and passive movement. Standardized tasks included reaching, flexing the elbow to bring the hand to the mouth, and executing fine motor activities like putting things in a box or manipulating.

Purpose: The purpose of the study was to analyze the Effectiveness of Standardized Rehabilitation on upper limb recovery in different types of stroke among Young Stroke subjects.

Methods: It is a Quasi-Experimental Study Design a total of 113 subjects were screened in that 81 subjects met the inclusion criteria and finally 79 subjects completed the study. These subjects were divided into Group - I with Ischemic subjects (42) and Group - II with Hemorrhagic subjects (39) these two groups were treated with standardized rehabilitation. Participants were given intervention 3 times a week for 6 weeks. The outcomes of this intervention were measured by FMA-UE and WMFT test.

Results: Independent 't' test was used to differentiate the mean significance difference between continuous variables. Paired 't' was used to assess the statistically significant difference pre and post test scores. Statistical analysis of the data revealed that within group comparison both groups showed significant improvement in all parameters where as in between group comparison Hemorrhagic stroke subjects showed better improvement compared to the Ischemic stroke subjects.

Conclusion: The present study concludes that after six weeks of intervention both groups were shown statistically significant improvement in post-test values. However more percentage of improvement was found in subjects with Hemorrhagic type of stroke when compared to Ischemic type of stroke from the findings of the current study, it can be recommended that the Standardized Rehabilitation may be opted as a treatment of choice for improving Functional and Motor recovery in Hemorrhagic stroke subjects.

Keywords: Young stroke, Ischemic stroke, Hemorrhagic stroke, Upper limb recovery, Standardized rehabilitation.

Introduction

Stroke was first described as the phenomenon of sudden paralysis by Hippocrates[1]. According to the World Health Organization (WHO), Cerebrovascular Accident (CVA) is the second leading cause of death and disability all over the world[2]. A stroke can be defined as a rupture or blockage of an artery of the brain parenchyma or in decreased blood supply[3].

There are two types of strokes: Ischemic (lack of blood flow) and Hemorrhagic (blood leakage). As a result, the affected area of the brain cannot function, which may cause difficulty moving limbs on one side of the body, Aphasia and hemianopia[4].

Each year, Ischemic strokes affect more than two million young adults worldwide. Stroke caused by ischemia occurs 68% of the time worldwide, while Hemorrhagic stroke occurs 32% of the time[5]. 10-15% of all first-ever strokes in India happen to adults between the ages of 18 and 50. Recent research has shown an alarming increase in young stroke cases; it has been noted that over the

previous four to five years, stroke cases have increasingly occurred in those under the age of 45[6].

Stroke is the most frequent neurological disorder that can lead to long-term disability and has significant emotional, social, and economic repercussions for patients, their families, and the healthcare system[7].

Young stroke should be viewed separately from older strokes for several reasons. There are specific risk factors to young age. Some risk factors only exist at young ages are pregnancy or postpartum period, oral contraceptive use[8]. Other risk factors can exist at all ages, but their influence on the stroke risk has been shown to be stronger at younger ages like patent foramen ovale, migraine with aura, infections. The factor may also be related to lifestyle-related feature in the population, which is more common at younger ages illicit drug use, heavy drinking, smoking, overweight. The spectrum of causes underlying young-onset Ischemic stroke differ markedly from those seen in the elderly patients[9].

The major causes of Ischemic stroke in the elderly, atherosclerosis in the large brain supplying arteries, atrial fibrillation, and small vessel disease of the brain are rather infrequent among the young[10]. This occurs probably because most traditional risk factors predisposing to these outcomes, such as hypertension, diabetes, and dyslipidemia, are either less common or less severe, or have not yet caused substantial damage to the cardiovascular system[11].

Stroke in young adults has a significant socioeconomic impact due to the high cost of healthcare and lost productivity at work[12]. It is particularly important to actively seek treatment options to promote the recovery of upper limb function in stroke patients because hand function recovery is slow during the process of upper limb disfunction recovery after stroke, and this directly affects subjects' ability to lead a normal daily life and their quality of life[13].

According to studies, Ischemic and Hemorrhagic pathways for brain injury and recovery are distinct. Ischemia, a mass effect brought on by cerebral edema, and inflammation in Hemorrhagic stroke are some of the mechanisms involved in Ischemic stroke[14]. The toxicity of lysed blood products on the brain parenchyma and vasculature as well as the bulk effect from the hematoma are additional causes. The reduction of tissue edema and the mass effect caused by the stroke, as well as the cascade of plasticity-enhancing mechanisms that began to take action within hours after the commencement of cerebral ischemia, could all be factors in the early clinical recovery from a stroke[15].

Patients with Hemorrhagic stroke who experienced poor upper limb recovery also had involvement of the anterior putamen, internal capsule, thalamus, periventricular white matter, and premotor cortex. These findings could be helpful for determining the prognosis of Hemorrhagic stroke and developing rehabilitation techniques[16].

According to one study, the severity of the initial stroke was the most crucial element, with stroke type having no effect on mortality, neurological or functional outcomes, or the time course of recovery[17].

Physiotherapy is an important component of stroke rehabilitation which aims to optimize physical function post stroke[18]. Early rehabilitation following a stroke has been proven to correlate with a better functional outcome after a stroke, with one study showing that the recovery of body functions and activities increases over time from 16% to 42% in the first 6 to 10 weeks after a stroke[19].

The Ipsi-lesional and Contra-lesional hemispheres' neuronal networks and micro environments can be reorganized with the help of rehabilitation. This includes increased neuroplasticity, angiogenesis, altered excitatory and inhibitory signaling, and improved hematoma clearance[20].

The standardized treatment protocol was given to the patient to provide upper limb rehabilitation. When it was required to address these limitations in order to complete the active tasks, the therapy plan also included some sensory training and passive movement. Standardized tasks included reaching, flexing the elbow to bring the hand to the mouth, and executing fine motor activities like putting things in a box or manipulating[21].

The exercises selected to target the main disabilities for upper limb rehabilitation. By using progressive resistant movements, strength training increases strength. Passive mobilization, a secondary disability following a stroke that can result in contracture, is used to increase range of motion. Dexterity is a necessary skill for carrying out daily tasks, and this category in the training protocol is intended to target functional activity involving everyday objects like jars, cups, and utensils. This is similar with other task-specific training initiatives[22]. The usefulness of this rehabilitation strategy in treating various types of strokes is yet unknown, despite the fact that standardized therapy addresses both the sensory and motor aspects of disability.

The purpose of the current investigation was to ascertain whether functional recovery differed between Ischemic and Hemorrhagic stroke in young stroke patients.

Need of the study

One of the most Prevalent diseases, stroke causes several limitations & impairments. Stroke prevalence is rising daily around the world. Young individuals who suffer from strokes are the most economically productive segment of society, making them particularly relevant in emerging nations.

Slow upper limb recovery during rehabilitation has a direct impact on a person's capacity for daily living. Individual’s entire functional capacity is limited. A substantial part of functional activity involves the upper limb. Patients who have upper limb impairment after a stroke depend on others for their daily needs.

Rehabilitation is a crucial part of care for stroke patients. All different forms of stroke patients are being treated according to the same protocol. The recovery of the upper limb during post-stroke rehabilitation is influenced by a number of variables, including the kind of stroke, the location of the lesion, various causes, risk factors, etc.

Understanding these factors and how they affect the healing process might aid the physiotherapist in creating a targeted plan for the management of upper limb rehabilitation in stroke patients. Therefore, a study is required to determine how different types of stroke affect young stroke patients ability to regain their upper limbs following standardized rehabilitation. The findings can also be used to create fresh approaches for treating different types of strokes in young stroke patients.

Aim of the study

The aim of the study was to assess the effectiveness of standardized rehabilitation on upper limb recovery in Ischemic versus Hemorrhagic stroke among young stroke subjects.

Objectives of Study

1. To determine the effectiveness of Standardized rehabilitation on upper limb recovery in Ischemic stroke subjects.

2. To determine the effectiveness of standardized rehabilitation on upper limb recovery in Hemorrhagic stroke subjects.
3. To compare the effectiveness of standardized rehabilitation on upper limb recovery in Ischemic and Hemorrhagic stroke subjects.

Hypothesis

Research Hypothesis (H_1): Hemorrhagic stroke subjects will have better upper limb recovery compared to Ischemic stroke subjects.

Alternate Hypothesis (H_2): Ischemic stroke subjects will have better upper limb recovery compared to Hemorrhagic stroke subjects.

Null Hypothesis (H_0): There is no significant difference between Hemorrhagic stroke and Ischemic stroke subjects on upper limb recovery.

Methodology

Study Design: Quasi Experimental Study Design.

Ethical Clearance and Informed Consent: The study protocol was approved by the Ethical Committee of GSL Medical College & General Hospital (Annexure-I) the investigator explained the purpose of the study and given the subject information sheet. The participants were requested to provide their consent for participation in the study (Annexure-II). All the participants signed the informed consent and the rights of the included participants have been secured.

Study Population: Young Stroke subjects diagnosed by Neurophysician.

Study Setting: Study was conducted at Department of Physiotherapy, GSL Medical College & General Hospital, Rajamahendravaram, Andhra Pradesh, India.

Study Duration: The study was conducted during the period between 2021 - 2022

Treatment Duration: 60 minutes per session, 3 sessions per week for 6 Weeks.

Sampling Method: Convenience sampling.

Sample Size: A total of 113 subjects were screened, in that 81 subjects were recruited in the study after meeting the inclusion criteria. Recruited participants were explained the purpose and relevance of the study. The participants were included in the study after obtaining informed consent. By using convenience sampling method all eligible participants were allocated in Group I (Ischemic stroke subjects) and Group II (Hemorrhagic stroke Subjects).

Group	No. of Subjects	Type of Stroke
GROUP - I	42	ISCHEMIC
GROUP - II	39	HEMORRHAGIC

Inclusion Criteria

- Subjects with first ever stroke confirmed by CT and MRI scan by Neurophysician.
- 18 to 50 years.
- Subjects who are having 60 degrees of antigravity shoulder elevation.
- Ability to participate in exercise intervention.
- Patients without Cognitive impairment

Exclusion Criteria

- Subjects with pre-existing neurological illness.
- Subject with spontaneous recovery.
- Subjects with Transient Ischemic stroke.
- Language and hearing deficits.
- Subjects with psychiatric disorders.

Outcome Measures

Fugl-Meyer Assessment Upper Extremity (FMA-UE)[23]: Used to measure motor recovery.

The 66-point upper limb component of the Fugl-Meyer Assessment Upper Extremity was used to measure

impairment. The Motor Assessment Log was used to assess the ability of participants to use their arms for daily activities. To determines the amount and quality of use of the affected arm during performance of 13 everyday activities, scored on a 6-point scale. Other measures of upper limb function were maximal pinch-grip strength between the thumb and the index finger, recorded with a calibrated load cell, and maximal tapping speed, determined by asking the participant to tap with the index finger as quickly as possible on a load cell for 5 seconds. Maximal hand-grip strength was also assessed using a hand-held dynamometer. Participants were asked to squeeze the dynamometer as hard as possible for 3 to 5 seconds. Each hand was tested 3 times, with a rest period of 30 seconds after each trial. The highest value of the 3 attempts was recorded on each occasion.

Wolf Motor Function Test (WMFT)[24]: Used to measure the function recovery

The WMFT consists of 17 items (6 joint-segment movements, 9 integrative functional movements and 2 strength items). Performance time of every item is measured between a precisely defined start and end-point for each task with a maximum of 120 s. The WMFT also contains a 6-point Functional Ability Scale (FAS) that rates the quality of movement and has values ranging from 0 (no attempt made to use the more affected UE) to 5 (movement appears to be normal).

Procedure

This study is a Quasi-experiment. A total of 78 patients who met the eligibility requirements were included in the study. Based on CT and MRI findings, they were separated into two groups, Ischemic as Group - I (n=40) and Hemorrhagic as Group - II (n=38). Using the Fugl-Meyer Assessment Upper Extremity evaluation for motor measurement and the Wolf Motor Function Test for functional measurement, baseline testing is conducted on all subjects. Following the evaluation, the individuals receive normal rehabilitation care over the course of a 6-week programme. All subjects were once more evaluated using the same motor and outcome measures at the conclusion of the treatment period.

Standardized Rehabilitation: This study has a 6-week protocol with three sessions of an hour each, three times per week. The therapy programme, which comprises of four blocks of straight training and three blocks of practising functional tasks, sought to enhance skill acquisition in the upper limb. When it was required to address these deficiencies in order to complete the active tasks, the training procedure also included some sensory retraining and passive movements. Reaching, bending the elbow to bring the hand to the mouth, executing fine motor activities like arranging objects in a box, and writing were among the standardised tasks. The exercises selected to target the main disabilities for upper limb rehabilitation.

Strength Training: It encompasses all of the upper limb's parts, including shoulder elevation, elbow flexion, extension, and supination, as well as wrist and mcp extension. The patient must be seated for this procedure. The propose performing three sets of eight to ten exercises and adjusting the weight to maintain the minimal amount of training desired. Subjects were encouraged to generate as much activity as they could through active-assisted motions. exercised eccentrically whenever possible in the range outside of active concentric control and through the range that is now available with gravity removed. The computed training resistance was applied to muscles that were rated between 3 and 5. Every three training days, the maximal

isometric voluntary contraction was measured again, and the resistance was changed as necessary to maintain 60-80% of the maximum. For each exercise, three sets of 10 repetitions were completed. Wrist extension, finger extension, thumb abduction, and grip strength were the activities practised. These movements were picked because of how crucial they are to hand function, especially for jobs that require grasp and manipulation. improving hand function, feeling, and proprioception through sensory-specific training.

Functional Training: In order to train three separate hand functions for the functional task practise training blocks, activities were created based on Elliott and Connolly's taxonomy of manipulative hand movements. Power grip, manipulation within the hand, and control over segmented fingers from each segment, subjects might select an activity. At first, tasks were assigned based on each person's ability. The number of degrees of freedom needed at the upper limb to accomplish tasks was used to define level of intensity in most cases. Therefore, level 1 would support the entire arm while the hand was being utilised in function; level 2 allows support at the elbow; and level 3, if necessary, support at the shoulder. For each level, the assignments varied in terms of their level of difficulty. Variability in practise was added after the intensity level was established, such as alterations in speed while keeping accuracy, in object attributes (weight, shape, size, frictional properties), etc. Progress was made by increasing the number of repetitions, altering the object's weight or size to make the task more challenging, moving the exercise to a different location in the workspace, and beginning to progress toward less proximal support for the arm and thus more degrees of freedom during the exercise. The main objective was for participants to work at a level that was constantly challenging them. Ten minutes were allotted for each functional task practise training block, during which the participant had to be continuously focusing on the task. As a result, the stop watch was also halted anytime they took a break to talk, move, or relax. By doing this, we hoped to guarantee that each participant worked in each exercise region for the same amount of time and with the same level of intensity.

Task 1: Power Grip – establish and maintain reach and pre-grasp orientation, manipulate things with the entire hand, employ a functional palmar grip, achieve and maintain the right amount of force, and anticipate the need for grip force.

Task 2: Within-Hand Manipulation – demonstrate dexterity by manipulating things in the hand, using simple and reciprocal synergistic grasps, and fractional finger movement.

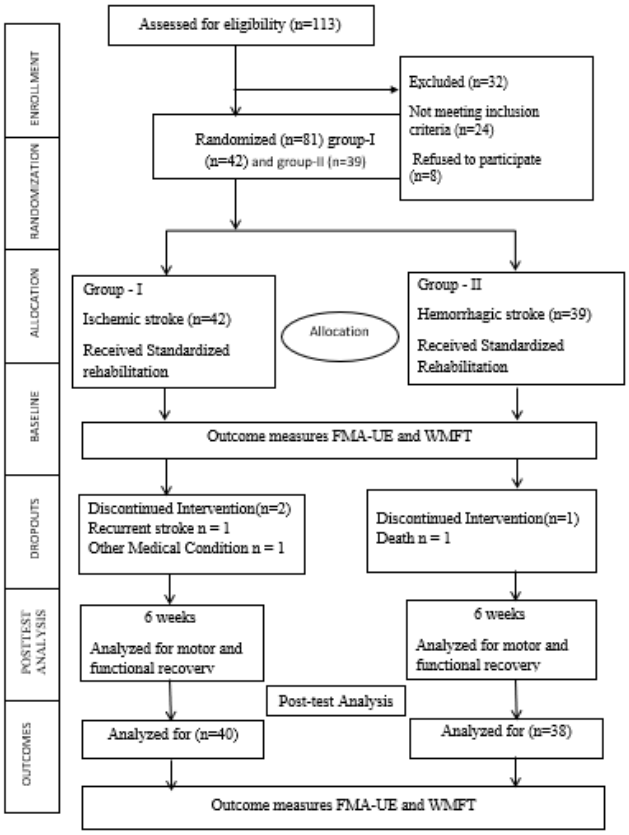
Task 3: Fractionated Finger Control – the ability to manipulate items in the hand; a functional sequential pattern; ulnar and palmar grasps; the capacity to fractionate finger movement; and dexterity.

Level 1: The wrist joint and the forearm rest on the surface of the support, and the hand can extend beyond the edge of the support to allow free finger mobility. Exercises that focus on whole-arm movements with the arm, forearm, and wrist supported and the hand performing the functional grip are encouraged. Support from the therapist is possible, but a hands-off approach is preferred. Movement at the wrist can be included if the subject can move without synergy. In functional tasks, including both uni- and bi-manual ones, the arm and hand are also used as stabilisers.

Level 2: At this level, the elbow is supported, forcing the individual to control the hand and wrist joints. When necessary, the surface or the therapist can offer support

(e.g., in reaching tasks). In order to get to level 3, it should be encouraged to perform some repetitions without assistance.

Level 3: In this level, the upper limb is not supported, allowing the subject to focus on controlling movement at all joints. Therapists are still welcome to offer support or direction at the shoulder, if necessary, but a hands-off approach is preferred[25].



Statistical Analysis

Statistical analysis was performed by using SPSS software version 20.0 and MS Excel-2007. Descriptive data was presented as mean +/- standard deviations and percentages.

Data was tabulated and graphically represented. Data was analyzed by using both descriptive and inferential statistics.

Within the groups: Paired T-test was used to compare the levels of pre and post-test scores (non-parametric or parametric accordingly). It was used to assess the statistical difference within the groups for FMA-UE and WMFT.

Between the groups: Unpaired 't-test' was used to compare the statistical difference between means of two independent group for FMA-UE and WMFT.

For all statistical analysis, $p \leq 0.05$ was consider as statistically significant.

Results

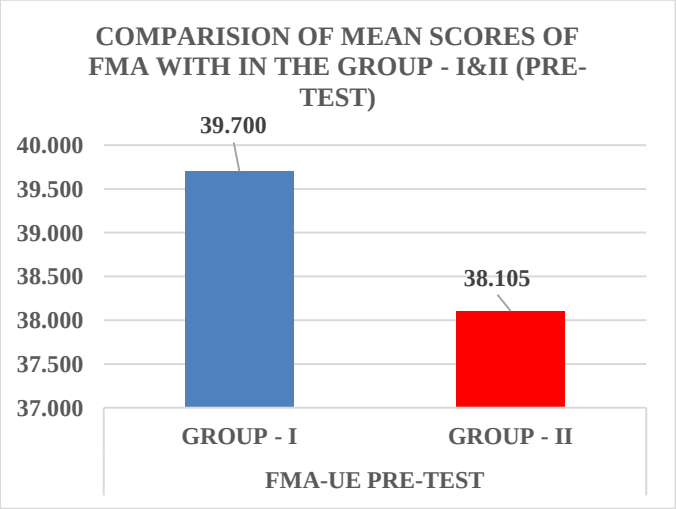
The results of the study were analysed by FMA-UE & WMFT to see the improvement in function & motor recovery.

The consort flow chart of the study showed the study organization in terms of Subjects Screening, Random allocation and analysis following the Intervention.

A total of 113 screened for eligibility, among them 81 subjects were included in the study trail. All the 81 subjects undergone baseline assessment and subjects who met the inclusion criteria were randomized into two groups consisting 42 and 39 subjects.

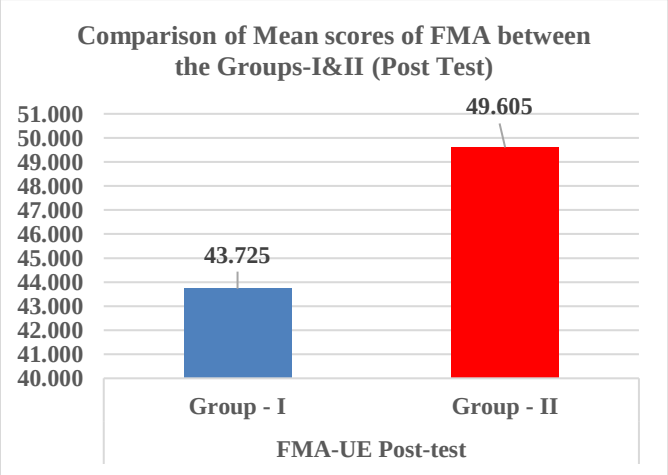
In this study 40 subjects completed training in Group - I and 38 subjects completed training in Group - II with dropouts of 2 and 1 in respective groups, results showed that there is a statistical difference in two groups.

Comparison of Mean scores of FMA-UE between Groups - I&II (Pre-Test)



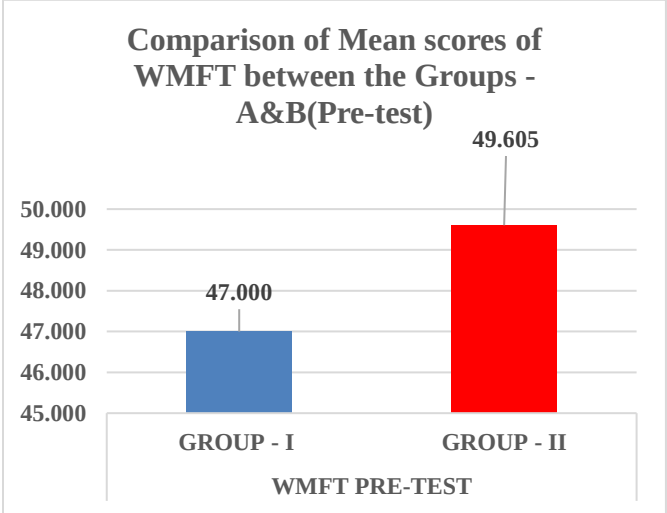
Results: The above Table and Graph shows the baseline measurement of FMA-UE in Group – A (39.700) and Group - II (38.1) were found to be statistically Insignificant.

Comparison of Mean scores of FMA-UE between Groups - I&II (Post Test)



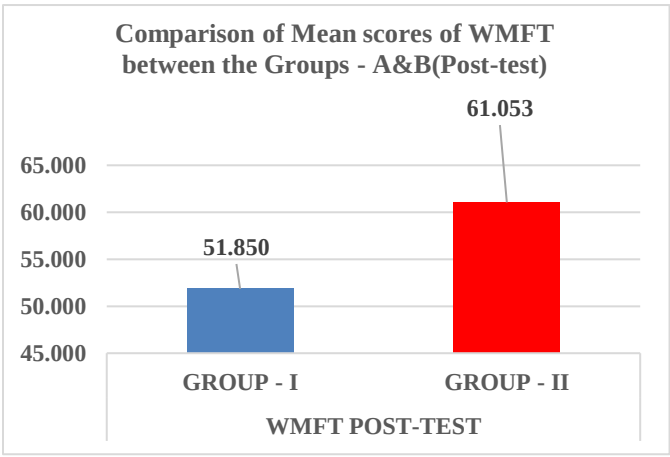
Results: The above Table and Graph shows the post-test measurement of mean score of FMA-UE changes between the Group - I (43.725) and Group - II (49.605) were found to be statistically significant (P<0.05).

Comparison of Mean scores of WMFT between the Groups - I&II (Pre-test)



Results: The above Table and Graph shows the baseline measurement of WMFT in Group - I (47.000) and Group - II (49.605) were found to be statistically insignificant.

Comparison of Mean scores of WMFT between the Groups - I&II (Post-test)



Results: The above Table and Graph shows the mean score of post-test measurement of mean score of WMFT changes between the Group - I (51.850) and Group - II (61.053) were found to be statistically significant (P < 0.05)

Discussion

The aim of the study was to investigate the Effectiveness of standardized rehabilitation on upper limb recovery in different types of strokes among young stroke subjects. One of the neurological disorder extensive rehabilitation

is stroke since recovery is frequently slow or requires time.

A young person of life is significantly influenced by stroke, which affects both physical and motor skills. They are more likely to be caring for children and are in a time of life where employment is crucial[26].

Young stoke survivors also face a lengthier term of disability because of their impairments, which poses a socioeconomic problem. These issues include stress among the family, institutionalisation, going back to work, and future requirements. These victims face particular rehabilitation obstacles as a result patients have been demonstrated to recover neurologically and functionally more quickly, have a better prognosis, and have a higher long-term survival rate than older stroke patients. The entire family is impacted by a stroke[27].

Subjects were assessed for motor and functional impairments at baseline and at the end of intervention using the FMA-UE for motor assessment and WMFT for functional assessment. Findings has also shown in Group - I there is statistically significant reduction in FMA-UE (P< 0.0010) and WMFT (p<0.0010) scores. According to chan-lin-chu et al, in Ischemic stroke, the mechanisms include mass effect due to cerebral edema and inflammation. According to Hala A. Shaheen et al, in his study stated that the early clinical recovery from the stroke could be explained by the resolution of tissue edema and the mass effect associated with infraction and within hours of cerebral ischemia onset, plasticity-enhancing mechanisms cascade started with dendritic growth, axonal sprouting, and the new synapses formation. Additionally, the most substantial improvement happened in the first few weeks post stroke.

In Group - II there is statistically more significant improvement in FMA-UE (P<0.0001) and WMFT (P<0.0001). According to Robert perna et al, although it is generally believed that Hemorrhagic stroke survivors have better neurological & functional progress than prognosis than non-hemorrhagic stroke survivors, Hemorrhagic stroke subjects showed somewhat faster functional motor gains & had shorter length of stay exhibited slower but greater recovery than those with Ischemic stroke[28].

According to Tomoko Kitago et al, even after just one week of therapy, rehabilitation drastically decreased the amount of perihematomal neuronal death, pointing to a potential neuroprotective impact. This study also looked at how iron toxicity and inflammation in post-hemmorhagic stroke were affected by rehabilitation. Rehabilitation has been shown to increase the clearance of toxic blood components including Hgb and iron and lessen oxidative stress at the hematoma/perihematomal interface starting one week after Hemorrhagic stroke. According to the author, rehabilitation speeds up the Hgb clearance pathway and slows down the anti-clearance pathway to prevent further harm.[29].

Rehabilitation facilitates reorganization of Ipsi-lesional and Contra-lesional hemisphere neural network and micro environment, including increased neuroplasticity, angiogenesis and altered excitatory-inhibitory signalling, and augmented hematoma clearance[30].

The study findings indicating that after 6 weeks of interventions standardized rehabilitation program was showed more upper limb recovery in Hemorrhagic stroke in both functional & motor components.

Limitations

- Due to Small sample size in this study results couldn't be generalized.

- No blinding evaluators of outcomes was done.

Recommendations Of Further Research

- This study only concentrates on Upper-Limb but a protocol for overall rehabilitation can be beneficial.
- Further follow up can be recommended.

Conclusion

The present study concludes that after six weeks of intervention both groups were shown statistically significant improvement in post-test values. However more percentage of improvement was found in subjects with Hemorrhagic type of stroke when compared to Ischemic type of stroke from the findings of the current study, it can be recommended that the Standardized Rehabilitation may be opted as a treatment of choice for improving Functional and Motor recovery in Hemorrhagic stroke subjects.

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