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EVALUATION OF PERFORMANCE BASED IMPAIRMENT OF STROKE PATIENTS

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ABSTRACT

Background: Stroke is the leading cause of physical dysfunction. It is imperative to identify the current level of physical activities of stroke patients to plan for effective rehabilitation strategies. Aim of the study was to evaluate the severity of performance impairment of stroke patients using Fugl-Meyer Assessment and Total motor score. **Methods:** Thirty-seven stroke patients were selected. The performance impairment was evaluated by FMA motor score. Both upper limb (UL) and lower limb (LL) motor function was evaluated. The maximum UL score was 66 and LL score was 34. The relationship of age and duration of condition with FMA motor score was studied by Pearson's correlation coefficients. The difference in the gender and type of stroke with the FMA motor score was analysed by Mann-Whitney 'U' test. **Result:** The mean FMA total score was 43.81 ± 7.12 . The relationship between age and total motor score was not significant with, $r = 0.004$, $p = 0.980$. There was no significant relationship between duration of the condition and motor recovery, $r = 0.46$, $p = 0.304 > 0.05$. The difference in the gender ($z = 0.55$, $p = 0.579$) and type of stroke ($z = 0.06$, $p = 0.956$) was not significant with the total motor score. **Conclusion:** It is concluded that stroke patients have severe performance impairment evaluated by FMA and Total motor score. Motor recovery was not dependent on the age and gender of patients.

Keywords: Stroke; Fugl-Meyer Assessment; Upper limb; Lower limb

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INTRODUCTION

Stroke is the second principal cause of death globally.^{1,2} The global burden of diseases (GBD) study has reported 5.87 million stroke deaths worldwide in 2010 in comparison to 4.66 million in 1990. This denotes 26% surge in global stroke deaths during the past two decades.^{1,2} GBD study further estimates that 85% of global stroke burden is carried by low- and middle-income countries (LMICS). The reliable source regarding physical and social burden, morbidity and mortality for stroke in India is lacking^{3,4,5,6}.

A systemic review of stroke in India has found that the cumulative incidence is between 105 to 152 / 1,00,000 persons per year and the crude prevalence is 44.29 to 559/1,00,000 persons in different parts of the country during the past decade.⁷ It has been found that stroke is the third leading cause of physical dysfunction globally. It is identified that 37%- 45% of stroke survivors are suffered from one or other form of functional disabilities and further revealed that these individuals are dependent on others for activities of daily living (ADLs)^{8,9,10}.

This dependency is the grave factor for continuing costs for stroke patients. Therefore, it is a high time to address the disability and complications of stroke survivors to make them progress in the functional ability and level of independence. For this, effective assessment of function and performance-based impairment is prerequisite to identify the current disability level of the

patient. The Fugl-Meyer Assessment (FMA) is specifically designed for stroke patients and is based on performance impairment index^{11,12}.

This scale evaluates five domains viz., motor function, sensory function, balance, joint range of motion and joint pain. The motor score ranges from 0 to 100 points. The classification for impairment severity has been based on FMA total motor scores. Plaiz T et al (2005) have identified excellent reliability of total motor score with intra-class correlation coefficient (ICC) = 0.97¹³. Likewise, many studies have demonstrated excellent criterion and construct validity for FMA total motor score^{13,14,15}. Therefore the aim of present study was to evaluate the performance impairment severity of stroke patients based on FMA total motor scores.

METHODS

Participants: Thirty stroke patients were chosen based on the selection criteria.

Study design and setting: The current study design was observational study and descriptive design. The study was carried out in the out-patient department of Bethany Navajeevan College of Physiotherapy, Thiruvananthapuram in Kerala, India between 2019-2020.

Fugl-Meyer Assessment: The performance-based impairment of stroke patients more specifically functional recovery of motor domain based on Fugl-Meyer Assessment (FMA) was evaluated for 37 post stroke patients. FMA motor domain evaluates the movement, coordination and reflex action of the shoulder, elbow, forearm, wrist,

hand, hip, knee and ankle. This is derived from natural history of motor recovery after stroke and also integrates Brunnstrom's stage of motor recovery. FMA is intended to evaluate recovery of stroke patients in the context of the motor system. Motor score ranges from 0 to 100 where '0' denote hemiplegia and 100 represents normal motor performance.

The motor score is allotted to 66 points for upper extremity and 34 points for the lower extremity. It is based on the ability to complete the item using a 3-point ordinal scale, where 0 = cannot perform, 1 = performs partially and 2 = performs fully. Scoring was made by direct observation of performance. The classification of severity of impairment was based on FMA total motor scores.

Selection Criteria

Inclusion Criteria:

- Post stroke patients aged 25 to 60 years.
- Duration of stroke was between 3 to 9 months.
- Patients with middle and anterior cerebral artery involvement confirmed by computerized tomography (CT.).
- Both ischemic and haemorrhagic type of stroke confirmed either by computerized tomography (CT) or magnetic resonance imaging (MRI).
- Brunnstrom recovery stage of 3 and 4.

Exclusion Criteria:

- Medically unstable patients.
- Patients with orthopaedic ailments.

- Associated with vertigo and difficulty in standing activity.
- Patients with posterior cerebral artery involvement.
- Other neurological conditions that affect safety of study patients, like central nervous system vasculitis, intracranial tumour, intracranial aneurysm, multiple sclerosis or arteriovenous malformations.
- History of seizure disorder 1 month or longer after strokes.
- A substantial cardiopulmonary or metabolic disorder.
- Patients associated with psychiatric illness and depression that had interfered with treatment.
- Change in the oral spasticity medications two weeks prior to enrolment or getting botulinum toxin A injections in the affected arm 4 months prior to enrolment.
- Patients with anosognosia of the affected arm.
- History of spinal cord injury, traumatic brain injury or spontaneous subdural or epidural hematoma.

Informed Consent: Written informed consent was obtained from each patient before enrolling them in to the study.

Ethical Clearance: Institutional human ethical clearance was obtained from the ethical board of Bethany Navajeevan College of Physiotherapy, Thiruvananthapuram, Kerala, India with letter reference number:Ec2017/Ph.D/1, dated 06/06/2018.

Sample Size Estimation: It was based on the studies of similar kind.^{16,17,18} It was identified from previous studies that a standard deviation of 12 in FMA was observed in post stroke total motor score after 4 to 9 months of the event. The confidence interval was fixed as 95%. The corresponding value was 1.96. The following formula was used to estimate the sample size.

$$N = \left(\frac{SD}{\text{Confidence interval}} \right)^2$$

$$N = \left(\frac{12}{1.96} \right)^2$$

N = 37 estimated sample size was 37.

Sampling Method: Systemic random sampling was used. Every 3rd patient with stroke who visited outpatient clinic of physiotherapy was selected once they have fulfilled the selection criteria. As the study patients were selected from outpatient department, sampling frame was not used.

Study Procedure: The performance-based motor impairment of the stroke patients was evaluated by Fugl-Meyer Assessment (FMA). It was carried out for 37 post stroke patients to identify the level of functional motor recovery. The current functional based performance was evaluated by FMA. It was evaluated for both upper limb and lower limb. The overall motor score was also recorded. The association of functional motor recovery with demographic profile like age and gender was studied. The relationship of motor recovery with clinical profile like type of stroke, duration of

stroke and associated co-morbidities was also studied.

Statistical Analysis: The descriptive tools such as mean and standard deviation were calculated for FMA motor recovery for upper limb, lower limb and overall recovery. The relationship between age and motor recovery was analysed by Pearson's correlation coefficients. Likewise, the relationship between duration and motor recovery was studied by Pearson's correlation coefficient. The difference in the gender and type of stroke with respect to FMA motor score was studied by Mann-Whitney 'U' test. The entire statistical analysis was carried out by the statistical packages of the social sciences (SPSS-21).

RESULTS

The mean age of the study patients was 51.03 ± 5.74 years. The mean duration of the condition was 5.78 ± 1.83 months. The basic characters are shown in Table-1. The most of the study patients (78.4%) had ischemic stroke. Left and right middle cerebral arteries were commonly involved (each 32.4%). Grade 1 (45.9%) and grade 2 (54.1%) spasticity was the common feature. The clinical characters of the study patients are shown in Table-2. The mean upper limb motor score was 24.51 ± 5.33 . The average lower limb motor score based on FMA was 19.29 ± 3.32 .

The average total FMA score was 43.81 ± 7.12 . The motor recovery of the study patients is shown in Table-3. It is inferred from Table-4 that there was no significant relationship between age and duration

with motor recovery of the study patients ($P > 0.05$) computed by Pearson's correlation coefficients. Therefore, it is revealed that motor recovery was not dependent on the age of the patients as well as the duration of the condition.

The difference in the gender and type of score with respect to motor score was analysed by Mann-Whitney 'U' test and is shown in Table-5. It was found that there was no significant difference in the motor scores with respect to gender and type of stroke ($P > 0.05$) for upper limb motor score, lower limb motor score and total motor scores.

Data Analysis:

Age (M, S.D.)	51.03	5.74
Gender (N, %)		
Male	29	78.4
Female	8	21.6
Duration (M, S.D.)	5.78	1.83
Side (N, %)		
R	22	56.8
L	16	43.2

Table 1: Basic Characters of the Study Patients

M- Mean, S.D. - standard deviation, N- number, R-right, L- left

Type of Stroke (N, %)		
Ischemic	29	78.4
Haemorrhagic	8	21.6
Site of Stroke (N, %)		
LACA	7	18.9
LMCA	12	32.4
RACA	6	16.4
RMCA	12	32.4
Spasticity (N, %)		
Grade 1	17	45.9
Grade 2	20	54.1
Brunnstrom Recovery (N, %)		
3	9	24.3
4	28	75.7

Table 2: Clinical Characters of the Study Patients

N- Number, LACA- left anterior cerebral artery, LMCA-left middle cerebral artery, RACA- right anterior cerebral artery, RMCA- right middle cerebral artery,

FMA motor score	M	S.D.
Upper limb	24.51	5.33
Lower Limb	19.29	3.32
Total Score	43.81	7.12

Table 3: FMA – Motor Recovery of the Study Patients

M- Mean, S.D.- standard deviation

	Pearson's Correlation Analysis	
	r	p
Age		
Upper limb	-0.073	0.679
Lower limb	0.121	0.472
Total score	0.004	0.980
Duration		
Upper limb	0.184	0.287
Lower limb	0.027	0.843
Total score	0.146	0.374

Table 4: The Correlation of the Age and Duration with FMA Motor Score

r- Regression coefficient, p- probability value

Variable	Mann Whitney 'U' test		
	U	Z	P
Gender			
Upper limb	67.50	1.79	0.072
Lower limb	99.00	0.63	0.528
Total Score	101.00	0.55	0.579
Type of Stroke			
Upper limb	114.50	0.06	0.956
Lower limb	106.50	0.35	0.725
Total Limb	114.50	0.06	0.956

Table 5: Difference in the Motor Score with Respect to Gender and Type of Stroke

U- Mann- Whitney U value, Z- test statistics, p- probability value

DISCUSSION

The mean total motor recovery of the study patients was 43.81 ± 7.12 . Therefore, the overall motor recovery impairment was severe as the total motor recovery score was < 50 . According to Fugl-Meyer, the score between 0-35 is very severe, 50-84 is marked and 95-99 denotes slight motor impairment¹¹. Zhuang JY et al have identified mean FMA- upper limb (UL) score of 31.5 in stroke patients¹⁹.

In the current work, the mean FMA- UL score was less, it was 24.51 ± 5.83 . The difference in the motor recovery between the present work and Zhuang JY et al could have influenced by genetic, pathophysiologic, sociodemographic and

therapeutic factors. In the majority of previous work UL motor function was evaluated. But in the present work both upper limb and lower limb motor recovery was assessed. The mean lower limb (LL) motor recovery was 19.27 ± 3.32 . Therefore, the level of LL motor impairment was 44% which was less compared to UL motor impairment which was 63%. Previous studies have shown that higher motor dysfunction of the affected UL is the grave factor in contributing to poor activities of daily living (ADLs) in stroke patients^{15,18}.

Chanubol R et al. showed that upper limb motor function was positively related to Barthel Index (BI) in sub-acute stroke patients ($r = 0.56$, $P < 0.001$)²⁰. Mercier L et al had found that motor function of the affected upper limb has a significant effect on independence in ADLs in comparison to perceptual and cognitive dysfunction²¹. Yamamoto H et al recently attempted to eliminate the possibility of a spurious relation caused by the level of LL motor function of the affected limb on the motor functions of the UL and ADLs.

The author concludes that the relationship between the upper limb motor function and ADLs are strongly influenced by lower limb motor function. Further, the mean FMA-LL score ($M = 19.3 \pm 12.1$) of that study is strongly matched with the present work ($M = 19.29 \pm 3.32$). The mean duration of the condition was 5.78 ± 1.83 months in the present investigation. Hence it is inferred that even after 6 months of stroke, the motor impairment was severe

and therefore it is the need of the hour to intensify the rehabilitation measures to improve the motor functions and thereby ADLs in post stroke patients. The present study provides the broad picture that stroke patients has poor motor recovery. Effective rehabilitation strategies should be initiated at the early stage of stroke to mitigate the motor impairment.

The present study was attempted to identify the current physical status of the stroke patients by evaluating performance-based motor recovery. As functional activities are by and large depending on the motor function, it is assumed that assessment of motor recovery is crucial in deciding the current physical conditioning of the patient. The current study has shown that motor recovery was not influenced significantly by age and gender as well as type of stroke and duration of the condition. There was less variation of age in the current population as the obtained mean & S.D. was 51.03 ± 5.74 years. This may be the reason for uniformity of motor score with reference to age. In the present work stroke patients with more than three months was only selected and greater than 9 months of duration was excluded. Hence duration of the condition has minimal effect on motor recovery score. The type of stroke has influence on motor recovery only at the acute stage and therefore has minimal impact on the motor recovery. The insignificant difference in the gender with reference to motor score revealed that early and effective rehabilitation is the

crucial factor than demographic variable in the motor outcome.

Conflict of interest: There was no conflict of interest to conduct this study.

Fund for the study: It was a self-financed study.

CONCLUSION

It is concluded that stroke patients have severe performance impairment evaluated by FMA total motor score. The motor recovery was not dependent on the age and gender of the patients and it was also not influenced by the type and duration of the condition. It is suggested to initiate vigorous and innovative rehabilitation approach at the beginning of stroke to mitigate the severity of performance-based impairment sequel.

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