A Study to Correlate Modified Modified Ashworth Scale(Mmas) and Modified Tardieu Scale(Mts) with H-Reflex to Assess Planterflexor Spasticity in Chronic Post-Stroke Patients- An Observational Study

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Abstract

Background : Stroke or cerebrovascular accident is the sudden loss of neurological function caused by an interruption of the blood flow to the brain. Stroke leads to various signs and symptoms, which includes alteration in tone (commonly spasticity), loss of superficial and deep sensations, muscle weakness, abnormal synergy patterns, abnormal reflexes, gait abnormality, altered coordination, etc. Modified Modified Ashworth scale and Modified Tardieu scale both are tools to assess spasticity in stroke patients. Modified Ashworth Scale was less reliable than Modified Tardieu scale hence Ansari et al. developed Modified Modified Tardieu scale.

Aim: The aim of the study is to correlate Modified Modified Ashworth Scale with H-reflex and Modified Tardieu Scale with H-reflex to assess Planterflexor spasticity in Chronic post-Stroke patients.

Method: This Observational study which included 40 chronic post- stroke patients whose age was between 45-60 years and having stroke since at least 1 year. The patients were assessed with MMAS and MTS along with H/M ratio to find spasticity in Planterflexors.

Result: Data was analysed using SPSS software version 23.0 using Spearman's correlation test. The statistical analysis showed MMAS has more positive correlation has H/M ratio as compared to MTS. ($p<0.05$)

Conclusion: From the above study it can be concluded that both MTS and MMAS have a positive correlation with H/M ratio. But MMAS has better positive correlation when compared and hence should be used as assessment tool in assessing planterflexor spasticity in chronic post-stroke patients.

Keywords*: Stoke, Modified Ashworth Scale, Modified Tardieu scale, Modified Modified Ashworth Scale, H-reflex, H/m ratio.*

Introduction

Stroke is defined as sudden loss of neurological functions resulting from ischemic or hemorrhagic lesions in the brain, which lasts more than 24 hours. It is caused by interruption of blood flow to the brain usually by atherosclerotic plaques that occur at certain sites of predilection. These sites generally include bifurcations, constrictions, dilation, or angulations of arteries.[1]

Spasticity is a common symptom observed following upper motor neuron syndrome. Diseases such as stroke, traumatic brain injury, spinal cord injury, cerebral palsy and multiple sclerosis are associated with significant spasticity. Spasticity has been defined classically by

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Lance as a motor disorder characterised by a velocity-dependent increase in tonic stretch reflexes.[2]

In 1994, Young added neurophysiological elements to define spasticity independently of the type of movement: "a motor disorder characterized by a velocity-dependent increase in tonic stretch reflex that result from abnormal intra-spinal processing of primary afferent input".[3]

Spasticity arises when the balance between inhibitory and excitatory fibers is disturbed i.e. either if the inhibitory pathways are interrupted or if there is increased activity in facilitatory pathways.[1,4,5]

It is important to measure spasticity to evaluate the impact of specific treatments and to choose the most efficient and cost effective management option for each patient.[6] To assess spasticity accurately in clinical practice and for research purposes, reliable and valid tools must be used.

Measurement of spasticity can be done by clinical and laboratory methods[7.] Several scales have been developed and validated to assess spasticity in patients with brain injury. The two most commonly used scales are the Modified Modified Ashworth Scale (MMAS) and the Modified Tardieu Scale (MTS).

The Ashworth Scale was originally developed in 1964, and modified by Bohannon and Smith in 1987.[8,9] The Bohannon-Smith Modified Ashworth Scale (MAS) has been recently modified by Ansari et al15 in 2006 as the Modified Modified AshworthScale (MMAS; table 1). The MMAS is an ordinal level measure of spasticity, which grades the intensity of spasticity from 0 to 4. The results of several studies have demonstrated that the MMAS is a reliable measure for assessing spasticity in lower limbs of patients with spasticity.[10-13]

The Tardieu Scale was developed by Tardieu et al[14] in 1954. Held and Pierrot-Deseilligny[15] modified it in 1969, and it was further modified in 1999 by Boyd and Graham. This latest version of the Tardieu Scale is called the Modified Tardieu Scale (MTS).[16,17] The MTS considers R2, R1 and R2−R1 to measure spasticity. The R2 is the passive range of motion measured during slow passive stretch. The R1 is the angle of muscle reaction measured during fast passive stretch, and occurs in a particular angle of 'catch' from hyperactive stretch reflex. Large and small differences between R2 and R1 indicate spasticity and muscle contracture, respectively.[16,18] Quality of muscle reaction during fast passive stretch is also graded based on 0–4 scores and is defined as the MTS scores (table 1).[19,20]

H-reflex was described by Johanan Hoffmann in 1918, hence called H-reflex.[21] It is a mono synaptic reflex elicited by submaximal stimulation of the nerve. It is analogous to the mechanically induced spinal stretch reflex. The primary difference between the H-reflex and the spinal stretch reflex is that the H-reflex bypasses the muscle spindle, and, therefore, is a valuable tool in assessing modulation of monosynaptic reflex activity in the spinal cord. The H-wave is a good indicator of the strength and distribution of the stimulus input from muscle spindle to the motor neuron pool, which lies at the site of the anterior horn of the spinal cord[21] and hence is an objective method for the measurement of spasticity. The reflex arc of H-reflex includes, i) large fast conducting group 1a sensory fibers, ii) spinal cord where afferent fibers synapse with alpha muscle. (As shown in fig 1.4) H-reflex is facilitated by submaximal stimulation. The inhibition of H orthodromic conduction in motor axons. In lower limb H-reflex is recorded from calf muscles by percutaneous stimulation at mid-popliteal crease with anode distal. H-reflex is influenced by a number of spinal and supraspinal variables. The H studies therefore provide valuable information, which are helpful in understanding the pathophysiology of various CNS abnormalities. The fraction of motor neuron pool activated in H be as high as 100%. The ratio of peak to peak maximum H M amplitude (Hmax/Mmax) provides an easy estimate of motor neuron pool activation, and therefore excitability. Although there is considerable variability of Hmax/Mmax ratio, Hmax/Mmax is normally less than 0.7.[8]

A study observed that spasticity primarily affects Elbow(79%), Wrist(66%) and Ankle(66%).[22]

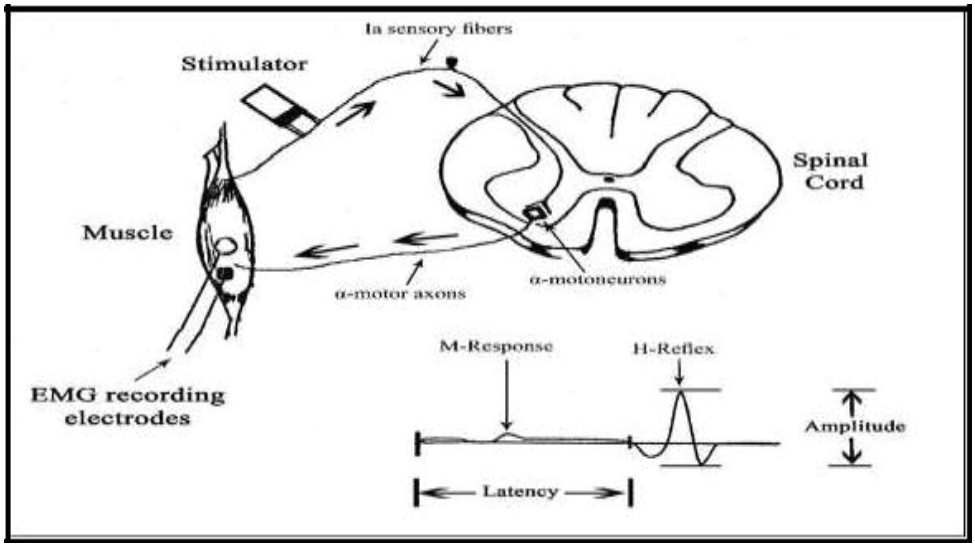

Figure 1: H-reflex Pathway

Aims and Objectives:

Aim:

- The Aim of the study is to find effective and reliable tool for measuring spasticity among Modified Modified Ashworth Scale and Modified Tardieu Scale for Ankle Planter Flexor Spasticity in Post-Stroke Patients.

Objectives:

- To assess Planter flexor Spasticity of Post Stroke Patients with Modified Modified Ashworth Scale.
- To assess Planter flexor Spasticity of Post Stroke Patients with Modified Tardieu Scale
- To assess Planter flexor Spasticity of Post Stroke Patients with H-reflex.
- To corelate and find effective and reliable tool for measuring spasticity among Modified Modified Ashworth Scale and Modified Tardieu Scale for Ankle Planter Flexor Spasticity in Post-Stroke Patients.

Hypothesis:

- **Null Hypothesis**: MTS is more corelated to H/M ratio in assessing Planter-flexor Spasticity in chronic post-stroke patients as compare to MMAS.
- **Experimental Hypothesis**: MMAS is more corelated to H/M ratio in assessing Planter-flexor Spasticity in chronic post-stroke patients as compare to MTS.

Method:

- SOURCE OF DATA: Physiotherapy Centres in and around Rajkot and Surat.
- STUDY DESIGN: Observational study.
- SAMPLE SIZE: 40 Post-Stroke Patients
- STUDY POPULATION: Post-Stroke Patients with post stroke duration more than 1 year.
- STUDY DURATION: One-time study
- SAMPLING METHOD: Purposive Sampling
- STUDY SETTING: Shree K. K. Sheth Physiotherapy College, Rajkot.

P P Savani University, Surat.

Materials and Tools

- Pen
- Paper
- Record and Data collection sheet

- Consent form
- Treatment table
- Pillow
- Spirit
- Cotton
- Electrodes
- Gel
- White Paper
- EMG-NCV machine (RMS EPMK-II, version 1.1)
- Micropore
- Universal Goniometer

Methodology

Ethical Approval regarding the methodology was taken from Ethical committee before starting the study.

A brief assessment was taken to include or exclude the patient in the study.

Inclusion Criterion:

- Patients having Stroke.
- Age: Between 40 and 65 years of age.
- Gender: Male as well as Female.
- Type of Stroke: Ischemic as well as Hemorrhagic type of stroke.
- Post-stoke period: Post-Stroke Patients with post stroke duration more than 1 year.
- Patient able to ambulate independently with or without assistive aid.
- Modified Ashworth Scale for planter-flexors: Grade 2 or more.

Exclusion criteria:

- Subjects having language, visual, or cognitive impairments.
- Any type of recent lower limb fracture.
- Any type of recent non-paretic lower limb fracture.
- Uncooperative patient.
- Subjects having associated other neurological disorder.
- Subject having Perceptual disorder.

Procedure:

The purpose and procedure of the study was explained to patient and a written consent was taken along with demographic data including name, age, sex, affected side and post stroke duration.

All measurements will be taken in the morning hours between 10:00 and 11:30 AM.

- The H-reflex was taken for spastic calf muscle.

Position : Prone lying

Recording :

- Active Electrode : Distal Edge of Calf Muscle
- Refrence Electrode : Achilles Tendon.

Stimulation -

- Square Wave pulse of 1 ms duration. [21]
- Modified Tardieu Scale:

A standard goniometer was used for angle measurements The leg position for measurement of R1 was the same as the position for PROM (knee maintained flexed at 30). The zero position for the measurement was set at 90. Ankle dorsiflexion and plantarflexion from this position were assigned positive and negative values, respectively. To measure R1, the joint was moved through the available range of motion with velocity V3 (i.e. as fast as possible) and the quality of muscle reaction was scored from 0–4 (Table I). If the MTS score was 2 or higher, the point of 'catch' was measured as the R1 using the goniometer. To rate spasticity, only one passive stretch was performed. [23]

- Modified Modified Ashworth Scale:

The patient was in supine position, lower limb in extension, with head in midline and the arms alongside the trunk. The rater, on the side being tested, placed one hand under the ball of the foot, while the other hand stabilized the limb around the ankle joint. The rater then moved the ankle into maximum possible dorsiflexion.[24]

Result

The patients' demographic and clinical variables are presented in Table 1 and Table 2 respectively. The MMAS and MTS scores ranged from '0' to '4'.

Graphical representation of Age and Gender distribution is depicted in Graph 1 and 2 respectively.

Table 1: Patient's Demographic

Gender (M/F)	Minimum	Maximum	Mean (SD)
Age	45	60	57.96
Height (cm)	168	188	172.34
Weight (kg)	47	88	63.22
BMI	17.4	27.8	19.18
Time since stroke (years)	1	5	2.37

Table 2: Clinical Variables

Variables	**Minimum**	**Maximum**	**Mean (SD)**
H/M RATIO	0.728	1.287	0.857
MMAS	2	4	2.833
MTS	1	3	1.9444

Statistics were performed using SPSS version 23.0 for Windows and Spearman correlation test was performed.

The result suggests that a positive correlation exists between H/M ratio-MMAS (R_S=0.812) and also between H/M ratio-MTS (R_S=0.562), while p value was less than 0.05.

But a strong correlation was found between H/M and MMAS as compared to H/M and MTS.

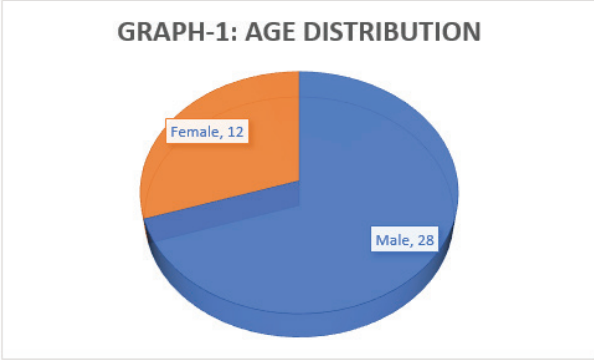

Chart 1 and Chart 2 represent Scatter diagram relation of H/M ratio with MMAS and MTS respectively.

Discussion

The result of the study shows that MMAS is more significantly corelated to H/M ratio compared to MTS. This proves the experimental hypothesis that MMAS is more corelated to H/M ratio in assessing Planter-flexor Spasticity as compare to MTS. This protocol utilises conventional and new indicators of motoneuron excitability in spasticity for comparative validity evaluation. Further, the protocol utilises standard methodology for spasticity assessment to indicate the excitability of the α motoneuron pool.[25] Hamid et al., in 2018 compared MMAS and MTS with H-reflex on wrist flexor spasticity and concluded that MMAS is more reliable assessment tool to assess spasticity in stroke patients. This supports the findings on the research.

Furthermore, MMAS as developed, by Ansari et al., is specifically modified to overcome limitation of MAS and make it more reliable assessment tool. Though MTS has more specific angle of reaction and quality of muscle reaction assessment, it takes more time to administer and also multiple repetitions for same muscle group. Whereas MMAS can be used and muscle spasticity be graded by single repetition.

Conclusion

From the above study it can be concluded that both MTS and MMAS have a positive correlation with H/M ratio. But MMAS has better positive correlation when compared and hence should be used as assessment tool

in assessing planterflexor spasticity in chronic post-stroke patients.

Limitations

- Neither therapist nor the subjects were blinded to the study.
- Room temperature could not be controlled.
- Type and site of lesion was not considered.

Furthur Recommendation

- Double-blinded study should be done to prove the above mentioned findings.
- Specific ACA infarct stroke patients should be taken.

Source of Funding:

- No Funding was required for this study.

Conflict of Interest: The study did not have any conflict of interest.

Ethical Clearance: Ethical Clearance was obtained from P P Savani University Ethical Committee.

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