

## Original Article

# EFFECT OF RIGHT SIDE MEDIAN NERVE STIMULATION ALONG WITH MULTI SENSORY COMA STIMULATION PROGRAM ON LEVEL OF CONSCIOUSNESS AND NEUROBEHAVIOURAL FUNCTION AMONG DIFFUSE AXONAL INJURY PATIENTS. -AN EXPERIMENTAL STUDY

Dr. Ganesan Arumugam<sup>1</sup>, Dr. Brammatha<sup>2</sup>, Dr. Shivananda V<sup>3</sup>, Dr. Nidhin Jose<sup>4</sup>, Dr. Sashidar<sup>5</sup>.

Neuro physiotherapist, Bangalore baptist hospital, Bangalore<sup>1</sup>, Assoc. Professor , KMCH college of physiotherapy, Coimbatore<sup>2</sup>, Chief physiotherapist, Bangalore Baptist Hospital, Bangalore<sup>3</sup>, Physiotherapist, Bangalore Baptist Hospital, Bangalore<sup>4</sup>, Physiotherapist, Sai Balaji Physiotherapy Centre, Bangalore<sup>5</sup>.

## ABSTRACT

**Objective:** The aim of the study is to find out the effect of right side median nerve stimulation along with structured multi sensory coma stimulation program on level of consciousness and behavioral function among diffuse axonal injury patients. **Materials and Methods:** STUDY DESIGN-Pre-test and post-test experimental study design. PARTICIPENTS-9 male diffuse axonal injury patients were selected and randomly assigned into experimental group and control group. INTERVENTIONS-Patients in the experimental group received right side median nerve stimulation along with multistructural sensory stimulation for 2 hours and control group received multistructural sensory stimulation along with sham stimulation. Both the group were treated for 2 weeks duration. OUTCOME MEASURES-Neuro behavioural function was assessed with western neuro sensory stimulation profile and level of consciousness was assessed by Glasgow coma scale at baseline and after two weeks of study. **Results:** After 2 weeks duration there was a significant improvement in the level of consciousness between the groups but there was no significant improvement in neurobehavioral function between the groups. **Conclusion:** The results showed that there was significant improvement in level of consciousness between the groups but there was no significant improvement in the Neuro behavioural function between the groups.

**KEY WORDS:** DIFFUSE AXONAL INJURY; MULTI SENSORY STIMULATION; MEDIAN NERVE STIMULATION; CONSCIOUS LEVEL; REHABILITATION.

**Address for correspondence:** Dr. Ganesan Arumugam, Neuro physiotherapist, Bangalore baptist hospital, Bangalore, India. **Email:** ganesharumugam.physio@gmail.com.

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## INTRODUCTION

The Centers for Disease Control and Prevention (CDC) defines Traumatic Brain Injury as "cranio cerebral trauma associated with neurological or neuropsychological abnormalities, skull fracture, intracranial lesions or death" .<sup>1</sup>

Traumatic brain injuries are a leading cause of morbidity, mortality, disability and socioeconomic losses in India and other developing countries.

It is estimated that nearly 1.5 to 2 million persons are injured and 1 million succumb to death every year in India<sup>2</sup>. After traumatic brain injury, patients in coma for greater than 1 week and aged 45 years or younger have a potential for good recovery and gains in function continue for years after the injury. The rehabilitation needs of brain injured persons are significantly high and increasing from year to year.<sup>3</sup>

Unconscious patients after brain injury may survive for days or months and often experience decreased quality of life. To facilitate the recovery process and to prevent sensory deprivation after brain injury, sensory stimulation program (SSP) beginning in the early stages of recovery can be beneficial.<sup>4</sup>

Coma recovery programs aim to provide multi sensory stimulation to patients in coma or vegetative state. Coma arousal therapy is believed to provide the sensory stimulation needed to activate the reticular system, which is responsible for maintaining consciousness.<sup>5</sup> These procedures are appropriate for any individual who is in coma or vegetative state and is medically stable. It involves repetitive tactile, auditory, visual, taste, proprioception, and olfactory stimulation.<sup>6</sup>

Median nerve stimulation brings numerous afferent inputs to the Ascending Reticular Activating System (ARAS) via the spinoreticular component of the median nerve synapsing with the neurons of the Ascending Reticular Activating System.<sup>7</sup> Median nerve stimulation seems to activate the entire central nervous system. It is proposed that this peripheral stimulus goes to the Ascending Reticular Activating System, which further connects with the intra laminar nuclei of the thalamus and then stimulates the cortical layers.<sup>8</sup>

Most of the studies in the past have only studied the effects of median nerve stimulation and coma stimulation as separate entities. So far it is the first study which combined right side median nerve stimulation and multistructural sensory stimulation for two weeks and it aims to find out its effectiveness on the level of consciousness and neurobehavioral function.

The aim of the study is to compare the combined effects of right side median nerve stimulation along with structured multi sensory coma stimulation program versus multi sensory coma stimulation program along with sham stimulation on the level of consciousness and neurobehavioral function of the individual with diffuse axonal injury.

## MATERIAL AND METHODS

Study was conducted with 9 subjects among those 4 were in control group and 5 were in experimental group, study design for this study is Pre and Post test experimental study design with purposive sampling and the study was conducted at Neuro intensive care unit and ward, KMCH Hospital, Coimbatore.

**INCLUSION CRITERIA:** Age between 18 to 45 years, Patient with stable vital signs, central venous pressure, and intracranial pressure (ICP) for 24 hours before the enrollment, The Glasgow Coma Scale (GCS) score between (2T, 3 and 8), Diffuse axonal injury patient (diagnosed by neurologist), Left dominant hemisphere patient (as told by caregivers – right handed).

**EXCLUSION CRITERIA:** Brain injury – traumatic open injury, endocrine dysfunction, metabolic coma, epilepsy hepatic coma, uremic coma, History of Visual dysfunction, History of Auditory dysfunction, Presence of brain stem injury or infarction, which was confirmed by imaging studies History of Congenital heart disease / valvular dysfunction / unstable angina & cardiomyopathy, pulmonary dysfunction, Patients with implanted pacemakers or defibrillators, Pregnancy, Alcohol and/or drug intoxication.

**PROCEDURE:** Informed consent was obtained from the patient care givers or relatives. Totally 9 patients were selected by purposive sampling technique. Out of these 9 patients 5 subjects were assigned to experimental group and 4 subjects were assigned to control group in an alternate manner. Control group consisted of Diffuse Axonal Injury patients and they received the multi sensory coma stimulation therapy along with sham stimulation. Experimental group consisted of Diffuse Axonal Injury patients and they received the multi sensory coma stimulation therapy along with right side median nerve stimulation.

Before the start of the treatment procedure the information about the duration of coma was collected for both the groups. pre-test score for level of consciousness was assessed using Glasgow Coma Scale, and neurobehavioral function was assessed using Western Neuro Sensory Stimulation Profile scale.

## MULTISTRUCTURAL SENSORY STIMULATION THERAPY

The following stimulation has been given in this program which includes

1. Visual
2. Auditory
3. Tactile
4. Proprioception

**SHAM STIMULATION** In this treatment protocol the patient was positioned in supine lying and active electrode was placed over the right side lower one third of forearm on the volar aspect and passive electrode was placed on the right side middle one third of forearm on the volar aspect and the intensity was not raised.

## RIGHT SIDE MEDIAN NERVE STIMULATION:

### PARAMETERS:

- Type of current: faradic current
- Wave form: asymmetrical biphasic
- Pulse duration: 300 ms
- Pulse frequency: 40 Hz
- Pulse amplitude: sufficient enough to achieve desired, strength of contraction.
- No of contraction: based on the response of the muscle in order to avoid fatigue
- On time : 20 sec/ min
- Off time : 40 sec/ min
- Active electrode : = volar aspect of right side forearm
- Inactive electrode : = volar aspect of lower 2/3 of right side forearm
- Duration : 1 hours/day

The skin was checked for erythema and burns under electrode site after each treatment sessions.

## DATA ANALYSIS & RESULTS

	Pre-test	Post-test
Mean SD	4.0 ± .81	18.75 ± 1.25
Mean Difference	14.7	
Calculated 'T' value	30.812	
P value and level of significance	P < 0.05 and significant	

**Table: 1.** Paired 't' test value for Western neuro sensory stimulation profile scale among control group.

As shown in table 1, the mean value of pre test and post test are 4.0 and 18.7 respectively. The calculated 't' value is 30.8 at 3 degrees of freedom at 5% level of significance. Since the calculated value is greater than table value, the alternate hypothesis ( $H_{a2}$ ) is accepted. Thus, there is a significant improvement in neuro behavioural function in sham stimulation along with multi structural sensory stimulation patients.

	Pre-test	Post-test
Mean SD	4.6 ± 1.81	20.4 ± 4.82
Mean Difference	15.8	
Calculated 'T' value	11.648	
P value and level of significance	P < 0.05 and significant	

**Table: 2** Paired 't' test value for Western Neuro Sensory Stimulation Profile scale among experimental group. As shown in table 2, The mean value of pre test and post test are 4.6 and 20.4 respectively. The calculated 't' value is 11.648 at 4 degrees of freedom at 5% level of significance. Since the calculated value is greater than table value, the alternate hypothesis ( $H_{a1}$ ) is accepted. Thus, there is a significant improvement in neuro behavioural function in right side median nerve stimulation along with multi structural sensory stimulation patients.

	Pre-test	Post-test
Mean SD	3.5 ± .57	6.5 ± .57
Mean Difference	3	
Calculated 'T' value	7.348	
P value and level of significance	P < 0.05 and significant	

**Table: 3** Paired 't' test value for Glasgow Coma Scale among control group.

As shown in table 3, the mean value of pre test and post test are 3.5 and 6.5 respectively. The calculated 't' value is 7.34 at 3 degrees of freedom at 5% level of significance. Since the calculated value is greater than table value, the alternate hypothesis ( $H_{a2}$ ) is accepted. Thus, there is a significant improvement in level of consciousness in sham stimulation along with multi structural sensory stimulation patients.

	Pre-test	Post-test
Mean SD	3.8 ± .83	7.6 ± .54
Mean Difference	3.8	
Calculated 'T' value	10.156	
P value and level of significance	P < 0.05 and significant	

**Table:4** Paired 't' test value for Glasgow Coma Scale among experimental group.

As shown in table 4, the mean value of pre test and post test are 3.8 and 7.6 respectively. The calculated 't' value is 10.15 at 4 degrees of freedom at 5% level of significance. Since the calculated value is greater than table value, the alternate hypothesis ( $H_{a1}$ ) is accepted. Thus, there is a significant improvement in level of consciousness in right side median nerve stimulation along with multi structural sensory stimulation patients.

	Experimental group	Control group
Mean SD	4.6 ± 1.81	4.0 ± .81
Mean Difference	0.6	
Calculated 'T' value	0.607	
P value and level of significance	P > 0.05 and significant	

**Table: 5** Independent 't' test value of pre-test for Western Neuro Sensory Stimulation Profile scale between experimental and control group.

As shown in table 5, the mean value of pre test is 4.6 and 4.0 respectively. The calculated 't' value is .607 at 7 degrees of freedom at 5% level of significance. Since the calculated value is lesser than table value, the null hypothesis ( $H_{03}$ ) is accepted. Thus, there is a no significant improvement in neurobehavioral function between experimental and control group.

	Experimental group	Control group
Mean SD	20.40 ± 4.8	18.75 ± 1.25
Mean Difference	1.65	
Calculated 'T' value	0.658	
P value and level of significance	P > 0.05 and significant	

**Table:6** Independent 't' test value of post-test for Western Neuro Sensory Stimulation Profile scale, scale between experimental and control group.

As shown in table 6, the mean value of post test is 20.4 and 18.75 respectively. The calculated 't' value is .658 at 7 degrees of freedom at 5% level of significance. Since the calculated value is lesser than table value, the null hypothesis ( $H_{03}$ )

is accepted. Thus, there is a no significant improvement in neurobehavioral function between experimental and control group.

	Experimental group	Control group
Mean SD	3.8 ± .83	3.5 ± .57
Mean Difference	0.3	
Calculated 'T' value	0.607	
P value and level of significance	P > 0.05 and significant	

**Table: 7** Independent 't' test value of pre-test for Glasgow Coma Scale between experimental and control group.

As shown in table 7, the mean value of pre test is 3.8 and 3.5 respectively. The calculated 't' value is .607 at 7 degrees of freedom at 5% level of significance. Since the calculated value is lesser than table value, the null hypothesis ( $H_{03}$ ) is accepted. Thus, there is a no significant improvement in level of consciousness between experimental and control group.

	Experimental group	Control group
Mean SD	7.6 ± .54	6.5 ± .57
Mean Difference	1.1	
Calculated 'T' value	2.925	
P value and level of significance	P < 0.05 and significant	

**Table: 8** Independent 't' test value of post-test for Glasgow Coma Scale between experimental and control group.

As shown in table 8, the mean value of post test is 7.6 and 6.5 respectively. The calculated 't' value is 2.925 at 7 degrees of freedom at 5% level of significance. Since the calculated value is higher than table value, the alternate hypothesis ( $H_{a3}$ ) is accepted. Thus, there is a significant improvement in level of consciousness between experimental and control group.

## DISCUSSION

The paired 't' test results show that both the control and experimental group had a significant improvement in Level of Consciousness by using Glasgow Coma Scale and also in Neurobehavioral Function by using Western Neurosensory Stimulation Profile scale. The independent 't' test values for post test between the groups showed that there is no significant difference in Neurobehavioral Function but there

exists a significant difference in Level Of Consciousness. But when comparing the post test mean values of both the groups the experimental group shows a better clinical improvement in the Neurobehavioral Function than the control group.

But we got a significant improvement in Level of Consciousness for the post test values between both the groups this can be explained on the basis that Glasgow Coma Scale is only a 15 point ordinal scale which primarily measures the 3 responses namely motor, verbal and eye opening. This only measures the severity of injury and directly implies the level of consciousness. The Western Neuro sensory Stimulation Profile Scale is a 110 point ordinal scale which measures the following 5 components visual, tactile, olfactory, auditory, expressive communication. Since this scale measures in depth analysis of various Neurobehavioral Functions compared to that of Glasgow Coma Scale and most of these functions cannot have a major improvement within the available two weeks and even when there is a change it might not be sufficient to reflect change in Western Neurosensory Stimulation Profile Scale. This may be the reason why the Western Neurosensory Stimulation Profile Scale failed to show statistically significant improvement although the post test mean values were higher for experimental group than the control group.

## SUMMARY & CONCLUSION

The present study was intended to find out the effect of right median nerve stimulation along with multisensory coma stimulation program on various sensory systems and level of consciousness of diffuse axonal injury patients.

The results showed that there was significant improvement in Level of Consciousness between the groups but there was no significant improvement in the Neurobehavioral Functions between the groups.

**LIMITATIONS:** The sample size is smaller, Long term follow up was not done, Quantifiable measures such as Functional Magnetic resonance imaging, Single Photon Emission Computerized Tomography, Somatosensory Evoked Potentials were not carried out.

**SUGGESTIONS:** Future studies can be done on a large sample population based on age; severity of injury; level of consciousness, time of injury and duration of coma, Long term follow-up can be taken to find out the improvement in the neuro behavioural functions.

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