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Effect of Right Median Nerve Stimulation on Level of Consciousness in Traumatic Brain Injury Subjects

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Abstract

Background: The median nerve serves a peripheral gateway to the central nervous system. Median nerve stimulation is positively associated with regaining the level of consciousness in patients with traumatic brain injury, but the level of evidence is still a research question. So the purpose of the study is to find out the effectiveness of right median nerve stimulation on the level of consciousness and the relation between them in subjects with traumatic brain injury. **Methodology:** Twenty subjects with traumatic brain injury of axonal type were selected for study and randomized into two groups. Experimental group received right median nerve stimulation along with medications where as control group received medications only one month, 30minutes a day. Glasgow coma scale is used to assess the changes in conscious levels. **Result:** The results have revealed that there is a significant improvement noted in experimental group when compared to control group. Comparison of Glasgow coma scale scores between experimental and control groups after one month showed significant difference with a P value of 0.0261. **Conclusion:** Right median nerve stimulation is strongly associated with improvement of consciousness in patients with traumatic brain injury.

Keywords: Right Median Nerve Stimulation, Traumatic Brain Injury, Unconsciousness

1. Introduction

Traumatic Brain Injury is defined as an alteration in brain function, or other evidence of brain pathology, caused by an external force[1]. Traumatic Brain injury is also associated with neurological or neuro psychological abnormalities, skull fracture, intracranial lesions. In India and other developing countries traumatic brain injuries are a leading cause of morbidity, mortality, disability and socioeconomic losses. In India nearly 1.5 to 2 millions are injured and 1 million deaths are occurring[2,3]. The incidence of traumatic brain injury in India is around 200 per 100,000 populations. Males are more prone to traumatic brain injury with 75% incidence when compared to females and the male to female ratio of traumatic brain injury in India was 3:1[4]. This includes the very young, young adults and the elderly. Mortality depends on severity of injury and age[5].

The most common cause of traumatic brain injury is road traffic accidents[6–8]. These subjects presents with the signs and symptoms of loss of consciousness, seizures, ear and nose bleeds, nausea, paresis, balance deficits, cognitive-communication and swallowing[9]. Although various treatment protocols for coma in traumatic brain injury are available, persistent coma is still a major clinical problem. Coma is characterized by absent or limited vocal or muscle activity and a severely reduced or abnormal response to noxious stimuli, an absence of sleep wake cycles[10]. As the person is in the state of coma, the phase of recovery is also late. Unconscious subjects are

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treated medically by manitol, nimodipine, diuretics, anti-convulsants such as sodium valproate, carbamazepine[11,12].

In literature, various studies have been conducted on level of consciousness in traumatic brain injury. These includes multi-structural sensory stimulation that is tactile, auditory, visual, taste, proprioception, kinesthetic stimulation, olfactory, wood programming[13–15] and environmental modifications[16], musical therapy[17,18]. Electrical stimulation is one among them which plays a prominent role in neuro rehabilitation. Most of the studies have documented the role of electrical stimulation in facilitation or inhibiting muscle tone. But it also plays a role in unconscious patients.

Ganesan et al. reported statistical significant improvement in level of consciousness between the groups ($P < 0.05$) and there was no significant improvement in the neurobehavioral function between the groups after right median nerve stimulation of traumatic brain injury[19].

There may be a relationship between superior levator palpebrae muscle, right median nerve and ascending reticular formulation in improving consciousness of traumatic brain injury subjects. None of the studies documented the relationship between them. So the purpose of study is to find out the effectiveness of right median nerve stimulation on the level of consciousness and the relationship between them in traumatic brain injury patients.

2. Methodology

The subjects who were clinically diagnosed axonal type of acute injury with loss of consciousness of Glasgow coma scale less than 8 were screened[20] for study and subjects with age of 15 to 40 years of both male and females were included in the study. Subjects with Vital signs unstable, congenital heart diseases, cardiac pacemakers, cardiac arrhythmia were excluded. The nature and purpose of the study was explained to the subject attendant before recruiting them in the study and informed consent form was taken from the attendants.

Twenty subjects were selected for study based on inclusion and exclusion criteria and the subjects were randomized into two groups, ten subjects in experimental and ten subjects in controlled group. Experimental group treated with right median nerve stimulation where as control group treated with medications. All subjects were evaluated with Glasgow coma scale and their level of consciousness was recorded before commencement of treatment.

In experimental group, right side forearm was selected for treatment. Position the forearm in supinated position and wipe with alcohol swab to reduce skin resistance and then electrical stimulation was given with the rubber electrodes of the size 7 cm × 5 cm placed on the skin and active electrode is placed over the volar aspect of the right side forearm and inactive electrode on the volar aspect of the lower 2/3 of the right side forearm and electrodes are secured with adhesive tape. The scientific physio stimulation has been used for the study. These electrical devices delivered trains of asymmetric biphasic pulses at an amplitude of 20 milli amperes with a pulse width of 300 microseconds at 40 HZ for 20 sec/min with faradic type of current and intensity was adjusted until visible contractions appeared such as thenar apposition and flexion and flexion of index and middle finger. The treatment was given for 30 mins per day for one month. After one month the subject was reassessed with Glasgow coma scale for the level of consciousness.

Figure 1. Right Median Nerve Stimulation.

3. Data Analysis and Results

Table 1. Comparison between pre test and post test values of Glasgow coma scale in experimental group (within group comparison of GCS in experimental group)

	Mean	Standard Deviation	P Value	T Value
Pre	5	1.491	<0.001	9.851
Post	8.3	2.452		

The two-tailed P value is <0.001, considered extremely significant. t = 9.851 with 9 degrees of freedom.

Table 2. Comparison between pre test and post test values of Glasgow coma scale in control group (within group comparison of GCS in control group)

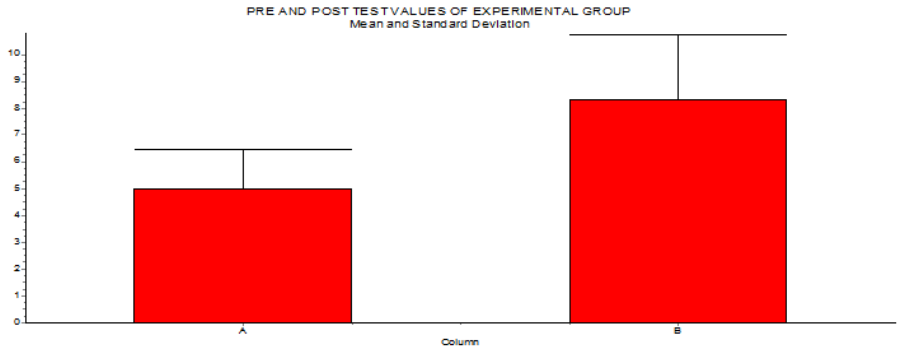
	Mean	Standard Deviation	P Value	T Value
Pre	4.9	1.524	0.0039	3.857
Post	5.8	2.150		

The two-tailed P value is 0.0039, considered very significant. t = 3.857 with 9 degrees of freedom.

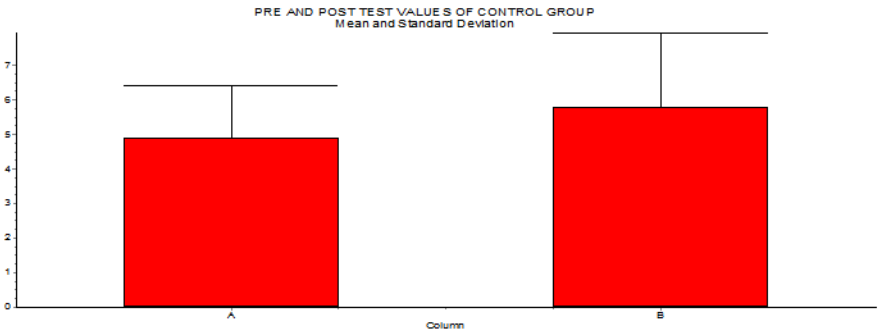
Table 3. Comparison between Post tests values of both groups (between groups comparisons of GCS score)

	Mean	Standard Deviation	P Value	T Value
Post E	8.3	2.452	0.0261	2.424
Post C	5.8	2.150		

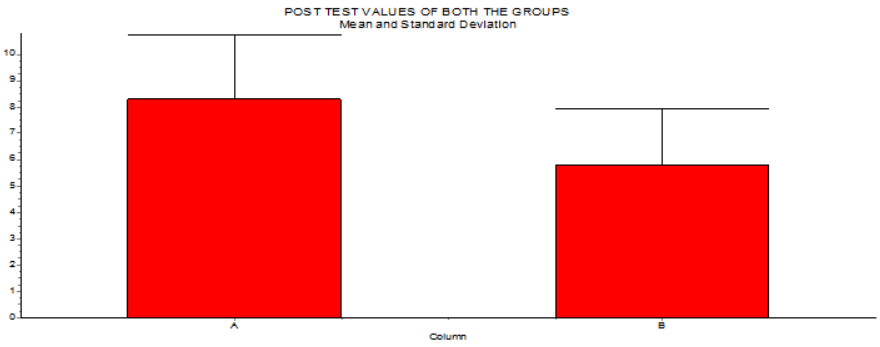
The two-tailed P value is 0.0261, considered significant. t = 2.424 with 18 degrees of freedom.



Graph 1. Diagrammatic representation of Glasgow Coma Scale score before and after treatment in experimental group.



Graph 2. Diagrammatic representation of Glasgow Coma Scale score before and after treatment in control group.



Graph 3. Diagrammatic representation of Glasgow Coma Scale score of both groups after one month.

4. Results

The statistical analysis concluded that the comparison between Pre-test and Post-test values of experiment group considered extremely significant with P value <0.001 and comparison between Pre-test and Post-test values of control group considered very significant with P value 0.0039. Comparison between Post-test values of both the groups considered significant with P value 0.0261.

5. Discussion

Severe brain injury is a cause for high morbidity and mortality rates. Individuals who sustain severe acquired brain injury, experience prolonged disorders of consciousness. So the purpose of this study is to find out the effectiveness of right median nerve stimulation on the level of consciousness in subjects with traumatic brain injury.

The results of this study have concluded that experimental group shows significant changes (P = 0.0261) when level of consciousness was measured by Glasgow coma scale. Although there is significance in experimental group in between the groups, significant difference noticed within the groups also (P < 0.0001, 0.0039). Post test values in experimental group have revealed that younger age group subjects have responded in much better way and there is increase in post test values of level of consciousness.

Experimental group showed improved level of consciousness this might be due to, median nerve stimulation brings numerous afferent inputs to the Ascending Reticular Activating System (ARAS) via the spino-reticular component of the median nerve synapsing with the neurons of the Ascending Reticular Activating System[21]. Median nerve stimulation will lead to activation of the entire central nervous system. It is proposed that this peripheral stimulus reaches the Ascending Reticular Activating System, which further connects with the intra laminar nuclei of the thalamus and then cortical layers are stimulated. Improvement of level of consciousness, whether in persons in acute coma, or those in a chronic vegetative or minimally conscious state, is driven by the electrically induced elevation of dopamine and norepinephrine[22,23]. Increase in cerebral blood flow, is another important factor in neuro-stimulation for re-awakening[24].

Unconscious patients have inhibition of Levator palpebrae muscle which elevates the upper eyelid. Median nerve stimulation will modulate the levator palpebrae muscle activity. Existence of electrophysiological relationship between nucleus of the levator palpebrae muscle and ascending reticular activating system in brainstem is also evident[25].

The right median nerve not only stimulate the brain stem and cerebrum to increase awareness but also better pattern of speech and abilities to calculate have been observed after right median nerve electrical stimulation[26,27]. As Broca's speech area is in the left fronto-temporal region, this area has been shown to become more active in positron emission tomography when a subject moves his or her hand[28].

In this study it has found that after median nerve stimulation there is increase in scores of Glasgow coma scale, improvement in speech, which helped in faster recovery of the subjects. So, right median nerve stimulation can be included as treatment in clinical practice to improve consciousness.

6. Conclusion

Right median nerve stimulation have positive role in improving the levels of consciousness in subjects with traumatic brain injury and there by promotes faster recovery. Even though there is a need to study the mechanism behind the improvement of consciousness with right median nerve stimulation, this treatment option is evident in the recovery of comatose patients after traumatic brain injury.

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