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Effect Of Rood's Approach and Coma Stimulation Techniques on Level of Consciousness in Traumatic Brain Injury Patients.

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ABSTRACT-

Background-Traumatic brain injuries are a leading cause of morbidity, mortality, disability and socioeconomic losses in India and other developing countries. In moderate and severe traumatic brain injuries, loss of consciousness is very common problem.coma stimulation helps to improve consciousness in patients of traumatic brain injury . But it is lack in standardized protocol and time consuming.therefore it is necessary to evaluate efficacy of neurotherapeutic approach in recovery of consciousness after traumatic brain injury. This study focused to assess the effect of Rood's approach and coma stimulation techniques on level of consciousness in traumatic brain injury patients.

Methodology -In this randomised control study 54 participants who were in coma after traumatic brain injury underwent Rood's approach and coma stimulation for 6 days for 4weeks.In conventional group auditory, visual, olfactory,tactile,gustatory inputs are given to patients for 30 minutes in a day. For experimental group coma stimulation with facillitatory techniques of roods approach such as fast brushing, fast icing, vibration, quick stretch,joint compression, tapping are given for 30 minutes in a day.Recovery of level of consciousness was taken by Glasgow coma scale and coma recovery scale-revised on 1stday, in 2nd week and in 4th week.

Results-There were notable differences in the posttest mean LOC scores between the intervention and control groups at the 1st day, 2nd week, and 4th week of the study ($P < 0.0001$). The intervention group experienced a significant increase in their posttest mean LOC scores ($P < 0.0001$). Although the control group also showed significant changes, the rate of improvement was slower compared to the intervention group ($P < 0.0001$).

Conclusion-The present study, showed that rood's approach and coma stimulation techniques are beneficial in improving level of consciousness in patients with traumatic brain injury.

Key words- coma, consciousness, Rood's approach , traumatic brain injury

INTRODUCTION -

Traumatic brain injury is defined as an alteration in brain function, or other evidence of brain pathology, caused by an external force. Alteration in brain function consist of one of the following character - period of unconsciousness or a decreased consciousness, loss of memory (short term and long term),Neurologic deficits i.e. weakness, loss of balance, change in vision, dyspraxia paresis or plegia, sensory loss ,aphasia, etc.,Any change in mental state at the time of the injury i.e. confusion, disorientation, slowed thinking, etc [1,3]
Traumatic brain injuries are a main cause of morbidity, mortality, disability and socioeconomic losses in India and other developing countries[1-2]. It is calculated that nearly 1.5 to 2 million people are injured, and 1 million lose their lives anually in India. RTAs are the main cause (60%) of TBI then, falls (20%–25%) and violence (10%). Alcohol drinking is known to be present among 15%–20% of TBIs cases seen while injury[2,28].
Traumatic injuries develop when the energy transferred from the environment to tissue exceeds the threshold that can be absorbed without resulting in dysfunction[5,6,13].The type ,intensity, direction and duration of all forces all involved in the chracteristics and severity of TBI. A focal lesion refers to localized brain injuries like contusions, lacerations, intracranial hemorrhage, and damage from increased intracranial pressure[4,13]. This pressure increase, caused by conditions such as hematomas and contusions, leads to brain swelling and elevated skull pressure [4,27]. As the lesion grows, the brain surface flattens and dries due to compression, midline structures shift, and ventricular size changes occur, with the affected side's ventricle shrinking. Compression of the brain stem can severely impact vital functions[5].

Types of traumatic brain injury

Focal injury	**Diffused injury**
Contusion	Axonal injury
Hematoma: extradural,subdural,intracerebral	Hypoxia/ ischaemia
swelling	Diffused vascular
Infarct	Fat embolism
Abscess	Subarachnoid

Table 1 types of brain injury[2]

Symptoms of a mild injury include headache, nausea, vomiting, drowsiness, dizziness, blurred vision, ringing in the ears, bad taste, sensitivity light and sound, a confused or disoriented state mood swings, and depression. Moderate and severe traumatic brain injury includes mainly coma or any disorder of consciousness, blurred or double vision, sensitivity to light and sound, persistent headache, repeated vomiting, weakness or numbness, irregular breathing, disturbed sleep awake cycle, etc[9].

In moderate and severe injuries, loss of consciousness is common. This occurs when either both cerebralhemispheres or the reticular activating system(RAS) are impaired.The RAS is in the brainstem, extending from the top of the spinal column to the rostral midbrain, and the thalamus and hypothalamus. It receives sensory input and sends it to the cortex, causing arousal. Without input from the RAS, consciousness is impaired[10]

The concussion reticular hypothesis attributes loss of consciousness after trauma to disrupted or reduced activity in the Reticular Activating System pathways. This is likely due to shearing strains at the craniocervical junction. Alternatively, the pontine-cholinergic system hypothesis suggests RAS dysfunction results from trauma-activated inhibitory cholinergic system in the dorsal pontinetegmentum.Severe brain injuries lead to extensive deafferentation, reducing input to neurons in the corticothalamic system. In extreme cases, this results in absence of electrical activity, usually seen in severe anoxic injuries. Most disorders of consciousness involve partially connected corticothalamic systems. Neurons in the cortex, thalamus, and striatum are highly sensitive to synaptic activity and can alter firing patterns with small membrane potential shifts. Patients with DOC may lack sufficient neuronal connectivity for conscious awareness, which requires neuron depolarization and synchronization across brain regions. Behavioral variations may result from changes in neuromodulatory tone and the extent of corticothalamic deafferentation.[7,8,11]Neuron depolarization releases excitatory neurotransmitters, increasing intracellular calcium. This activates enzymes like caspases and calpases, and free radicals, leading to cell degradation and apoptosis. The resulting cell breakdown triggers inflammation, breaches the blood-brain barrier, and causes edema. Secondary injury, developing over minutes to days, involves a complex cascade of molecular, chemical, and inflammatory events that worsen brain damage.[10]

Coma stimulation involves systematically providing sensory input to coma patients by healthcare professionals or family members. It aims to enhance responsiveness and aid in recovery by engaging the patient's senses-touch, smell, vision, taste, and hearing[12,17,18]. Techniques include gentle massages, exposure to odours, showing photos and familiar objects, offering favorite foods, and playing preferred music or voices. The theory of sensory deprivation suggests that coma patients have reduced sensory input, affecting their potential to respond to stimuli and effectivelyraising the activation of the reticular activating system. Controlled sensory stimulation is thus crucial for awakening and rehabilitation. [19]

The Rood’s Approach, is by Margaret Rood in the 1950s for treating CNS disorders, focuses on enhancing motor function through sensory manipulation[14]. It integrates somatic, autonomic, and psychological factors to regulate motor behavior[15,16]. Techniques like quick stretch, tapping, joint compression, light touch, and quick icing stimulate muscle responses and enhance arousal and reflexes in patients[15,16].A quick stretch is used to facilitate contraction. It works with stimulation of muscle spindle endings and Ia alpha motor neuron with the monosynaptic reflex. Tapping is another type of quick stretch designed to stimulate muscle spindles and cause phasic contraction. Joint compression is used to facilitate stabilising muscles as well as to facilitate proprioceptors. Light touch has an effect on alpha fibers which help the reticular activating system in the arousal mechanism. Quick icing used to facilitate alpha fibers. The important factors are mainly the effect on arousal and the stimulation of a reflex withdrawal response. Fast brushing is also used to facilitate alpha fibers and is used in arousal mechanism of the patient. [14,15-17]

Patients with altered levels of consciousness, particularly those in a coma, face significant physical and mental challenges and therefore require nursing care[1,19] Providing long-term care for these patients places a heavy financial burden on healthcare systems, increases hospital bed occupancy, and limits access to care for other patients [19].These issues negatively impact patients' quality of life, cause considerable emotional stress for families, and contribute to burnout among healthcare providers. Consequently, promoting recovery and enhancing consciousness in traumatic brain injuries patientsare key goals for healthcare providers, particularly in intensive care unit[18,19].A closer look at the literature has showed that many studies have focused on all five senses, some studies have focused on single sensory organ for the recovery of consciousness. These interventions, lack a standardised protocol which leads to inconsistent patient outcomes, and is more time-consuming. Some of the studies used procedures like peripheral and cranial stimulation with electrical modalities, trans-magnetic stimulation, and nerve stimulation, which are invasive and expensive too.

Materials and Methods

The study is carried out in Krishna hospital, karad. Sample size is calculated, with a confidence level of 0.95 and a power of 0.90,we concluded that 54 patients were needed for the study.This study get an ethical approval from the Ethics Committee of KrishnaVishwaVidyapeeth , Karad, in May 2023. Prior information about the aim and procedure of study were given to the family members of all participants . All patients have freedom to participate or to withdraw from the study . Associated data of the patients were remaining confidential. Eligible patients were consecutively enlisted and randomly assigned to an experimental, or a control group randomly.The protocol was 6 days a week for 4 week in the ICU.

Study Participants

The inclusion criteria were a 3–8 grade according to Glasgow Coma Scale (GCS) , and an age of 18–65. Patients who are sedated, had a wound, died,LAMA during the study were excluded.Outcome measures were GCS and CRS–R.The Glasgow Coma Scale (GCS) assesses neurological status by evaluating eye opening, verbal response, and motor response. Scores range from 3 (severe impairment) to 15 (full consciousness).The Coma Recovery Scale-Revised (CRS-R) contains 23 items across six subscales: audition, vision, motor, communication, speech, and arousal. Scores range from reflexive activity (low) to cognitive behaviors (high). It shows a strong validity correlation (0.9) with the Disability Rating Scale**.**Participants were randomly assigned to one of group A (coma stimulation), group B (coma stimulation and roods approach) – by convenience random sampling . Assessments were taken on each 1 day n 2nd,3rd and 4th week. Level of Consciousness were assessed using coma recovery scale – revised and Glasgow Coma Scale.

Interventions

The intervention were given for six days for four weeks. During this For group A Coma stimulation techniques were given for 25 minutes. It includes auditory, visual,tactile, olfactory, gustatory stimulation. For group B coma stimulation techniques and facillitatory techniques of Rood's approach were given for 25minutes . It includes fast brushing ,fasticing,quick stretch, joint compression, pressure on muscle belly, tapping over muscle tendon. The assessment was taken on 1st day and in 2nd , 3rd,,4th week.

Statistical Analysis-

Sample size -The required sample size is calculated according to results of parent article. The formula for sample size is$4(SD^2)/(X*€)^2$according to this sample size is 54 ,27 in each group. With confidence level 95%

Statistical analysis- The data of primary outcomes were analyzed by SSPS software version 25. To check the changes in the CRS-R scores and GCS scores over time, the differences within groups are analysed by repeated ANNOVA test. between the groups analysed by unpaired t test.

RESULTS-

During the study, 54 subjects were recruited according to inclusion and exclusion criterion.6 patients lost to follow up due to death, LAMA process. As Table 2 shows, 36 included were male (75%) and 12 were female (25%). 6 subjects were below 25 age (12%), within 25-55 were 34 patients (71%). Above 55 were 8 subjects (17%) undergo traumatic brain injury due to road accident and other causes like falls,assaults. They suffered from hemorrhage(80%), diffused axonal injuries (20%), received mechanical ventilation (80%). The mean of participants' age was 41±13 years in total.

Results were taken on 1st day,recovery in 2nd week and recovery after 4th week. Control group shows ; according to GCS 3.3± 0.4,5.6± 1.1,8.3± 1.2 respectively. According to CRS-R 1.5±2,6.2±2, 12±2.4 respectively (table 4).For Experimental group according to GCS 3.6±1.1,7.9±2.2, 13.7±1.3 respectively.According to CRS-R 1.4±2, 9.7±2.6,20±2.4 respectively (table 5).Between the group comparison ,pre (1st day) and post (4th week) were taken. According to GCS control group (group A) shows 3.3±0.4 and 8.3±1.2 .experimental (group B) shows 3.6±1.1 and 13.7±1.3 respectively with p value < 0.0001 (table 6). According to CRS-R control group (group A) shows1.5±2.04 and 12±2.4 While experimental (groupB) shows1.4±2.06 and20.7±2.4 respectively with p value <0.0001 (

table 7). Thus results revealed that experimental group(group B) shows significant increase in GCS and CRS-R scores than control group (group A).

Baseline characteristics	**Group A**	**Group B**
Age	45±13	35 ±11
Gender		
Male	19 (80%)	17 (71%)
Female	5(20%)	7 (29%)

Table no 2-Demographic characteristics of study population

Within group analysis:

Group A	**1st day**	**2nd week**	**4th week**
GCS	3.3±0.4	5.6±1.1	8.3±1.2
CRS-R	1.5±2	6.2±2	12±2.4

Table no 3-mean score of group A

Interpretation – These results indicate significant improvements in level of consciousness; GCS and CRS-R after conventional techniques in groupA

Group B	**1 stday**	**2nd week**	**4thweek**
GCS	3.6±1.1	7.9±2.2	13.7±1.3
CRS-R	1.4±2	9.7±2.6	20.74±2.4

Table no 4-mean score for group B

Interpretation– These results indicate significant improvements in level of consciousness; GCS and CRS-R after experimental techniques in group B.

GCS	**GCS**	**CRS-R**	**Pvalue**	**Inference**
GroupA	8.3±1.2	12±2.4	< 0.0001	Extremely significant
GroupB	13.7± 1.3	20.7±2.4		

Table no 5-pre and post mean score of Glasgow Coma Scale for group A and group B

Interpretation – These results indicate significant improvements in level of consciousness; GCS and CRS-R after experimental techniques in group B than group A

DISCUSSION

The study was directed on the effect of Rood's approach and coma stimulation techniques on level of consciousness in patients with traumatic brain injury. 54 patients were included according to inclusion criteria. Patients were treated for 25 minutes a day for 4 weeks. The results manifested that at the end of the four weeks, the group A (the control group coma stimulation is given) and B (the experimental group coma stimulation along with facilitatory techniques of rood's approach is given) experienced significant improvements in consciousness. Group B (experimental) experienced greater outcomes for all variables in comparison to group A (conventional).

Out of total 54 traumatic brain injury patients 41 were males and 13 were females. Amit Agrawal et al, demonstrated that road traffic accidents are the major cause of TBI . It affects chiefly young adult males. At least 10% of survivors experience moderate or severe disabilities due to TBI.[2]

In severe traumatic brain injuries, loss of consciousness is very common problem [2].Around one third of those patients remain in coma after medical stability. It is proposed that 41% of the long time unconscious patients were expected to gain consciousness within 3-6 months after the injury and 52% could recover within 1 year[26].4 Therefore, enhancing recovery through the use of currently available methods , is a useful to improve the prognosis and functional outcomes[25]. Physiotherapy has shown its efficacy in management of traumatic brain injury [29], altered higher functions in Brain injury [30]. Its has been found to be effective in most of the upper motor neuron lesions[31].

MEGHA et al found that short, high-frequency sessions are more effective in improving consciousness in comatose TBI patients[17].Marzieh Moattari et al. showed that sensory stimulationby nurses and families improves consciousness, cognitive function, and sensory recovery.[18] Salmani F et al. demonstrated a study and recommended its integration into nursing care plans and curriculam[20] Jing Li et al. reviewed on the progress of sensory stimulation for coma arousal after traumatic brain injury. They found that sensory stimulation activates the reticular activating system, boosting sympathetic activity, norepinephrine release, and consciousness [27].
The human nervous system responds strongly to various stimuli, essential for its development. Positive stimuli trigger hormone release in the frontal cortex, boosting brain

activity and consciousness.[19] Olfactory stimulation enhances blood flow to areas involved in planning and judgment, while music promotes neurogenesis and neuroplasticity, improving cognitive function and attention through increased dopamine levels. Music therapy also helps minimize intracranial pressure[20,21]Rood's approach, as stated, activates or deactivates sensory receptors, considering the interplay of somatic, autonomic, and psychic factors in motor behavior[14].Rood's theory suggests that the dominance of parasympathetic or sympathetic activity affects sensory stimulus interpretation, making sensory manipulation beneficial for unconscious patients[14,15,16].

Davis and White noted that certain stimuli encourage dendritic growth, improving synaptic connectivity[19,24,27]. In cases like traumatic brain injury, increased synaptogenesis during neural regrowth is significant. Targeted stimulation during critical periods of neuroplasticity can enhance neural connection reformation[23,24].The sympathetic nervous system is activated by stimuli such as icing, unpleasant smells, sharp commands, bright lights, and fast, arrhythmic music[26] Sensory stimuli affects cortical and autonomic responses. Pleasant odours lower blood pressure, heart-rate, and skin temperature, indicating increased autonomic arousal[20,19] Rocking or vibratory movements raise respiration frequency through vestibule respiratory adaptation.Coloured light enhances heart rate variability and skin conductance, affecting the autonomic nervous system[22] Neutral warmth and gentle touch activate the parasympathetic nervous system, supporting Rood's concept. Quick icing stimulates the central nervous system's arousal mechanism, facilitates alpha motor neurons, and reduces edema[15-16]. These neurophysiological facilitation techniques can improve ventilation in patients with reduced consciousness [14,16]. Significant improvements were observed post-intervention. The experimental group showed a marked difference in the Glasgow Coma Scale (GCS) and Coma Recovery Scale compared to the control group ($p < 0.0001$ for both). By the second week, the intervention group's consciousness levels increased significantly, whereas the control group had slower recovery with no complete recovery according to the GCS and no cognitive recovery per the Coma Recovery Scale.
Rood's approach and coma stimulation techniques led to faster recovery from coma and higher GCS and CRS-R scores. The recovery depends on age, health, pre-hospital care, injury severity and location, hospital interventions, and resources. The experimental group recovered faster, while the control group stayed unconscious longer. This method is expected to enhance both consciousness and motor recovery in coma patients. A common challenge is lost to follow up due to LAMA and death. In this study, no subjects had increased blood pressure, heart rate, or respiratory rate, and no patients were harmed.

CONCLUSION

The present study showed that rood's approach and Coma Stimulation Techniques are beneficial in improving level of consciousness in patients with traumatic brain injury.

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