10.5005/jp-journals-10001-1114
RESEARCH ARTICLE

Effectiveness of Early Intervention of Coma Arousal Therapy in Traumatic Head Injury Patients

Mandeep, Pravin Kumar

ABSTRACT

Objective: To find out efficacy and benefits of early intervention of coma arousal therapy on coma patients after sustaining traumatic head injury.

Materials and methods: Thirty comatose patients with traumatic head injury were systematic randomly selected. Both experimental group and control group were having 15 patients each. Patients in experimental group were given coma arousal therapy while those in control group did not receive any coma arousal therapy. Glasgow coma scale (GCS) and coma recovery scale (CRS) were assessed before and after 1 and 2 weeks protocol.

Results: The independent t-test was used for between the group data analysis. Repeated measure ANOVA and post hoc paired t-test were used in within the group analysis. Group A, mean of GCS on 1st, 7th and 14th day of coma arousal therapy was 3.93 (±1.09), 6.33 (±1.04) and 8.46 (±0.91) respectively and for Group B was 3.93 (±1.27), 4.80 (±1.26) and 5.93 (±1.94) respectively, which showed significant improvement ($p < 0.05$). Group A, mean of CRS on 1st, 7th and 14th day of coma arousal therapy was 2.06 (±1.03), 4.86 (±1.24) and 9.66 (±1.83) respectively and for Group B was 2.33 (±1.11), 2.93 (±1.09) and 4.73 (±2.18) respectively, which showed significant improvement ($p < 0.05$). When compared between the groups, experimental group showed significant improvement.

Conclusion: This is concluded from the result of this study that coma arousal therapy is having significant effect on GCS and CRS in traumatic head injury patients when compared to the patients who did not receive coma arousal therapy.

Keywords: Coma arousal therapy, Traumatic head injury, Glasgow coma scale, Coma recovery scale, Coma.

How to cite this article: Mandeep, Kumar P. Effectiveness of Early Intervention of Coma Arousal Therapy in Traumatic Head Injury Patients. Int J Head and Neck Surg 2012;3(3): 137-142.

Source of support: Nil

Conflict of interest: None

INTRODUCTION

Traumatic brain injury (TBI), defined as brain damage caused by externally inflicted trauma to the head, may result in significant impairment of an individual's functioning—physical, cognitive and psychosocial. TBI is a significant public health problem worldwide and is predicted to surpass many diseases as a major cause of death and disability by the year 2020.[1] It is the most common cause of death in trauma victims accounting for about half of deaths at the accident site.[2] TBI is a leading cause of mortality, morbidity and socioeconomic losses in India. Irrespective of the cause, nonfatal TBI results in extensive disability with both financial and social consequences.[3]

One other main consequences of head injury is coma. Coma is a sleep like state in which patient makes no purposeful response to the environment and from which he/she cannot be aroused, the eyes are closed and do not open spontaneously, the patient does not speak and there is no purposeful movement of the face or limbs, verbal stimulation produces no response, mechanical (e.g. painful) stimulation may produce no response or may elicit nonpurposeful reflex movements mediated from spinal cord or brainstem pathways.[4] Patients in coma experience sensory deprivation. Because their ability to respond to internal and external stimuli is altered because of this alteration, the threshold of activation of the reticular activating system may increase so; a controlled stimulation may meet the higher threshold of reticular neurons and increase cortical activity.[5] The practical implication of sensory deprivation is that controlled stimulation may meet the higher threshold of the reticular neurons and increase cortical activity or that the undamaged axons may actually send out collateral connections, called collateral spouting, which assist in reorganizing the brain's activity. On the basis of an animal model, sensory stimulation of sufficient frequency, intensity and duration has shown to arouse the brain by improving neuronal organization, increased dendritic branching and increased numbers of dendritic spines; stimulating the reticular activating system and increasing the level of cognitive function.[6]

The study aims to find out the improvement in scores of Glasgow coma scale (GCS) and coma recovery scale (CRS) in comatose patients receiving coma arousal therapy and to compare the scores of GCS and CRS in patients receiving coma arousal therapy and the patients not receiving coma arousal therapy.

MATERIALS AND METHODS

The study design was experimental in nature. Study was conducted in intensive care units of hospitals. Total duration of study was 1.5 years. Total 30 patients were systematic randomly assigned to Group A (experimental group) and Group B (control group); 15 patients in each group. Selection criteria for patients was: TBI comatose patients,

72 hours after TBI and GCS < 8 as inclusion criteria and medically unstable patients, comatose patients on ventilation, pediatric and medical comatose patients were in exclusion criteria.

Procedure

Written consent forms were taken from the relative of patients and the stimulation therapy was given using a coma kit, which was prepared by locally available and easily affordable materials. Four senses (kinesthetic, visual, tactile and auditory senses) were stimulated twice a day for 2 weeks.[7] The GCS[8] and CRS[9] were measured on day 1, 7 and 14. Since all the patients were with tracheostomy, so only eye and motor response were taken for GCS.

Procedure for Coma Arousal Therapy

Kinesthetic Stimulation

Each movement two times, allowing 1 minute to respond. This was performed either on bed or on wheelchair, one extremity at a time.[10]

Lying on Bed

A. *Movement of arms*: Patient's arm was supported at the elbow and hand. And then arm was slowly moved above the head as far as it goes. Then it was held for 3 seconds then arm was lowered, keeping the elbow as straight as possible.
B. *Movement of legs*: Patient's leg was supported at the knee and ankle. Then it was slowly bended toward the chest as far as it goes. Then it was held for 3 seconds then leg was lowered down, attempted to straighten out the knee.
C. *Movement of head*: Head was turned side-to-side, stretching as far as it goes.
D. Patient's knees were bent, placing the feet flat on the bed. Keeping the knees together, knees were slowly stretched side-to-side, held for 3 seconds in each position.

Auditory Stimulation

One second was used per sequence. The stimulus was presented for 5 to 10 seconds, two times, with a 3-second break between each stimulus, on right side, then on left side. Materials used were ring bell and familiar voices.

Tactile Stimulation

Stimulus was presented for 5 seconds, two times, with a 3-second break between each stimulus. It was repeated to right and left upper extremities; then right and left lower extremities. Materials used were brush, various cloth textures, sandpapers, cotton balls.

Visual Stimulation

Stimulus was presented for 5 seconds, two times, with a 3-second break between each stimulus in front. It was repeated as above, to right and left sides then up and down. Materials used were, brightly colored block, familiar photo, functional object.

Statistical Analysis

Statistics were performed by using SPSS 15. Results were calculated by using p-value < 0.05. The t-test was used to compare age between the two groups. Unpaired t-test was used to compare GCS and CRS between the two groups. Repeated measure ANOVA and post hoc paired t-test were applied to determine the differences in the values of GCS and CRS after the treatment for within group analysis.

RESULTS

Total 30 patients were taken for the study. Among these, 15 patients received coma arousal therapy along with upper limb and lower limb passive movements and chest physiotherapy. Whereas 15 patients received only upper limb and lower limb passive movements and chest physiotherapy.

The demographic characteristics of the study showed no significant difference between Groups A and B, similar with respect to age and mean of variables GCS and CRS before starting the treatment (Table 1).

Group A (Experimental Group)

GCS: On day 1 (3.93 ± 1.09), day 7 (6.33 ± 1.04), day 14 (8.46 ± 0.91). Statistically, there was a significant improvement in GCS between 1st day and 7th day and there was a significant improvement in GCS between 7th and 14th days of the treatment and also the significant improvement between 1st and 14th days of treatment (Table 1 and Graph 1).

Eye response: Day 1 (1.40 ± 0.50), day 7 (2.40 ± 0.50), day 14 (3.66 ± 0.48). In group A, there was a significant improvement in eye response of GCS between 1st day and 7th day, 7th and 14th days and also the significant improvement between 1st and 14th day of treatment (see Table 1).

Motor response: Day 1 (2.53 ± 0.99), day 7 (3.93 ± 0.88), day 14 (4.80 ± 0.56). In group A, there was a significant improvement in the motor response of GCS between 1st and 7th day, and also the significant improvement between 1st and 14th day of treatment (see Table 1).

CRS: Day 1 (2.06 ± 1.03), day 7 (4.86 ± 1.24), day 14 (9.66 ± 1.83). Statistically, there was a significant improvement in CRS between 1st day and 7th day, 7th and 14th days and also the significant improvement between 1st and 14th day of treatment (see Table 1 and Graph 1).

CRS–Auditory: Day 1 (0 ± 0), day 7 (0.40 ± 0.5), day 14 (1.66 ± 0.48). Repeated measure ANOVA test showed significant improvement in CRS–Auditory score between 1st day and 14th day.

CRS–Visual: Day 1 (0 ± 0), day 7 (0.26 ± 0.45), day 14 (1.73 ± 0.59). Repeated measure ANOVA test showed significant improvement in CRS–Visual score between 1st day and 14th day.

CRS–Motor: Day 1 (1 ± 0.65), day 7 (1.86 ± 0.83), day 14 (2.8 ± 0.56). Repeated measure ANOVA test showed significant improvement in CRS-Motor score between 1st day and 14th day.

CRS–Oromotor: Day 1 (0.66 ± 0.48), day 7 (1 ± 0), day 14 (1 ± 0). Repeated measure ANOVA test showed significant improvement in CRS–Oromotor score between 1st day and 14th day.

CRS-Communication: Day 1 (0.06 ± 0.25), day 7 (0.40 ± 0.50), day 14 (0.86 ± 0.35). Repeated measure ANOVA test showed significant improvement in CRS–Communication score between 1st day and 14th day.

CRS–Arousal: Day 1 (0.33 ± 0.48), day 7 (0.93 ± 0.25), day 14 (1.60 ± 0.50). Repeated measure ANOVA test showed significant improvement in CRS–Arousal score between 1st day and 14th day.

Group B (Control Group)

GCS: Day 1 (3.93 ± 1.27), day 7 (4.80 ± 1.26), day 14 (5.93 ± 1.94). Statistically there was a significant improvement in GCS between 1st day and 7th day, 7th and 14th day and also the significant improvement between 1st and 14th day (see Table 1 and Graph 2).

Eye response: Day 1 (1.20 ± 0.41), day 7 (1.60 ± 0.63), day 14 (2.13 ± 0.91). In group A, there was a significant improvement in eye response of GCS between 1st day and 7th day, 7th and 14th days and also the significant improvement between 1st and 14th day of treatment (see Table 1).

Motor response: Day 1 (2.73 ± 1.16), day 7 (3.26 ± 1.16), day 14 (3.8 ± 1.42). In group A, there was a significant improvement in motor response of GCS between 1st day and 7th day, 7th and 14th days and also the significant improvement between 1st and 14th day of treatment (see Table 1).

CRS: Day 1 (2.33 ± 1.11), day 7 (2.93 ± 1.09), day 14 (4.73 ± 2.18). Statistically, there was a significant improvement in CRS between 1st day and 7th day, 7th and 14th days and also the significant improvement between 1st and 14th day of treatment (see Table 1 and Graph 2).

CRS–Auditory: Day 1 (0 ± 0), day 7 (0.06 ± 0.25), day 14 (0.33 ± 0.61). Repeated measure ANOVA test showed significant improvement in CRS–Auditory score between 1st day and 14th day.

CRS–Visual: Day 1 (0 ± 0), day 7 (0 ± 0), day 14 (0.33 ± 0.61). Repeated measure ANOVA test showed significant improvement in CRS-Visual score between 1st day and 14th day.

CRS–Motor: Day 1 (1.26 ± 0.79), day 7 (1.53 ± 0.83), day 14 (2 ± 1). Repeated measure ANOVA test showed significant improvement in CRS–Motor score between 1st day and 14th day.

CRS–Oromotor: Day 1 (0.86 ± 0.35), day 7 (0.86 ± 0.35), day 14 (0.93 ± 0.25). Repeated measure ANOVA test

Table 1: Comparison between groups A and B

Variables		*Group A Mean ± SD*	*Group B Mean ± SD*	*t-value*	*Level of significance*
GCS	Day 1	3.93 ± 1.09	3.93 ± 1.27	0.000	1.000
	Day 7	6.33 ± 1.04	4.8 ± 1.26	3.617	0.001
	Day 14	8.46 ± 0.91	5.93 ± 1.94	4.565	0.001
GCS motor	Day 1	1.4 ± 0.50	1.2 ± 0.41	1.183	0.246
	Day 7	2.4 ± 0.50	1.6 ± 0.63	3.82	0.0007
	Day 14	3.66 ± 0.48	2.13 ± 0.91	5.724	0.0001
GCS eye	Day 1	2.533 ± 0.99	2.73 ± 1.16	0.507	0.616
	Day 7	3.933 ± 0.88	3.26 ± 1.16	1.767	0.088
	Day 14	4.8 ± 0.56	3.8 ± 1.42	2.530	0.017
CRS	Day 1	2.066 ± 1.03	2.333 ± 1.11	0.680	0.501
	Day 7	4.866 ± 1.24	2.933 ± 1.09	4.505	0.0001
	Day 14	9.666 ± 1.83	4.733 ± 2.18	6.687	0.0001

GCS: Glasgow coma scale; CRS: Coma recovery scale

showed nonsignificant improvement in CRS–Oromotor score between 1st day and 14th day.

CRS–Communication: Day 1 (0 ± 0), day 7 (0 ± 0), day 14 (0.26 ± 0.45). Repeated measure ANOVA test showed significant improvement in CRS–Communication score between 1st day and 14th day.

CRS–Arousal: Day 1 (0.2 ± 0.4), day 7 (0.46 ± 0.51), day 14 (0.93 ± 0.45). Repeated measure ANOVA test showed significant improvement in CRS–Arousal score between 1st day and 14th day.

Comparison of Groups A and B

GCS: On the 1st day before treatment: Group A (3.9 ± 1.09), Group B (3.93 ± 1.27). It showed nonsignificant difference between both the groups on day 1. After 7th day of treatment: Group A (6.33 ± 1.04), Group B (4.80 ± 1.26). It showed significant improvement in Group A as compared to Group B. After 14th day of treatment: Group A (8.46 ± 0.91), Group B (5.93 ± 1.94). It showed significant improvement in Group A as compared to Group B (see Table 1 and Graph 3A).

Eye response: On the 1st day before the treatment: Group A (1.40 ± 0.50), Group B (1.20 ± 0.41). It showed nonsignificant difference between both the groups. After 7th day of treatment: Group A (2.40 ± 0.50), Group B (1.60 ± 0.63). It showed significant improvement in Group A as compared to Group B. After 14th day of treatment: Group A (3.66 ± 0.48), Group B (2.13 ± 0.91). It showed significant improvement in Group A as compared to Group B (see Table 1).

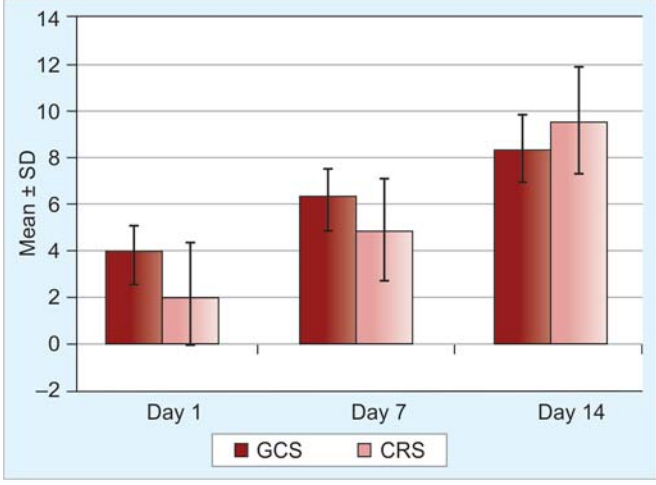
Motor response: On the 1st day before the treatment: Group A (2.53 ± 0.99), Group B (2.73 ± 1.16). It showed nonsignificant difference between both the groups. After 7th day of treatment: Group A (3.93 ± 0.88), Group B (3.26 ± 1.16). It showed nonsignificant improvement between the groups. After 14th day of treatment: Group A (4.80 ± 0.56), Group B (3.80 ± 1.42). It showed significant improvement in Group A as compared to Group B (see Table 1).

CRS: On the 1st day before the treatment: Group A (2.06 ± 1.03), Group B (2.33 ± 1.11). It showed nonsignificant difference between both the groups. After 7th day of treatment: Group A (4.86 ± 1.24), Group B (2.93 ± 1.09). It showed significant improvement in Group A as compared to Group B. After 14th day of treatment: Group A (9.66 ± 1.83), Group B (4.73 ± 2.18). It showed significant improvement in Group A as compared to Group B (see Table 1 and Graph 3B).

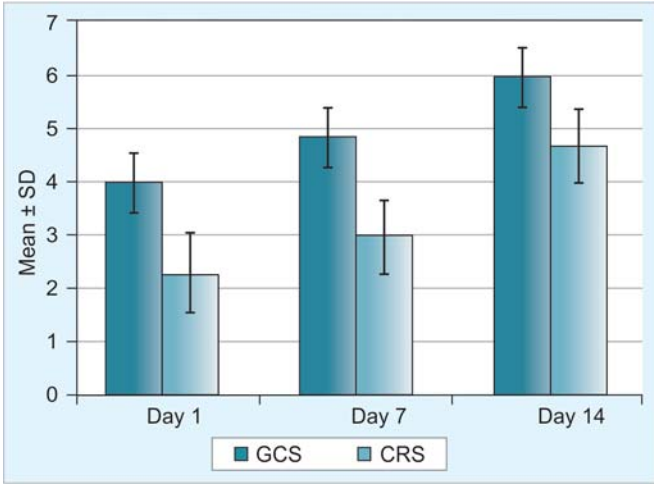
Auditory score: On the 1st day before the treatment: Group A (0.00 ± 0.00), Group B (0.00 ± 0.00). It showed nonsignificant difference between both the groups. After 7th day of treatment: Group A (0.40 ± 0.50), Group B (0.06 ± 0.25). It showed significant improvement in Group A as compared to Group B. After 14th day of treatment: Group A (1.66 ± 0.48), Group B (0.33 ± 0.61). It showed significant improvement in Group A as compared to Group B.

Visual score: On the 1st day before the treatment: Group A (0.00 ± 0.00), Group B (0.00 ± 0.00). It showed nonsignificant difference between both the groups. After 7th day of treatment: Group A (0.26 ± 0.45), Group B (0.00 ± 0.00). It showed significant improvement in Group A as compared to Group B. After 14th day of treatment: Group A (1.73 ± 0.59), Group B (0.33 ± 0.61). It showed significant improvement in Group A as compared to Group B.

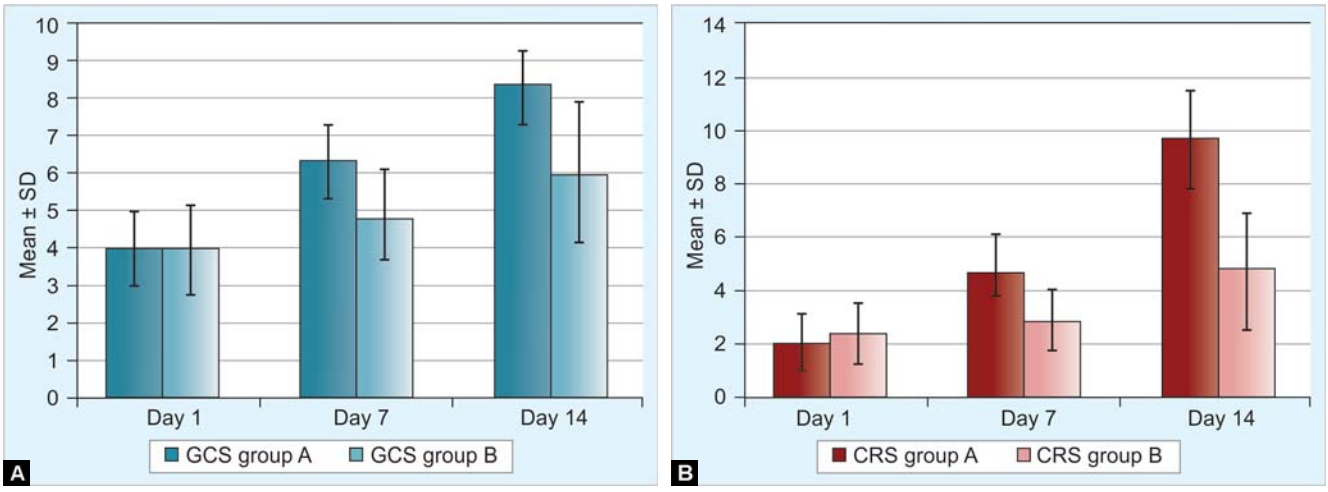
Motor score: On the 1st day before the treatment: Group A (1.00 ± 0.65), Group B (1.26 ± 0.79). It showed nonsignificant difference between both the groups. After 7th day of treatment Group A (1.86 ± 0.83), Group B (1.53 ± 0.83). It showed nonsignificant improvement between



Graph 1: Comparison of GCS and CRS of group A



Graph 2: Comparison of GCS and CRS of group B



Graphs 3A and B: (A) Comparison of GCS between groups A and B, (B) comparison of CRS between groups A and B

both the groups. After 14th day of treatment: Group A (2.80 ± 0.56), Group B (2.00 ± 1.00). It showed significant improvement in Group A as compared to Group B.

Oromotor score: On the 1st day before the treatment: Group A (0.66 ± 0.48), group B (0.86 ± 0.35). It showed nonsignificant difference between both the groups. After 7th day of treatment: Group A (1.00 ± 0.00), Group B (0.86 ± 0.35). It showed nonsignificant improvement between the groups. After 14th day of treatment: Group A (1.00 ± 0.00), Group B (0.93 ± 0.25). It showed nonsignificant improvement between the groups.

Communication score: On the 1st day before the treatment: Group A (0.06 ± 0.25), Group B (0.00 ± 0.00). It showed nonsignificant difference between both the groups. After 7th day of treatment: Group A (0.40 ± 0.50), Group B (0.00 ± 0.00). It showed significant improvement in Group A as compared to Group B. After 14th day of treatment: Group A (0.86 ± 0.35), Group B (0.26 ± 0.45). It showed significant improvement in Group A as compared to Group B.

Arousal score: On the 1st day before the treatment: Group A (0.33 ± 0.48), Group B (0.20 ± 0.41). It showed nonsignificant difference between both the groups. After 7th day of treatment: Group A (0.93 ± 0.25), Group B (0.46 ± 0.51). It showed significant improvement in Group A as compared to Group B. After 14th day of treatment: Group A (1.60 ± 0.50), Group B (0.93 ± 0.45). It showed significant improvement in Group A as compared to Group B.

DISCUSSION

The results of this study suggest that implementation of coma arousal therapy for 2 weeks can enhance consciousness recovery in comatose traumatic head injury patients. Our results confirm previous observations that sensory stimulation implemented at an early stage of coma is beneficial to brain-injured patients (Kater, 1989; Mitchell et al 1990; Sosnowski and Ustik, 1994).[6] The rationale is that coma arousal therapy of sufficient frequency, intensity and duration arise the brain by improving neuronal organization, increased dendritic branching, increased numbers of dendritic spines; stimulating the reticular activating system and increasing the level of cognitive function. Maximum reorganization of the brain occurred within the first few weeks after brain injury.[6] The rationale is that exposure to frequent and various sensory stimulations facilitates both dendritic growth and improves synaptic connectivity in those with damaged nervous system.[11]

Limitation of the Study

1. Duration of study was short.
2. There was no follow-up.
3. All patients were of tracheostomy and so, verbal response was not assessed.

CONCLUSION

This is concluded from the result of this study that coma arousal therapy has significant effect on GCS and CRS when compared to patients who did not receive coma arousal therapy. Hence, null hypothesis is rejected and alternate hypothesis is accepted.

REFERENCES

1. Puvanachandra P, Hyder AA. The burden of traumatic brain injury in Asia: A call for research. Pak J Neurol Sci 2009;4(1): 27-32.
2. Yattoo GH, Tabish A. The profile of head injuries and traumatic brain injury deaths in Kashmir. J Trauma Manag Outcomes 2008;2:5.
3. Gururaj G. Epidemiology of traumatic brain injuries: Indian scenario. Neurol Res 2002;24(1):24-28.
4. Greenberg DA, Aminoff MJ, Simon RP. Clinical neurology (5th ed). Chapter 10: Coma. McGraw-Hill/Appleton & Lange 2000;5: 199-236.

5. Bos S. Coma stimulation. Journal of Knowledge Synthesis for Nursing 1997;4:1-6.
6. Urbenjaphol P, Jitpanya C, Khaoropthum S. Effects of the sensory stimulation program on recovery in unconscious patients with traumatic brain injury. J Neurosci Nurs 2009;41(3);10-16.
7. Kater KM. Response of head-injured patients to sensory stimulation. West J Nurs Res 1989;11(1):20-33.
8. Mitchell S, Bradley VA, Welch JL, Britton PG. Coma arousal procedure: A therapeutic intervention in the treatment of head injury. Brain Inj 1990;4(3):273-79.
9. Giacino JT, Kalmar K, Whyte J. The JFK coma recovery scale-revised: Measurement characteristics and diagnostic utility. Arch Phys Med Rehabil 2004;85(12):2020-29.
10. Lehmkuhl LD, Krawczyk L. Physical therapy management of the minimally-responsive patient following traumatic brain injury: Coma stimulation. J Neurol Phys Ther 1993;17(1): 10-17.
11. Hotz GA, Castelblanco A, Lara IM, et al. Snoezelen: A controlled multi-sensory stimulation therapy for children recovering from severe brain injury. Brain Inj 2006;20(8): 879-88.

ABOUT THE AUTHORS

Mandeep (Corresponding Author)

Student, Department of Physiotherapy, DAV Institute of Physiotherapy and Rehabilitation, Jalandhar, Punjab, India, e-mail: doc_mandeep@yahoo.com

Pravin Kumar

Associate Professor and Registrar-Academics, Department of Physiotherapy, DAV Institute of Physiotherapy and Rehabilitation Jalandhar, Punjab, India