



EFFECT OF SENSORY STIMULATION IN COMATOSE PATIENTS: AN EVIDENCE BASED REVIEW OF LITERATURE

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INTRODUCTION

Traumatic brain injury is an insult to the brain, caused by an external physical force, that may produce a diminished or altered state of consciousness, which results in impairment of cognitive abilities or physical functioning (national head injury foundation)¹.

It is a leading cause of disability, morbidity and mortality. In India around 1.5-2 million people injured due to accidents in which around 1 million death occurs due to Traumatic brain injury. 60% of the TBI occurs due to road traffic injury. Another 25-30% causes are due to falls and 10% due to violence.² majority of victims of traumatic brain injury undergoes in state of coma and then gradual recovery is possible³.

Patients in coma present a complete unresponsiveness of the arousal system with no spontaneous eye opening and are unable to be awakened by application of vigorous sensory stimulation.⁴ Patients of the traumatic brain injury can be further classified according to the level of consciousness and responsiveness to the stimulus. Patients with traumatic brain injury who is in prolonged unconsciousness but gain consciousness when eyes are open and moved is called as persistent vegetative state (VS) in which stimulus induced arousal is seen due to responsiveness of sleep awake cycle.

Apart from coma and vegetative state another state in which a patient of TBI can be classified as minimal conscious state. Minimal conscious state is the condition in which a patient is recovering from the vegetative state and there is minimal preservation of consciousness to self or environment.⁵

Assessment of level of consciousness is the good predictor of the prognosis after traumatic brain injury. Glassgow coma scale is widely used as the predictor of consciousness due to high validity and reliability.⁶ Other than GCS, Rancho los amigos scale (RLA) and disability rating scale can also be used as the outcome predictor of consciousness.⁷

Various treatment intervention like deep brain stimulation, there are no standard physical therapy treatment for arousal from coma in which non-invasive stimulation can be considered as the most acceptable treatment. Sensory stimulation, median nerve stimulation, ultrasonic stimulation laser stimulation, trigeminal nerve stimulation techniques can be used as a non-invasive stimulation technique. Among them sensory stimulation techniques are easy to apply and effective technique.⁸

Sensory stimulation consists variety stimulation such as visual, auditory, olfactory, gustatory and tactile stimulation.⁹ Sensory stimulation can be given as multimodal and unimodal stimulation but despite of various studies which mode give significant effect is unclear till the date as various techniques and modes are used to arouse the patients from coma but there are doubts regarding exact way of intervention. Various literature reviews were done in previous years but they were not giving evidence about the use of sensory stimulation in comatose patients. hence, there is need for a review to know the most effective technique of sensory stimulation to improve the state of consciousness in patients.

METHODOLOGY

➤ Sources of data collection

Literature search was carried out in data base including science direct, MEDline, Pub med, Cochrane database, PEDro scale, CINHAL database. The search was carried out using terms traumatic brain injury, coma, vegetative state, sensory stimulation. The search was limited to the articles published in English language.

➤ Study selection criteria

1. Inclusion criteria

- All level of evidence were included for the review from Level 1 (Randomised control trials) to level 5(case reports).
- Articles published between 2009 to 2020
- Subjects of age ≥ 18 years of age with traumatic brain injury in stage of coma, vegetative stage, minimal vegetative stage.

2. Exclusion criteria

Articles are excluded if

- Full text was not available
- Altered consciousness state due to causes not involving traumatic brain injury

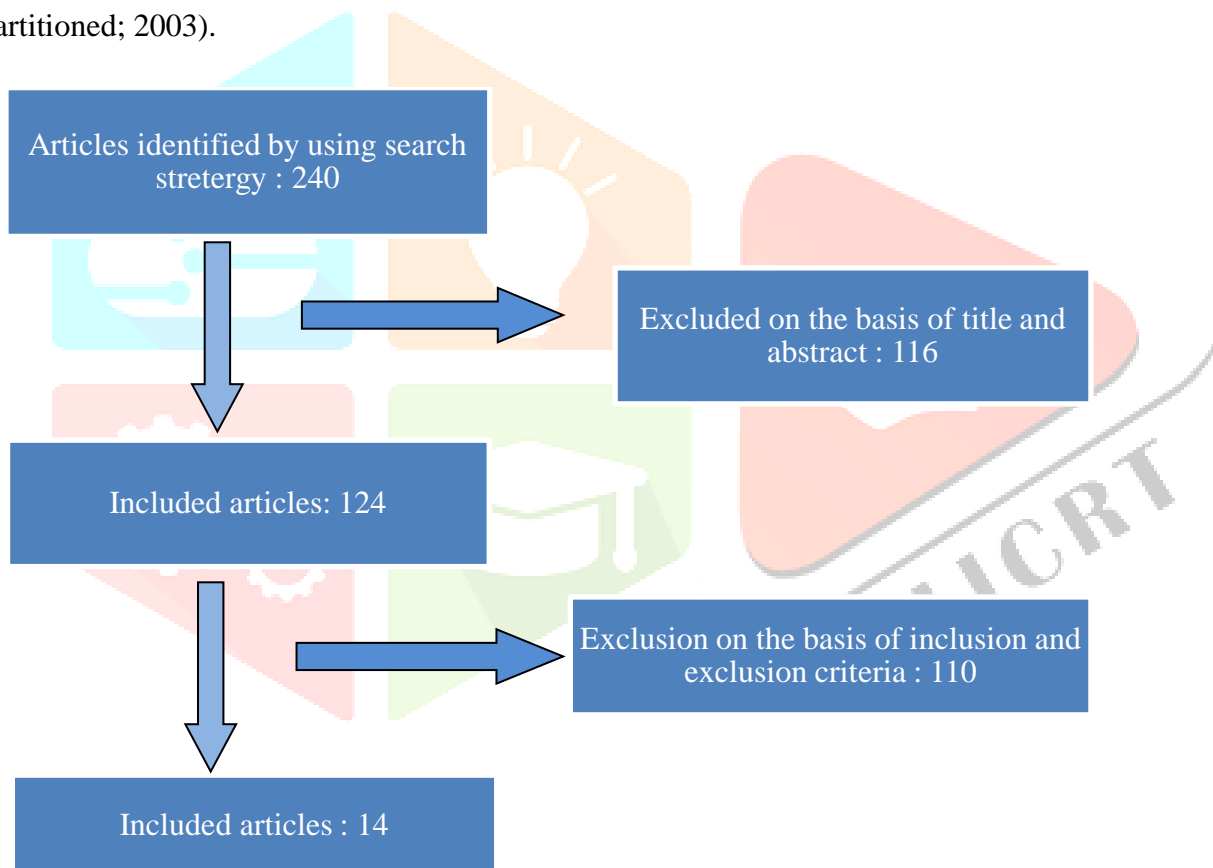
➤ Data extraction

Articles were reviewed after they met inclusion criteria and following data are extracted: level of evidence and study design, participants description, intervention description, description of outcome measure.

The following level of evidence was used for the review. (Table 1)

Level 1	Systemic reviews, meta-analysis, RCTs
Level 2	Non RCT, case control trials
Level 3	Pre-test-post test design, cross sectional studies
Level 4	Single subject design, case series
Level 5	Case reports, narrative literature reviews

Along with the level of evidence PEDro scale was used to assess the quality of the randomised control trials. (partitioned; 2003).



Consort flow diagram

➤ Summary of reviewed articles

Author	No of patients/ inclusion	Study design	treatment	result	Level of evidence /pedro
Alashran et al. 10	356/ GCS: < 8	Systematic review	Multimodal sensory stimulation	Improvement in LOC	Level 1
Jiaojiao et al 11	-/ GCS: < 8	Systematic review	Auditory and tactile stimulation by family	Significant improvement in GCS within 24 hours	Level 1
Yekefallah et al. 12	54/ GCS: < 8	Randomised control trial	EG- Auditory stimulation 15min/day For 7 days CG- only headphones are applied no music tap was played	Significant improvement in intervention group after 3 rd day	PEDro: 8 Level 1
Sedghi et al 13	80/ RASS 2-4 GCS: < 8	Quasi experimental study	EG- music therapy(Beach walk music) 60-80 beats/min 15 min/day for 7 days CG – silent headphones for 15 min	Significant improvement in GCS on 6 th and 7 th day till then no improvement	Level 2
Li et al 14	332/ GCS: <8 RASS: 2-4	Systematic review	Sensory stimulation	High quality trial are needed to establish protocol	Level 1
Chuaykarn 4	45 GCS: <8	A randomized control trial	Multisensory stimulation Vs standard	Improvement in level of recovery in	PEDro:6\11 Level 1

		3 groups	rehabilitation 30 min	multisensory stimulation group	
Cheng 6	29 GCS:<8	Pre post experimental study	Multisensory stimulation 3 days/week 20 m/session For 4 weeks	No significant improvement seen	Level 3
Deena s v 7	60 CRS: low	Non randomised control trial	Multisensory stimulation 6 days to EG	Significant improvement is seen in EG	Level 2
Mandeep 8	60 GCS:<8	RCT- EG –Sensory stimulation CG-no treatment	multisensory Stimulation 2 session/day for 14 days	Experimental group shows significant improvement in CRS	Pedro 7/11 Level 1
Megha 15	30 GCS:<8	RCT A-MSS B-MSS C- conventional For 2 weeks	A-5 times/d 20 min B-2 times/d 50 min C-2 times/d PROM ex. 10 rep.	Significant improvement in GCS & WNSSP A&B High fr. short duration is more effective	PEDro 7/11 Level 1
Urbanjaphol 16	40 GCS:<8	RCT EG-Sensory stimulation CG-UG	MSS 30 min/session 2 hr interval 14 days	Significant improvement in GCS & SMART	PEDro: 7 Level 1
Meyer 17	135	review	Sensory stimulation	Improvement in variety of outcome measures & GCS	Level 5

				improve	
Salmani et al. 18	90 / GCS: 5-8	Randomised controlled trial	EG: auditory stimulation by family 2 times/day for 7 days CG: same stimulation by other trained person	Significant improvement in GCS and coma recovery scale in EG.	PEDro: 8 Level 1
Rene Padilla et al. 19		Systematic review	Sensory stimulation	Sensory stimulation is an effective treatment for the arousal from coma	Level 1

*GCS- Glasgow coma scale,EG-experimental group, CG- Control group,RASS-Richmond Agitation-Sedation Scale, RMNS- Right median nerve stimulation, MMS- Multimodal stimulation, NBP- Normal blood pressure, WNSSP- Western neuro sensory stimulation profile, UG- Usual treatment group, SMART- Sensory modality assessment and rehabilitation technique, PROM- Passive range of motion

RESULT

Total 240 articles were located using key words, title, abstract and study selection criteria from which 116 articles were excluded by title and abstract, 124 articles did not match the study selection criteria and were excluded from the study. At the end 14 articles were selected for the review.



DISCUSSION

The review of the studies shows that sensory stimulation techniques are effective to improve arousal in comatose patients. The evidences suggests that multisensory stimulation is an effective way to improve level of consciousness in TBI patients. (Alashram et al) It seems an important and cost-effective strategy to arouse patient from unconscious or semi-conscious state. various stimuli such as auditory, visual, tactile, olfactory, kinaesthetic stimuli are given for arousal.

From the analysis of the level of evidence 10 articles are suggestive of level 1 evidences. Level 1 evidences support the use of multimodal sensory stimulation given by family members or close relatives which shows more significant improvement compare to nursing and other health care staff. ^{18, 20}. The possible reason behind more significant effect of multisensory stimulation given by family member is due to receptance of emotional stimuli from person that will excel in the attention and increase activation of cognitive system to arouse the patient. ^{21,22,23}

The familiar stimuli passage a vast network in brain region and autonomic nervous system. This will improve consciousness and vital signs of a patient. Along with this connection familiar stimuli involving emotional content will interact together and work in synchrony to improve the level of consciousness. It is also suggested that early intervention (within 24 hours) by family members may lead to positive results in consciousness, reduce hospital stay, improve neurological function and early return to vocation. ^{24,25}

Some of the level 1 evidences suggest the early intervention of unimodal auditory stimulation given for 7-30 mins can improve the consciousness after 3rd and 5th day of intervention. But there are no strong evidences suggesting use of unimodal auditory stimulation over multimodal sensory stimulation.

Sensory stimulations are effective with prologue application of stimulus in early stages. Sensory stimulation will stimulate reticular formation by improving the autonomic activity and also activates limbic system of the brain. It will improve goal directed behaviour. Along with behaviour it will improve emotional state by enhancing the amygdaloidal activity which will help to arouse the patient from coma. ⁴

The multi modal coma stimulation technique is effective due to decreased resting metabolic rate of the comatose patients. During these phases primary cortical activity of area, no 41 and 42 are intact and it will respond to auditory stimulation. Similarly visual stimulation will enhance visual cortex activity and hence stimulations to autonomic nervous system increase increasing the function of reticular activation system and level of consciousness. ^{26,27}

Another proposed mechanism for improvement in the state of coma can be a neural plasticity as there is sensory deprivation of the comatose patients the sensory stimulation will improve the cortical electrical activity and improve synaptic activity of the brain. It will lead to process of learning. ^{28,29}

The use of multimodal sensory stimulation will give more positive results According to JiaoJiao et al. it is proven that early family centred combined acoustic and tactile stimulation during multimodal stimulation was effective in arousal of the patient.

CONCLUSION

Recent evidences support that sensory stimulation techniques in coma has potential effect in the recovery of comatose patients. From the review sensory stimulation 2 sessions per day for at least 15 min of each stimulation could give more significant improvement in level of consciousness. Although Family centred early multimodal stimulation gives better outcomes in level of consciousness in comatose patient after traumatic brain injury but further high-quality studies are required to justify the ideal dosage, frequency and most effective method of application for each stimulation.

LIMITATION

- Different intervention methods are used in every studies.
- Heterogeneous measurement tools were used in studies

FUTURE RECOMMANDATION

- Further studies are needed to know the effectiveness of the intervention protocol for the stimulation and with the use of homogenous measurement tools (GCS, CRS).
- More exploration of dosage and most efficient delivery method is recommended in future studies.

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