

Effectiveness of sensory stimulation to the level of consciousness in head trauma patients: systematic review

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ABSTRACT

Introduction

One indicator of the criticalness and prognosis in head trauma is the level of consciousness. Several studies have shown that sensory stimulation can increase the level of consciousness in patients with head trauma. This systematic literature review seeks to find out how effective sensory stimulation is to increasing levels of consciousness in head trauma patients.

Methods

Selected search terms were entered into five databases to identify potentially relevant publications. Inclusion and exclusion criteria were applied and articles were categorised as relevant or irrelevant based on a review of title and abstract and when necessary full text review. The inclusion criteria used were studies that used head trauma patient data by comparing two groups, namely the group with sensory stimulation and the control group without sensory stimulation therapy.

Results

Six studies met the inclusion criteria. Six studies showed statistically significant increases in head trauma patients who experienced impaired consciousness. All research results varied in the characteristics of respondents, types of sensory stimulation, the use of additional therapy and the subjects which doing the stimulations.

Conclusion

There is evidence of the effectiveness of sensory stimulation of the level of consciousness in head injury patients. However, further research is needed regarding the duration and type of sensory stimulation that is most effective in head trauma patients.

Keywords

Sensory Stimulation; Head Trauma; Level of consciousness

BACKGROUND

Head trauma is the most common cause of death and disability from trauma, especially among young adults and is estimated to exceed many diseases as a major cause of death and disability in 2020 (Cox, Becker, & Motsumi, 2018). The level of consciousness itself is one indicator of gravity and prognosis in head injury. In a critical state the patient experiences psychological and physiological changes, therefore the role of the nurse is a central position to understand all the

changes that occur in the patient, identify nursing problems and actions that will be given to the patient. Physiological changes that occur in patients with impaired consciousness include meeting basic needs, namely respiratory problems, damage to physical mobility, disruption of hydration, impaired swallowing activities, communication skills, elimination disorders (Lumbantobing & Anna, 2015).

Epidemiological studies show that the increasing proportion of those who experience head trauma are adults (Whitehouse, Jeyaretna, Enki, & Whitfield, 2016). The exact number of head injuries is difficult to determine because of various factors, for example some fatal cases never reach the hospital, on the other hand many mild cases do not come to the doctor unless complications arise later. Real head injury incidents that require hospital care can be estimated at 480,000 cases per year. Head injury is most common in males between the ages of 15-24 years, where the incidence of head injury in males (58%) is more than females, this is due to high mobility among productive age (Lumbantobing & Anna, 2015).

Management of head injury sufferers is determined on the basis of the severity of the injury and carried out in priority order. The ideal is carried out by a team consisting of trained paramedics, neurologist, neurosurgery, radiology, anesthesia and medical rehabilitation. Patients with head injuries should be treated and monitored continuously from the time of the accident, during the trip from the scene to the hospital, emergency room, radiology room, to the operating room, treatment room or ICU, because at any time it can worsen due to aspiration, hypotension, seizures and so on (Li et al., 2015). In life-threatening head injury patients, the priority is to do a short physical examination called the primary survey. Identification and correction of airway obstruction, inadequate ventilation, and shock are priorities above neurological assessment. The initial evaluation of the airway begins by showing that there is a patent airway, can be maintained and breathed spontaneously. Monitoring of oxygenation and ventilation must be assessed continuously with an assessment of oxyethral oxytetric saturation (SPO₂) and monitoring of ETCO₂. After ensuring that airway and ventilation are adequate, the next step is assessment and optimization of circulation. Head trauma is at risk for hypotension and inadequate perfusion and there are a number of potential causes of this problem. There may be a source of blood loss (Tasker, 2010).

Interventions that can be carried out on clients with head injuries are by handling pharmacologically through the administration of drugs and surgery, this intervention will be supported by its success through non-pharmacological actions (Muttaqin, 2008). Other non-pharmacological therapies that can be given to patients are by providing sensory stimulation in the form of stimulation to the visual, olfactory, tactile, gustatory, auditory. Sensory stimulation immediately after detectable head trauma is thought to prevent widespread damage to the brain area (*Society for Neuroscience*, 2010). Head trauma patients experience the inability to process stimulation optimally due to decreased consciousness, some patients also experience mobility

restriction and long bed rest. These things are factors of sensory deprivation, where patients will experience sensory perception disorders so that they experience self-care deficits, communication barriers and there are some patients who experience memory impairments, in addition to the consequences caused by the decrease in consciousness is a non-patent airway. circulation that can be disrupted due to immobilization (Lumbantobing & Anna, 2015).

This study is a systematic review of the literature conducted to answer the question: How effective is sensory stimulation on the level of consciousness in head trauma patients?

METHODS

This study uses a method of systematic review of the literature in accordance with the research topic. Journal articles included in this study are research with experimental methods, quasi-experiments, retrospective review and cohort studies. Database of journal articles sought for systematic review in this study without limitation on the language used with a period between 2000 and 2018. This study uses five journal databases, namely: EBSCO, Proquest and PubMed, MEDLINE and ScienceDirect. Search strategies in article search are focused on specific information about research topics. The keywords used are "Sensory Stimulation", "Head Injury", "Level of consciousness" and synonyms of some of these words.

The inclusion criteria used were studies that used head trauma patient data by comparing two groups, namely the group with sensory stimulation and the control group without sensory stimulation therapy. Abstracts are reviewed and evaluated using screening criteria regarding research objectives, methods and research results. In the results of the study at least one of the criteria for the effectiveness of sensory stimulation and level of awareness must be reported. In order to be eligible, a systematic review must be carried out that aims to cover all relevant research and to carry out a qualitative synthesis as well as quantitative synthesis from research.

RESULTS

A comprehensive search identified 11,627 journal articles that discussed the role of sensory stimulation at the level of awareness in both English and Indonesian. The number of journal articles that are relevant to the research and after the same article is issued are 602 journal articles. Journal articles that meet 602 research criteria. After further search, only 8 journal articles are complete and qualify. Of the 10 journal articles that meet the requirements, there are 6 journal articles that best fit the research topic that will be searched. Clearly shown in Figure 1 and description of the appraised studid shown in table 1.

DISCUSSION

Based on the journal entitled "The Effect of Sensory Stimulation on Glasgow Coma Scale Value on Head Injured Patients in the Neurosurgical Critical Unit of RSUP dr. Hasan Sadikin Bandung" done by Lumbantobing & Anna (2015) showed the results of the effect of sensory stimulation on Glasgow Coma Scale (GCS) values in primary head injury patients ($p = 0.041$). The impact of this study is that sensory stimulation is expected as non-pharmacological therapy can be considered as a complementary therapy in the treatment of head injury patients. Likewise the need for socialization to all nurses who care for patients with head trauma and can be considered in making a Standard Operating Procedure (SOP) regarding sensory stimulation.

Despite the insignificant differences between the two groups regarding the initial level of consciousness, the results of a one-way analysis of variance revealed on the seventh day of the study, however, the level of consciousness in the experimental group was significantly higher (9.1 ± 2.1) than placebo (7.2 ± 1.1), control group (6.6 ± 1.7) ($P < 0.001$). In addition, on the seventh day of the study, the Coma Recovery Scale score in the experimental group (11.9 ± 3.7) was significantly greater than placebo (9.0 ± 2.0) and control group (6.6 ± 1.6) ($P < 0.001$). The value of recovery rate and effect size also confirms the effectiveness of greater affective stimulation compared to pure sensory stimulation. The results of this study show that family-centered affective stimulation is more effective than sensory stimulation in increasing the level of awareness among coma patients with brain injury. Family-centered affective stimulation is recommended to be integrated into the nursing curriculum and routine care plans for coma trauma patients in the intensive care unit (Salmani, Mohammadi, Rezvani, & Kazemnezhad, 2017). From these studies showed that sensory stimulation can increase the level of awareness of patients with head trauma even though the level of influence is higher by using affective stimulation techniques. This situation is also influenced by various factors including the age of the patient, the degree of head injury and others.

Results of research conducted by Wijnen, Heutink, Boxtel, Eilander, & Gelder (2006) showed Heart Rate Variability (HRV) and Skin Conductance Level (SCL) as a reaction to sensory stimulation changed with recovery to consciousness. HRV and SCL indices representing sympathetic activity of the Autonomic Nervous System (ANS) increase with recovery, while the index representing parasympathetic activity decreases. In addition, there was an improvement in sympatho-vascular balance from ANS with recovery. Awareness recovery is determined by clinical observation in Traumatic Brain Injury (TBI) in the post-acute phase associated with changes in SCL and HRV during sensory stimulation. The reactivity of ANS to environmental stimulation can provide objective additional information about the clinical state of STBI patients, and can contribute to decision making in the treatment policy of unresponsive patients.

Semua pasien dengan *Minimally Conscious State* (MCS) menunjukkan perbaikan klinis segera setelah perawatan. Pasien yang menerima putaran kedua *transcranial Direct Current Stimulation* (tDCS) 3 bulan setelah partisipasi awal menunjukkan perbaikan lebih lanjut dan munculnya

kesadaran setelah stimulasi, tanpa perubahan di antara perawatan. Satu pasien yang berada di MCS kurang dari satu tahun sebelum pengobatan menunjukkan peningkatan lebih lanjut dan munculnya ke kesadaran pada 12 bulan follow-up (Angelakis et al., 2014). Kontribusi stimulasi sensori, stimulasi afektif maupun *transcranial Direct Current Stimulation* (tDCS) dalam meningkatkan kesadaran pasien cedera kepala, selain dengan membantu mengoptimalkan efek terapeutik dari terapi standar dengan mengatasi efek samping yang ditimbulkannya, juga melalui beberapa mekanisme neuroprotektif dari stimulasi.

All patients with Minimally Conscious State (MCS) show clinical improvement immediately after treatment. Patients who received a transcranial Direct Current Stimulation second round (tDCS) 3 months after initial participation showed further improvement and emergence of consciousness after stimulation, without changes between treatments. One patient who was at MCS less than one year before treatment showed further improvement and emergence to consciousness at 12 months of follow-up (Angelakis et al., 2014). Sensory stimulation, Direct Current Stimulation (tDCS) affective stimulation and contribution in increasing awareness of head injury patients, in addition to helping to optimize the therapeutic effects of standard therapies by addressing the side effects they cause, also through several neuroprotective mechanisms of stimulation.

CONCLUSIONS

In conclusion, there is evidence of the effectiveness of sensory stimulation on the level of consciousness in head trauma patients. Most studies have shown significant results in improving the level of awareness of head trauma patients. Implications for nursing services are expected to be able to socialize sensory stimulation as one of the complementary therapies in increasing the level of awareness in head injury patients that will affect patient and family satisfaction, most likely can reduce ALOS and achieve cost effective and be a consideration in making a Standard Operating Procedure (SOP) regarding sensory stimulation and for further researchers can examine and measure the effectiveness of each type of sensory stimulation to the level of awareness that can be measured through the action potential generated by each of these stimulations.

Declarations

Author's Contribution

In this article, author has its own contiburion. Didik Mulyono as main author and writing of this article

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

There is no data that needs to be shown because this type of research is a systematic review

Competing interests

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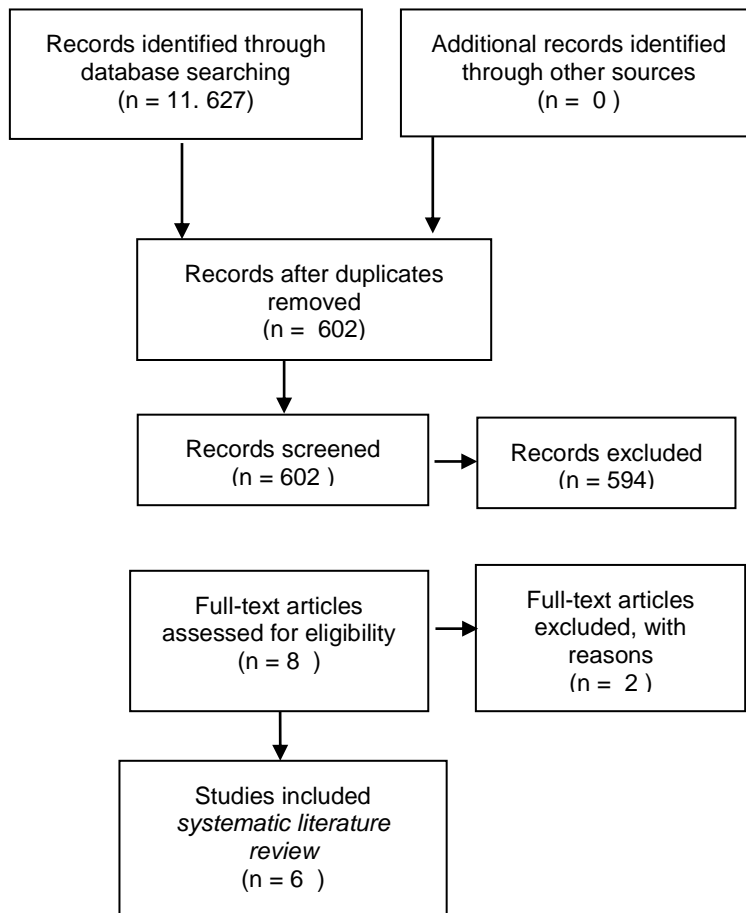
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Figures

Figure 1. Literature research and study selection



Tables

Table 1 . The results of the literature review on the effectiveness of sensory stimulation on the level of awareness in head trauma patients

Penulis dan Tahun	Negara	Metode (Desain)	Tujuan Penelitian	Temuan
(Lumbantobing & Anna, 2015)	Indonesia	Quasy Ekperiment - Pretest-Posttest Control Group Design	To identify the effect of sensory stimulation on the value of GCS in head injury patients at RSUP Dr. Hasan Sadikin Bandung.	The results of statistical tests showed the influence of sensory stimulation on the value of GCS in primary head injury patients (p = 0.041). The impact of this study is that sensory stimulation is expected as non-pharmacological therapy can be considered as a complementary therapy in the treatment of head injury patients.
(Salmani et al., 2017)	Iran	three-group double-blind randomized controlled trial	To evaluate the effects of sensory stimulation by families on coma patients with head trauma.	Family-centered affective stimulation is more effective than sensory stimulation in increasing the level of awareness among coma patients with brain injury.
(Wijnen et al., 2006)	USA & Netherland	Randomized controlled trial	To examine changes in the activity of the autonomic nervous system (ANS) that are related to recovery to consciousness in the post-acute phase after severe traumatic brain injury (sTBI).	Recovery to consciousness determined by clinical observation in sTBI in the post-acute phase is related to changes in SCL and HRV during sensory stimulation. ANS reactivity to environmental stimulation can therefore give objective supplementary information about the clinical state of sTBI patients, and can contribute to decision-making in the treatment policy of unresponsive patients
(Angelakis et al., 2014)	Yunani	A prospective, case series trial with 12-months	To assess the efficacy of transcranial direct current stimulation (tDCS) on improving consciousness in patients	tDCS seems promising for the rehabilitation of patients with severe disorders of consciousness. Severity and duration of

Penulis dan Tahun	Negara	Metode (Desain)	Tujuan Penelitian	Temuan
		follow-up.	with persistent unresponsive wakefulness syndrome (UWS) (previously termed as persistent vegetative state, PVS) or minimally conscious state (MCS).	pathology may be related to the degree of tDCS' beneficial effects
(Schnakers, 2014)	Los Angeles	ABAB (time-series) design	To evaluate sensory stimulation in patients with severe trauma.	Sensory stimulation programs exert an effect on the recovery of consciousness in severely brain injured patients
(Li et al., 2015)	China	Prospective study	To study the role of brain responses to thermal stimulation in outcome prediction of patients in either vegetative or minimally conscious states	Using fMRI and EEG to measure brain responses to thermal stimulation is capable of predicting patient outcomes with a high degree of predictive accuracy. Thermal stimulation can be used as an objective and quantifiable somatosensory stimulation mode for clinical EEG-R and fMRI tests