Effectiveness Of Smart On Sensory Perception Ability Among Patients With Sensory Deprivation Admitted In Neuro Critical Care Unit At Indira Gandhi Government General Hospital And Postgraduate Institute (Igggh & Pgi), Puducherry

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Abstract

Introduction: A study was conducted to evaluate the effectiveness of SMART on sensory perception ability among patients with sensory deprivation admitted in Neuro critical care unit at Indira Gandhi Government General Hospital And Post-Graduate Institute (IGGGH & PGI),Puducherry

Objectives:

•To assess the sensory perception ability among patients with sensory deprivation in neuro critical care unit before SMART.

•To evaluate the effectiveness of SMART on sensory perception ability among the patients with sensory deprivation in Neuro critical care unit.

•To associate the post test score of sensory perception ability with selected demographic and clinical variables.

Materials and Method: The research approach used for this study was quantitative approach. One group pre and post test design was adopted for this study. Convenient method of sampling technique was used to select the subjects. The conceptual frame work of this study was based on Weidenbach's Helping Art of Clinical Nursing (1964).The tool consists of three parts such as part I includes Glasgow Coma Scale, part II includes demographic and clinical variables and part III includes Modified Disorder of Conscious Scale used before and after intervention. The outcome of the study was evaluated by descriptive and inferential statistics.

Result: Pre test mean level of consciousness on sensory deprived patient's 11.48 was lesser than post test mean 13.38. The pre-test mean level of sensory perception ability on sensory deprived patients 10.08 was lesser than post- test mean 13.58. The difference in level of consciousness and sensory perception ability was confirmed by paired't' test value of (8.71) and (8.78) which was highly significant at p<0.001 level. Hence it is concluded that SMART therapy was effective in improving the sensory perception ability among sensory deprived patients. The results showed a statistical association with the post-test score of level of consciousness of the subjects with selected demographic variable "education and "co Morbid illness which is evident with significant p <0.05level.

Keywords: SMART, Glasgow Coma Scale, Modified Disorder of Conscious Scale

Introduction

Consciousness is the state of being aware of external objects or internal conditions, while unconsciousness is a state of unawareness and unresponsiveness, often due to conditions like sleep or medical issues (Brunner and Suddarth, 2011). Unconsciousness can result from disturbances in sensory perception, leading to a lack of awareness of physical and physiological needs (Workman ML). It can be caused by factors such as lack of oxygen, head injuries, poisoning, and blood loss.

Patients in an unconscious state often suffer from sensory deprivation due to altered stimuli response, which impacts the brain's reticular activating system (Davis & White, 1995). Controlled sensory stimulation, involving auditory, gustatory, olfactory, tactile, kinesthetic, and visual modes, can help reorganize brain activity (Sosnowski & Ustik, 1994).

Sensory stimulation aims to awaken coma patients by stimulating their senses. The two primary causes of sensory deprivation are traumatic brain injury (TBI) and cerebrovascular accidents (stroke). TBI, caused by external mechanical forces, leads to significant impairments and altered states of consciousness, with road traffic accidents being the leading cause in India (Neuro Res Gururaj.G 2002).

India faces high rates of head injuries, with inadequate care during the critical "golden hour" post-injury, leading to high mortality and disability rates (Indian Head Injury Foundation, 2014). Stroke, defined by the WHO as the

rapid development of neurological disturbances due to inadequate blood flow, is another major cause of sensory deprivation, with high incidence rates in India and globally (WHO 2005, 2007).

The Sensory Modality Assessment and Rehabilitation Technique (SMART) is a tool used for assessing and rehabilitating patients with severe brain injuries. Developed at the Royal Hospital for Neuro-disability, SMART improves sensory perception across all senses using various assessment scales, including the 'Disorder of Conscious Scale,' which is preferred for its standardized approach.

SMART categorizes observed behavioral responses to sensory stimulation, providing quantitative data on patients' cognitive functions and responses to stimuli. This method offers a comprehensive approach to enhancing sensory perception in patients with disorders of consciousness.

Methodology:

Research approach: Quantitative research approach.

Research design

Researchdesignisamasterplanspecifyingthemethodofprocedureforcollecting and analyzing the needed information (Ahuja R., 2001)

The pre experimental design (One group pre-test post test design) was used to evaluate the effectiveness of SMART on sensory perception ability among patients with sensory deprivation.

Variables

Dependent variable –In this study the dependent variable is sensory perception ability.

Independent variables – In this study the independent variable is SMART therapy (Sensory Modality Assessment and Rehabilitation Technique).

Setting of the study

This study was carried out in the neurological ward at Indira Gandhi Government General Hospital & Postgraduate Institute (IGGGH & PGI),Puducherry comes under the Dept. of Health, Puducherry.

It is a 1000 bedded super specialty hospital, situated in the beach road and whichis7km away from MTPG&RIHS.Thewardconsistsof20 beds for both male and female neuro patients with four intensive care unit beds included in it. The investigator selected this setting for the availability of the sample and feasibility of the study.

Population

The term population includes all persons, events, and objects under study. (Polit and Hungler, 1998). All patients who were admitted to the neuro critical care unit with head injury and cerebro vascular accident in Indira Gandhi Government General Hospital and Postgraduate Institute (IGGGH & PGI),Puducherry.

Sample

Sample is a subset of the population that is selected for a particular study and members of sample are the study subjects. All patients who were admitted to the neuro critical care unit with head injury and cerebro vascular accident falling under the inclusion criteria during the period of studyin Indira Gandhi Government General Hospital and Postgraduate Institute (IGGGH & PGI), in Puducherry.

Sample technique

The term sampling technique refers to the process of selecting a part of the population to represent the entire population. (Polit&Hungler, 1999)

The sampling technique used for the study was convenient sampling technique. Every day the investigator had gone to the Neuro Critical Care Unit and identified the new cases and selected the samples that full filled the inclusion criteria and also follow the old case.

Sample size

The sample size for the present study was 50

The Sample size is determined through a pilot survey using the following formulae:

Sample size

$$n = \frac{(r+1)^2 (z_\alpha - z_{1-\beta})^2 \sigma^2}{r\delta^2} \quad \text{where, } r = n/n \text{ and } \delta = \mu - \mu$$

Criteria for sample selection

Inclusion criteria:

- Patients who shows willingness to participate in this study.
- Patients under the age group of 18-65 years.
- Both male and female.
- Patients who had stable vital signs.
- The Glasgow Coma Scale (GCS) score of 9 and above.
- Patient's present during the period of data collection.

Exclusion criteria:

- Patients under sedation, unconscious, on ventilator support.
- Past history of brain injury o any other cerebral pathology seizure history, blindness, hearing loss, or color blindness.
- History of brain stem injury or infarction, which was confirmed by imaging studies.
- Cardiac arrest lasting longer than 4minutes during this admission.

Ethical clearance:

The Research proposal was approved by the dissertation committee, prior to conducting the pilot study and main study. The written permission was obtained from the concerned authorities and consent was obtained from the subjects afterexplanation regarding the objective and nature of study.

Methodology:

The investigator collected the data after obtaining prior permission from the head of the institution, IGGGH & PGI, Puducherry. The data was collected over a period of 4 weeks. The investigator selected the subjects who fulfilled the inclusion criteria using convenient sampling technique. Samples participated in the pilot study were excluded in the main study. After giving self-introduction, the purpose of the study was explained to the participant's care taker. Informed consent was obtained, and confidentiality was assured.

A Glasgow Coma Scale was used on the first day of data collection to assess the level of consciousness of the patient. On the very same day, the level of sensory perception ability was also assessed using Modified Disorder of Conscious Scale (MDOCS).The patients who were having the Glasgow Coma Scale score >9 were selected. By using Modified Disorder of Conscious Scale those patients were categorized according to the level of response. All six senses were stimulated using various techniques by researcher for the patients. The same procedure was repeated for 15 min of duration, 3 times per day for one week, on the 8th day Glasgow Coma Scale was reassessed and Modified Disorder of Conscious Scale (MDOCS) was also reassessed and scoring was done separately for each patient in a single sheet.

Plan for data analysis:

Data analysis is a technique used to reduce, organize, and give meaning to data. The collected data was analyzed by using both descriptive and inferential statistics. Descriptive statistic like frequency, percentage, mean, standard deviation was used to analysis the demographical and clinical variables, their sensory perception ability and the inferential statistics like paired 't'- test and was used to analyze the effectiveness of SMART therapy among sensory deprived patient, before and after intervention and Chi-square test was used to associate the study findings with Selected demographical and clinical variables.

Data analysis :

This chapter deals with the distribution of the sample, analysis and interpretation of data to assess the effectiveness of SMART therapy on level of sensory perception among patients with sensory deprivation in NCCU (Neuro Critical Care Unit). The analysis of the data was planned based on the objectives and hypothesis of the study. Both descriptive and inferential statistics were used for the data analysis and interpretations. The data obtained were

tabulated, organized & analyzed based on the objectives of the study using descriptive and inferential statistics as follows.

Organization of the findings

Section I: Percentage Distribution of the patients with sensory deprivation by their demographic variables and clinical variables.

Section II: Percentage Distribution of patient's pre and post- test score of GCS & MDOCS scale among patients with sensory deprivation.

Section III: Percentage Distribution of mean and standard deviation of pre and post- test score of level of sensory perception ability among patients with sensory deprivation.

Section IV: Comparison of pre and post –test score of GCS and MDOCS scale on sensory deprivation among patients in NCCU.

Section V: Association of post test level of sensory perception ability with selected demographic and clinical variables among patients with sensory deprivation.

TABLE.No.4.1:1Distribution of the sensory deprived patients by their age group

Age in years	Frequency	Percentage
<40	12	24.0
40-60	10	20.0
>60	28	56.0

The above table shows the age of the subjects majority 28(56%) of subjects belong to >60 years, 12(24%) belongs to <40 years, and 10(20%), belongs to age group 40-60 years.

TABLENO.4.2:1percentage distribution of pre & post test score of GCS among patients with sensory deprivation.(N=50)

GCS scale score	9-12(Semiconscious)		13-15(Conscious)	
	F	(%)	F	(%)
Pretest	32	(64%)	18	(36%)
Posttest	15	(30%)	35	(70%)

The above table shows the level of consciousness before and after intervention. The level of consciousness was measured by Glasgow Coma Scale, in the pre-test, majority 32(64%) of patients were in the score of 9-12(semiconscious) and 18(36%) were in the score of 13-15(conscious) group. Whereas in the post-test, majority 35(70%) of patients were in the score of 13- 15(conscious) group and 15(30%) were in the score of 9-12(semiconscious) group respectively. Thus the results showed improvement in the level of consciousness after SMART therapy.

TABLE NO.4.2:2 Percentage distribution of pre & post test level of sensory perception ability among the subjects with sensory deprivation assessed by MDOCS (Modified Disorder of Conscious Scale).(N=50)

MDOCS score	Very poor (0-4)		Poor (5-8)		Average (9-13)		Good (14-18)	
	F	(%)	F	(%)	F	(%)	F	(%)

Pretest	5	(10%)	15	(30%)	17	(34%)	13	(26%)
Posttest	0	(0)	6	(12%)	15	(30%)	29	(58%)

The above table shows the level of sensory perception ability before and after SMART intervention. The level of sensory perception ability was measured by modified disorder of conscious scale. Based on the score obtained by the subjects they were categorized in four major categories, namely 0-4(very poor), 5-8(poor),9- 13(average)and 14-18(good) sensory perception ability.

The pre-test score obtained by the subjects using MDOCS showed 5(10%) were in the score of 0-4(very poor), 15(30%) were in the score of 5-8(poor),17 (34%) were in the score of9-13(average) and 13(26%) were in the score of14-18(good) sensory perception ability.

Whereas the post – test score showed that 6(12%) were in the score of 5-8(poor),15 (30%) were in the score of9-13(average) and 29(58%) were in the score of14- 18(good) sensory perception ability. The findings showed that there was definite improvement in the sensory perception ability after SMART therapy.

TABLE NO. 4.3 Mean and standard deviation of pre & post test level of consciousness& sensory perception ability among subjects assessed by GCS (Glasgow coma scale) & MDOCS (Modified Disorder of Conscious Scale).(N=50)

	GCS scale score		MDOCS scale score	
	Mean	S.D	Mean	S.D
Pre-test	11.48	2.04	10.08	4.32
Post-test	13.38	1.41	13.58	3.56

From the above table it reveals that the mean and standard deviation of pre and post- test score of both level of conscious and sensory perception ability. Before intervention, the average GCS score obtained was 11.48 with a standard deviation of 2.04, after the intervention the score were increased to the mean of 13.38 with a standard deviation of 1.41.

Whereas in the case of MDOCS score, the mean obtained was 10.08 with a standard deviation of 4.32 before intervention of SMART, after the intervention GCS mean obtained was 13.58 with the standard deviation of 3.56.Hence the above table shows there was a significant improvement in the level of consciousness as well as in the level of sensory perception ability.

Table4.5:1Associationofpost-testlevelofconsciousnesswiththeageofthe subjects.(N=50)p>0.05 N.S=Non significant

Demographic variable	Level of consciousness				Level of sensory perception ability			
Age	Table value	Chi square value	Level of significance	df	Table value	Chi square level	Levelof significa nce	df
	5.99	1.305	0.521	2	9.49	4.16	0.38	4

The above table shows the association between post test level of consciousness and sensory perception ability with the age of the subjects with sensory deprivation.

With regard to the age factor, the non- significant 'p' value (0.52) of the interaction effect between the groups and age inferred that age had no influence on the level of consciousness.

With regard to the age factor, the non- significant 'p' value (0.38) of the interaction effect between the groups and age inferred that age had no influence on the level of sensory perception ability.

Table4.5:2Associationofpost-testlevelofconsciousnessandsensoryperception ability with the gender of the subjects.(N=50)

Demographic variable	Level of consciousness				Level of sensory perception ability			
	Table value	Chi square value	Level of significanc e	df	Table value	Chi square level	Level of significance	df
Gender	3.84	0.93	0.33	1	5.99	1.801	0.406	2

p>0.05N.S=Non significant

The above table shows the association between post test level of consciousness and sensory perception ability with the gender of the subjects with sensory deprivation.

With regard to the gender, the non- significant 'p' value (0.33) of the interaction effect between the groups and gender inferred that gender had no influence on the level of consciousness.

With regard to the gender, the non- significant 'p' value (0.40) of the interaction effect between the groups and gender inferred that gender had no influence on the level of sensory perception ability.

Table4.5:3Associationofpost-testlevelofconsciousnessandsensoryperception ability with the education of the subjects.(N=50)

Demographic variable	Level of consciousness				Level of sensory perception ability			
	Table value	Chi square value	Level of significance	df	Table value	Chi square level	Level of significanc e	df
Education	5.99	9.81	0.00	2	9.49	7.54	0.11	4

***p=<0.05-highlysignificant,p>0.05N.S=Non significant

The above table shows the association between post test level of consciousness and sensory perception ability with the education of the subjects with sensory deprivation.

With regard to the education status, the non- significant 'p' value (0.00) of the interaction effect between the groups and education infers that education had a highly significant influence on the level of consciousness.

With regard to the education status, the non- significant 'p' value (0.01) of the interaction effect between the groups and education infers that education had no influence on the level of sensory perception ability.

Table4.5:4Associationofpost-testlevelofconsciousnessandsensoryperception ability with personal habit of the subjects.(N=50)

Demograph ic variable	Level of consciousness				Level of sensory perception ability			
	Table value	Chi squar e value	Level of significance	df	Table value	Chi square level	Level of significance	df
Personal habit	7.82	0.92	0.81	3	5.99	5.37	0.49	2

p>0.05N.S=Non significant

The above table shows the association between post test level of consciousness and sensory perception ability with the personal habit of the subjects with sensory deprivation.

With regard to the personnel habit, the non- significant 'p' value (0.81) of the interaction effect between the groups and personal habit inferred that personal habit had no influence on the level of consciousness.

With regard to the personal habit, the non- significant 'p' value (0.49) of the interaction effect between the groups and personal habit inferred that personal habit had no influence on the level of sensory perception ability.

Table4.5:5Associationofpost-testlevelofconsciousnessandsensoryperception ability with the type of illness of the subjects.(N=50)

Demogra phic variable	Level of consciousness				Level of sensory perception ability			
	Table value	Chi square value	Level of significanc e	df	Table value	Chi square level	Level of significanc e	df
Type of illness	3.84	0.89	0.50	1	5.99	1.86	0.39	2

p>0.05N.S=Non significant

The above table shows the association between post test level of consciousness and sensory perception ability with the type of illness of the subjects with sensory deprivation.

With regard to the type of illness, the non- significant 'p' value (0.50) of the interaction effect between the groups and type of illness inferred that type of illness had no influence on the level of consciousness.

With regard to the type of illness, the non- significant 'p' value (0.39) of the interaction effect between the groups and type of illness inferred that type of illness had no influence on the level of sensory perception ability.

Table4.5:6Associationofpost-testlevelofconsciousnessandsensoryperception ability with the co morbidity of the subjects.(N=50)

Demograp hic variable	Level of consciousness				Level of sensory perception ability			
Co morbid illness	Table value	Chi square value	Level of signific ance	df	Table value	Chi square level	Level of significa nce	df
	3.84	4.36	0.03	1	5.99	3.62	0.16	2

*p=<0.05-significantp>0.05N.S=Non significant

The above table shows the association between post test level of consciousness and sensory perception ability with the co morbidity of the subjects with sensory deprivation.

With regard to the comorbidity ,then on- significant 'p'value (0.03) of the interaction effect between the groups and co morbidity inferred that co morbidity had a significant influence on the level of consciousness.

With regard to the co morbidity status, the non- significant 'p' value (0.16) of the interaction effect between the groups and co morbidity inferred that co morbidity had no influence on the level of sensory perception ability.

Discussion:

This chapter deals with the discussion of the study findings and compares with appropriate review of literature, statistical analysis based on the objectives of the study. The aim of the present study was to evaluate the effectiveness of SMART on sensory perception ability among patients with sensory deprivation in Neuro critical care unit at Indira Gandhi Government General Hospital And Post-Graduate Institute (IGGGH & PGI),Puducherry.

The study was conducted based on quantitative approach with pre- experimental design with one group pre and post-test design among sensory deprived patients (head injury and cerebro vascular accident) in IGGGH&PGI, Puducherry. The total number of 50 patients was selected by convenient method of sampling. The investigator explained the study to the care takers of sensory deprived patients and evaluated the effectiveness of SMART therapy among sensory deprived patients. The effectiveness was analyzed using descriptive statistics (Frequency, mean and standard deviation) and inferential statistics ('t' test and chi-square test). The data was analyzed and discussed based on the objectives of the study.

Distribution of demographic and clinical variables:
Considering the distribution of the samples based on their demographic and clinical variables, Table 4.1 shows, With respect to the age, majority 28(56%) of subjects belong to >60 years, 12(24%) belongs to <40 years, and 10(20%), belongs to age group 40-60 years.

In relation to the gender, majority 37(74%) of subjects belong to male and 13(26%) of subjects belongs to female gender. With respect to educational status, majority 23(46%) of subjects were illiterate, 18(36%) of subjects finished their high school and 9(18%) of subjects finished their higher secondary and college.

With respect to the income of the family, more than half of the 34(68%) of subjects income was Rs. <2000 per month and 16(32%) of subjects income was Rs.>2000 per month. Regarding the pre habitual lifestyle, majority 13(26%) of subjects had both alcohol & smoking habit, 12(24%) of subjects had the habit of consuming alcohol only and remaining 3(6%), of subjects had smoking habit only. With respect to the type of illness, majority 33(66%) of patients were diagnosed as head injury and 17(34%) of subjects were diagnosed as cerabro vascular accident. Regarding co morbidity, 33(66%) had co morbidity and 17(34%) had no co morbidity. The level of consciousness was measured by Glasgow Coma Scale, in pre-test majority 32(64%) of patients were in the score of 9-12(semiconscious) and18 (36%) were inthe score of 13-15(conscious) group during pre-test. The average GCS score obtained was 11.48 with a standard deviation of 2.04.

The pre-test score obtained by the subjects using MDOCS showed 5(10%) were in the score of 0-4(very poor), 15(30%) were in the score of 5-8(poor),17 (34%) were in the score of 9-13(average) and 13(26%) were in the score of 14-18(good) sensory perception ability. The mean obtained was 10.08 with a standard deviation of 4.32 before intervention of SMART.

Hence it shows that there is sensory deprivation among patients with head injury and cerebro vascular injury. The findings of the present study were consistent with retrospective cohort study done by Smitt, et al(2008) to analyze sensory alteration in critically ill patients admitted to a to a Neuro ICU during a 36 months period. 41% of patients were with sensory impairment, enrolled in this study.

The findings showed, that the post-test score of level of consciousness, majority 35(70%) of patients were in the score of 13-15(conscious) group and 15(30%) were in the score of 9-12(semiconscious) group.
Whereas the post – test score of sensory perception ability showed that 6(12%) were in the score of 5-8(poor), 15 (30%) were in the score of 9-13(average) and 29(58%) were in the score of 14-18(good) sensory perception ability, and there was no sample in the score of 0-4(very poor).

Before intervention, the average GCS score obtained was 11.48 with astandarddeviationof2.04.Aftertheinterventionthescoreincreasedtothemeanof 13.38 with a standard deviation of 1.41.The above mean value was compared by applying paired't' test. The highly significant p value (p<0.000) inferred that after the SMART intervention there was a significant improvement in the level of consciousness among the subjects.

Whereas in MDOCS score, the mean obtained was 10.08 with a standard deviation of 4.32 before intervention of SMART, after the intervention the mean obtained by GCS was 13.58 with the standard deviation of 3.56. Paired't' test was applied to compare the two mean value. The highly significant 'p' value inferred that after the SMART intervention the sensory perception ability of sensory deprived patients was increased compared to their score obtained before intervention. Hencethe hypothesis H1- which states that there will be significant difference between pre- test and post-test level of sensory perception ability of the sensory deprived patients was accepted.

The findings of the present study was consistent with a study vijayalakshmi (2010). Her study was to assess the effectiveness of SMART on senses among 30 patients admitted in neuro critical care unit of erode trust hospital using Glasgow Coma Scale and Coma Recovery Scale. The results of the study revealed that, the overall mean percentage score for the pre test was 43%, where as in the post test was 87%, revealing a difference of 44% and the overall mean percentage score for control group post test mean percentage was 56%, where as in experimental group post test mean percentage was 87%, revealing a difference of 30%, it shows smart was highly effective in all areas of senses. On chi square ,No significance association between senses among control and experimental group of patient in neuro critical care unit with the demographic variable i.e. age, sex, risk factors, duration of illness, history of physical illness. When analyzing SMART was found to be an effective tool to help to improve the sensory and motor function among patients in neuro critical care unit. This result supports the present study results also.

The level of consciousness and level of sensory perception ability was associated with all the demographic and clinical variables but The study results showed the association of post test score of level of consciousness of the subjects with selected demographic variable "education and "co morbid illness are evident that there was statistically significant association at p< 0.05 level. Hence the hypothesis H2-which states that there will be significant association between post-test level of sensory deprivation and selected demographic and clinical variables, was accepted.

Conclusion
The study results showed that SMART therapy was effective in improving level of consciousness as well as the level of sensory perception ability among the sensory deprived patients. This is also a convenient and easy to measure. Hence SMART therapy can be applied as an adjunct therapy by nurses in day today caring the sensory deprived patients in hospital setting.

References
1. Urbenjaphol P .Journal of Neuroscience Nursing: Effects of the Sensory StimulationProgramonRecoveryinUnconsciousPatientsWithTraumatic Brain Injury .2009 ;41: E10 - E1

2. Ansell, B. J.Slow-to-recover brain-injured patients: Rationale for treatment.JournalofSpeechandHearingResearch.1991;24;1017-1022.
3. Cope,D.,&Hall,K.Head injuryrehabilitation: Benefitofearly
4. intervention.ArchivesofPhysicalMedicineandRehabilitation.1982;63:433- 437.
5. Davis,A.E.,&White,J.J.Innovativesensoryinputforthecomatosebrain- injured patient.Critical Care Nursing Clinics of North America.1995;7(2): 351-361.
6. DeYoung,S., &Grass, R.B. Comarecoveryprogram. Rehabilitation Nursing.1987;12(3):121-124.
7. Gill-Thwaites, H., & Munday, R.The SensoryModalityAssessment and Rehabilitation Technique (SMART): A comprehensive and integrated assessmentandtreatmentprotocolforthevegetativestateandminimally responsivepatient.NeuropsychologicalRehabilitation.1999;9:305-320.
8. Kater, K. M. Response of head-injured patients to sensorystimulation.WesternJournalofNursingResearch.1989;11(1):20-33.
9. Larkin,M.Reorganizationandrehabilitation:Theoriesofneuralplasticityat work. Headlines. 1993;4(1):18-19.
10. Lippert-Gruner, M., Wedekind, C., Ernestus, R., & Klung, N. Early rehabilitativeconceptsintherapyofthecomatosebraininjuredpatients.Acta Neurochirurgica. Supplementum. 2002; 79: 21-23.
11. Mackay,L.E., Bernstein,B.A.,Chapman,P.E.,Morgan,A.S.,&Milazzo,
12. L.S.Earlyinterventioninsevereheadinjury:Longtermbenefitsofa formalized program. Archives of Physical Medicine and Rehabilitation.1992;73: 635-641.
13. Mitchell, S., Bradley, V. A., Welch, J. L., & Britton, P. G. Coma Arousal Procedure:Atherapeuticinterventioninthetreatmentofheadinjury.Brain Injury.1990;4(3): 273-279.
14. Oh,H.,&Seo,W.Sensorystimulationprogrammetoimproverecoveryin comatose patients.Journal of Clinical Nursing.2003; 12:394-404.
15. Sazbon, L., Zagreba, F., Ronen, J., Solzi, P., & Costeff, H. Course and outcomeofpatientsinvegetativestateofnontraumaticaetiology.Journalof Neurology, Neurosurgery and Psychiatry. 1993;56: 407-409.
16. Segatore,M.,&Way,C.TheGlasgowComaScale:Timeforchange.Heart and Lung. 1992; 21: 548-557.
17. Sosnowski, C., & Ustik, M. Early intervention: Coma stimulation in the intensivecareunit.JournalofNeuroscienceNursing.1994;26(6):336-341.
18. Teasdale,G.,&Jennett,B.Assessmentofcomaandimpairedconsciousness: A practical scale. Lancet.1974; 2(7872): 81-84.
19. Walsh,R.Sensoryenvironments,braindamage,anddrugs:Areviewof interactions and mediating mechanisms. International Journal of Neuroscience. 1981; 14: 129-131
20. American Academy of Neurology. Practice Parameters: Assessment and Management of Patients in the Persistent Vegetative State (Summary Statement). Report of the quality Standards Subcommittee of the American AcademyofNeurology.1995.ReaffirmedJul2006.AccessedOct23,2007. Available at URL address: http://www.aan.com/professionals/practice/guideline/index.cfm
21. Johnson DA, Roething-Johnston K, Richards D. Biochemical and physiologicalparametersofrecoveryinacutesevereheadinjury.BrainInjury 1993;7(6):491–499.
22. KarmaD,RawatAK.EffectofStimulationinComa. IndianPediatr.2006
23. ;43(10):856-60.
24. KaterKM.Responseofhead-injuredpatientstosensorystimulation.Western Journal of Nursing Research 1989;11(1):20–33.
25. LombardiF,TariccoM,DeTantiA,TelaroE,LiberatiA.Sensorystimulation of brain-injured individuals in coma or vegetative state: results of a Cochrane systematic review. Clin Rehabil. 2002 ;16(5):464-72.
26. MitchellS,BradleyVA,WelchJL,BrittonPG.Comaarousalprocedure:a therapeuticintervention in thetreatment ofhead injury. Brain Injury1990; 4(3):273–279.
27. NationalInstituteofNeurologicalDisordersandStroke(NINDS).Disorders. ComaandPersistentVegetativeStateInformationPage.Feb2007.Accessed Oct 23, 2007. Available at URL address: http://www.ninds.nih.gov/disorders/coma/coma.htm
28. National Institute of Neurological Disorders and Stroke (NINDS). Disorders. Locked-in Syndrome Information Page. Accessed November 1, 2007. Available at URL address: http://www.ninds.nih.gov/disorders/lockedinsyndrome/lockedinsyndrome.htm