

Increased Intracranial Pressure: Effect of Educational Nursing Guidelines on Nurses' Performance in Neuro-Critical Care Unit

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Abstract: Enhancing competency in the nursing care of patients with increased intracranial pressure is recommended to maintain a current knowledge base and practice. Ongoing participation in education on the management of those patients required for nurses to provide optimal care and optimize patients' outcomes. **Aims:** The aim of this study was to assess and evaluate the effect of educational nursing guidelines on nurses' performance caring for patients with increased intracranial pressure in neuro-critical care unit. **Subjects and Methods: Design:** A quasi experimental design was used. **Setting:** The study was conducted in Intensive Care Unit at El-Demerdash University Hospital. **Sample :** A purposive sample of 30 nurses caring for patients with increased intracranial pressure in the previously mentioned setting. **Tools for data collection:** A Self administered structured questionnaire and observational checklists. **Results :** There was a statistically significance differences between pre & post guidelines implementation regarding knowledge, practice and attitude of the studied nurses caring for patients with increased intracranial pressure. **Conclusions:** educational nursing guideline was helpful on the improvement of knowledge, practices and attitude of the nurses' caring for patients with increased intracranial pressure. **Recommendations:** Periodic in service – training advanced care programs regarding the nursing care for patients with increased intracranial pressure.

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Key words: Increased intracranial pressure, guidelines, nurses' performance

1. Introduction:

Increased intracranial pressure (ICP) is a common problem in neurosurgical and neurological practice. It can arise as a consequence of intracranial mass lesions, disorders of cerebrospinal fluid (CSF) circulation, and more diffuse intracranial pathological processes. Its development may be acute or chronic. Rapid or prolonged increases in an intracranial pressure present a serious threat to life. Elevations in ICP are critical because it can decrease cerebral perfusion and blood flow. The brain requires 50 to 55 mL of blood per 100 g of brain tissue to maintain a normal metabolic state (Morton & Fontaine, 2013).

Intracranial hypertension may be due to central nervous system infection, brain edema, cerebral hemorrhage or ischemic injury, or brain trauma. Fatality may not result from the immediate traumatic or hemorrhagic injury; rather, progressive damage to brain tissue may develop over time. Brain damage becomes even more progressive if intracranial hypertension is a consequence of injury. Once the pressure exceeds the accommodation point, the brain will herniate through weak points (for example, the foramen magnum). Irreversible neurological damage or death will result. Elevated ICP carries a mortality rate of around 20% (Ramont, Niedringhaus & towel, 2012).

Patients with ICP have the signs and symptoms which include change in level of consciousness which may occur over a period of minutes, hours, or days, characterized by a diminished response to environmental stimuli. Responsiveness ranges from alert and oriented to no response to stimuli; confusion, restlessness, disorientation, and drowsiness may be signs of an impending change; headache increases in severity with coughing, sneezing, or straining at stool; vomiting; papilledema /pupil changes ;edema and pressure of both the optic nerve and the oculomotor nerve at the point at which they enter the globe is caused by venous congestion resulting from increased intracranial pressure; pupil on the affected side may be nonreactive; pupils may be unequal, dilated, pinpoint, or nonreactive; elevation of blood pressure with a widened pulse pressure; decreased pulse rate (may be increased initially) and decreased respiratory rate (Ignatvicius & Workman, 2010).

The significance of the onset of intracranial hypertension is not limited to the initial traumatic or hemorrhagic event. The initial event causes a physical distortion and damage to neural tissue or an increase in pressure within a single compartment. Additional vascular and tissue injury may then occur. This phenomenon, known as secondary brain injury, occurs over hours to days after the initial brain injury.

Secondary injury is progressive and often begins shortly after brain injury (**Burns, 2014**).

Intracranial hypertension can lead to potentially catastrophic consequences, including permanent neurological damage and disability. Intracranial hypertension may be due to central nervous system infection, brain edema, cerebral hemorrhage or ischemic injury, or brain trauma. Traumatic brain injury is a major cause of morbidity and mortality. Fatality may not result from the immediate traumatic or hemorrhagic injury; rather, progressive damage to brain tissue may develop over time. Brain damage becomes even more progressive if intracranial hypertension is a consequence of injury (**Luca et al, 2015**).

Intracranial pressure is a frequent target for goal-directed therapy to prevent secondary brain injury. Despite the multidisciplinary nature of ICP management, in critical care settings, nurses deliver many interventions to patients having an increased intracranial pressure. Although some interventions are specifically targeted to reduce ICP, a variety of interventions may directly or indirectly affect ICP. Astute nursing assessment and early, aggressive resuscitation of critically ill patients may prolong life. Rapid control of fluctuations and elevations in intracranial pressure (ICP) may increase the potential for optimal functional recovery (**McNett & Gianakis, 2010; Olson, Lewis, Bader, 2013**).

Consistent and professional nursing management, with accurate assessment and recording of observations is required to minimize the risk of further increases and on the morbidity and mortality of the patient is very important. Nursing interventions can positively or negatively affect intracranial pressure (ICP). Nurses have a unique opportunity to manage patient care in order to decrease elevated ICP and prevent secondary brain injury. Nursing management aims to reduce the potential for further neurological damage and the potential for more raising in intracranial pressure (**Burke, Lemon & Brown, 2014**).

Evidence indicates that routine nursing interventions may affect physiological variables, leading to secondary brain injury. Specifically, endotracheal suctioning and repositioning of patients are associated with changes in blood pressure, ICP, cerebral perfusion pressure, and heart rate in critically ill neurologically impaired patients. Some researches explored the effects of some nursing interventions that performed with the aim of specifically decreasing ICP values. These included repositioning endotracheal tubes or cervical collars, draining cerebrospinal fluid (CSF), raising the head of the bed, and administering medications, limiting environmental stimulation and

talking with the patient (**Dang et al, 2015; Olson et al, 2013**).

In neurosurgical patients, many factors such as hypercapnia, hypoxemia, endotracheal aspiration, valsalva maneuver, noxious stimuli and activities increasing cerebral metabolism affect intracranial pressure. The interventions applied in the care of a neurosurgical patient mainly focus on determining the frequency of observations, detecting early signs and symptoms of increased intracranial pressure, administering the appropriate treatment and care in a timely manner, preventing herniation and thus reducing the risk of morbidity and mortality. Nurses providing care for neurosurgical patients should be well aware of the factors affecting intracranial pressure, care interventions to prevent intracranial pressure increase, as well as a thorough understanding of the early signs of increased intracranial pressure. They should also be capable of both planning and implementing specific individual care interventions (**Zomorodi, 2011; Ugras, 2014**).

Treatment and care interventions for neurosurgical patients focus on recognition of early signs and symptoms of increased ICP, proper monitoring, and treatment and care in a timely manner to prevent a possible brain herniation and death. The nurse providing care to a neurosurgical patient should be aware of the factors associated with increased ICP, be capable of performing necessary interventions to prevent an increase in ICP and to establish early diagnosis, and be competent in planning and performing personal care tasks (**Koenig, 2011; Ugras, 2014**).

Intracranial pressure monitoring and optimizing therapy according to the ICP has significant influence on the rate of survival. ICP monitoring is necessary in all patients to minimize the destructive effects of the associated side effects and in improving the outcome (**Luca et al., 2015**). The nurse should determine ICP reference ranges for each patient as determined by physician orders, underlying pathology, and plan of care. Also, the nurse should determine a daily interdisciplinary plan of care including individualized daily goals, plan nursing care at intervals to allow patients with elevated ICP to help to control ICP and assist in prevention of further increase (**lewis, Heitkemper, Dirksen, Bucher & Camera, 2011; Chen et al., 2012**).

Significance & justification

Elevated ICP carries a mortality rate of around 20%. Many evidence indicated that routine nursing interventions may affect positively or negatively on physiological variables, leading to good prognosis or bad prognosis. Nurses have a unique opportunity to manage patient care in order to decrease elevated ICP and prevent secondary brain injury. Proper nursing

management for patients with ICP is essential in order to reduce the risk of complications and enhance patients' recovery.

Nurses work as part of an integrated health team has essential role in improving patients' outcomes. The nursing staff therefore, needs to know and implement the proper nursing management for patients with ICP and understand their potential underlying value. Nurses should be given training on how to care for those patients to be competent to care for those patients. Also, it is important to examine nurses' knowledge, practice and attitude before and after an educational intervention to be sure that they are equipped well with the proper performance for their job competence.

Education of the nursing staff is an integral part for managing patients with ICP. All nursing staff involved with any aspect of care and management of those patients must have received the appropriate training and be able to demonstrate competence. Educational guidance is a process of assisting the individual student to reach optimum educational development. The nurses must have the necessary knowledge, skills, attitudes, values and/or abilities to be deemed competent in caring for those patients. Also, ongoing development and maintenance of competency is their responsibility to achieve professional Practice, So, the nurse must be trained and have been assessed as competent to care for those patients.

Aim of the study:

The aim of this study was to assess and evaluate the effect of educational nursing guidelines intervention on nurses' performance caring for patients with increased intracranial in neuro-critical care unit. This has been achieved through the following specific objectives:

1. Assess level of nurses' knowledge regarding care of patients with increased intracranial pressure.
2. Assess level of nurses' practice regarding care of patients with increased intracranial pressure.
3. Assess attitude of the nurses caring for patients with increased intracranial pressure.
4. Design and implement the educational guidelines regarding nursing management of patients with increased intracranial pressure.
5. Evaluate the effect of educational nursing guidelines on nurses' performance caring for patients with increased intracranial pressure immediately post guidelines intervention.

Nurses' performance:

It involved nurses' knowledge, practice and attitude regarding caring for patients with increased intracranial pressure as is an important aspect in nurse's role.

Hypothesis:

This study hypothesized that:

There is a statistically significance differences between pre, immediately post-guidelines intervention regarding nurses' performance caring for patients with increased intracranial pressure'.

Subjects and Methods

Research design

A quasi experimental study design was utilized to accomplish this study.

Settings

The study was conducted in Intensive Care Unit at El-demerdash University Hospital.

Subjects

A sample of 30 nurses was taken from the previously mentioned study settings included in this study. They were from both gender, with different age, educational levels and years of experience, who caring for patients with increased intracranial pressure and willing to participate in the study.

Tools for data collection

Two tools were used to collect data pertinent for this study. They included the following:

1- A Self Administered Structured Questionnaire:

It was written in a simple Arabic language and comprises three parts. **The first part** was concerned with characteristics of the studied nurses such as age, gender, qualification, years of experience, and attendance of related training courses. **The second part** was used to assess the nurses' knowledge regarding increased intracranial pressure (*as definition, normal range and volume of intracranial pressure, its causes and risk factors, sign and symptoms, diagnostic measures, its complications*) and nursing management for patients with increased intracranial pressure. **The third part** was used to assess the nurses' attitude when caring for patients with increased intracranial pressure by using a Likert scale. The second and third parts were developed by the researchers based on the related literature (*Lewis et al., 2011; Ramont, Niedringhaus & towel, 2012; Morton & Fontaire, 2013; Burns, 2014; Luca et al, 2015*) and validated by a group of five experts in medical surgical nursing department at Faculty of Nursing, Ain Shams University.

Scoring systems

Regarding the 2nd part: The total score of knowledge was 39 degrees. The score one was given for each correct answer and zero for incorrect answer. For each area of knowledge, the scores of the items were summed-up and the total score divided by the number of the items. These scores were converted into a percent score. The total nurses' knowledge was considered satisfactory if the percent score was 75% or more (≥ 29.25 degrees), and unsatisfactory if less than 75% (< 29.25 degrees).

Regarding to the 3rd part: The total score of attitude was 20 grades. Each correct answer was given one grade and the incorrect answer was given zero. It was considered as follows: $\geq 75\%$ was considered a positive attitude when the total grades ≥ 15 grades and $< 75\%$ was considered a negative attitude when the total marks < 15 grades.

2- Performance observational checklist:

The observational checklist was developed and constructed by the researchers based on the related literature (*Potter et al., 2011; Morton & Fontaine, 2013; Olson et al., 2013; Burke, Lemon & Brown, 2014*) and validated by a group of five experts in medical surgical nursing department at Faculty of Nursing, Ain Shams University. An observational checklist was designed to assess nurses' practices when caring for patients with increased intracranial pressure which included the following: A- maintaining a patent airway, B- achieving an adequate breathing pattern, C- Optimizing cerebral tissue perfusion (*which included I- proper positioning II- bowel and bladder regimen III- minimizing environmental stimuli*), D- maintaining negative fluid balance, E- Monitoring for more increase in ICP and potential complications.

The scoring system

The total score of practice was 56 degrees. The item observed to be done correctly were scored "1" and the item not done or incorrectly done was scored "0". For each procedure, the scores of the items were summed - up and the total divided by the number of the items. These scores were converted into a percent score. The practice was considered satisfactory if the percent score was 75% or more of the sum of the total practice score (≥ 42 degrees) and unsatisfactory if less than 75 % (< 42 degrees).

Educational guidelines:

Educational guidelines were designed by the researchers based on the needs of the studied nurses to improve the nurses' knowledge and practice caring for patients with increased intracranial pressure in neuro-critical care unit based on the related literature (*Smeltzers, Bare, Hinkle & Cheever, 2010; Ramont, Niedringhaus & towel, 2012; Morton & Fontair, 2013; Olson et al., 2013; Burns, 2014*). Educational guidelines was written in Arabic language. The guidelines were revised by a group of five experts in Medical Surgical Nursing at faculty of Nursing, Ain Shams University for the content validity and applicability. It included three parts. **The first part:** It included knowledge regarding increased intracranial pressure (as definition, causes, risk factors, signs, symptoms, diagnosis & complications). **The second part:** It included knowledge regarding nursing management for caring of patients with increased intracranial pressure. **The third part: II- Practical part;** It was concerned with the nurses' practices

regarding practice caring for patients with increased intracranial pressure which included five parts: I- Nurses' practices regarding maintaining a patent airway, II- Nurses' practices regarding achieving an adequate breathing pattern, III- Nurses' practices regarding optimizing cerebral tissue perfusion (*which included:- proper positioning, bowel and bladder regimen & minimizing environmental stimuli*), IV- Nurses' practices regarding maintaining negative fluid balance, V- Nurses' practices regarding monitoring for more increase in ICP and potential complications.

2-Operational Design:

It includes preparatory phase, content validity and reliability, pilot study and field work.

A. The preparatory Phase:

It included reviewing of related literature, and theoretical knowledge of various aspects of the study using books, articles, internet, periodicals and magazines to develop data collection tools, the educational guidelines content and media.

B. Validity and Reliability

Testing validity: The study tools were tested by inspecting the items to determine whether the tools measure what supposed to measure. Testing validity of the study tools was done by a jury of 5 experts from different academic categories (professors and assistant professors) of the medical –surgical nursing at the faculty of nursing, Ain Shams University. The expertise reviewed the tools for clarity, relevance, comprehensiveness, simplicity and minor modification was done. **Testing reliability** of the proposed tools was done statistically by Crombach alpha test.

Ethical consideration:

The aim of the research was explained to the participants. Verbal consent was obtained from each nurse to participate in the study, after clarifying the procedures of the study. Participants were informed about their right to refuse participation and to withdraw at any time without any consequences. Confidentiality of data was ensured for the study subjects.

C. Pilot Study:

The pilot study commenced once ethical approval had been obtained. The pilot study was conducted on 5 nurses to test the clarity, feasibility and applicability of the determent tools. Based on the result of the pilot study, modifications and omissions of some details were done and then the final forms were developed. The nurses and patients who included in the pilot study were excluded from the study sample.

D-Field Work:

The actual filed work of this study started at the beginning of (June 2015) and had been completely of (September 2015). This period of time was divided into:

I-Implementation phase:

Before conducting the study, an exploratory visit was done in the previously mentioned study setting in order to estimate the number of nurses and the suitable time for collecting data. Personal communication was done with nurses and physician to explain the purpose of the study and gain their best possible cooperation to conduct the study. The researchers were available 2 days per week at the morning shift in the previously mentioned setting.

First, the observational checklist was filled out by the researchers who were available 2 days per week alternatively in the different study settings while the studied nurses were involved in patients' care in the morning shift. **Then**, the questionnaire format was filled in the clinical area by the studied nurses in the presence of the researchers. The assessment was done on the first five weeks for total study sample. The total numbers of nurses were 30, divided into six main groups according to study settings. **Finally**, implementation of the guidelines was carried out at the previously mentioned study settings for each group separately based on their needs. The duration of each session took approximately 1 to 1.5 hours, sessions started according to nurses' available time. Arabic language was used to suit the nurses' level of understanding. Methods of teaching used were lectures and group discussion for theoretical sessions and demonstration and re-demonstration for practical sessions. An instructional media was used; it included the guidelines handout and audiovisual materials.

II-Evaluation phase:

The evaluation phase was emphasized on estimating the effect of educational nursing guidelines on performance (knowledge, practice and attitude) of the nurses caring for patients with increased intracranial pressure through comparing between the results pre- and post- guidelines intervention to determine the level of improvement in nurses' knowledge, practices and attitude.

Statistical design:

Data entry and analysis were done using the Statistical Package for Social Science (SPSS) version

10. Data were presented in the tables and charts using actual numbers and percentages. Appropriate statistical methods were applied (percentage, chi-square (X²), correlation coefficient (r), Regarding P value, it was considered that: non-significant (NS) if P > 0.05, Significant (S) if P < 0.05, Highly Significant (HS) if P < 0.01.

Results:

Table (1) showed that the mean age of nurses under the study was 32.7±4.5. Regarding their gender, it was found that, 66.66% of the nurses were females. As regards their qualifications, it revealed that 80% of them were diploma nurses, while only 10% were have Bachelor degree. In relation to years of experience, 53.33% of the nurses under the study experienced 5 - <10 years. This table also shows that 73.33% of the nurses under the study didn't receive training courses or lectures.

Table (2): Shows the studied nurses' knowledge in relation to theoretical background of increased intracranial pressure pre- & post guidelines intervention, regarding nurses' knowledge pre – guidelines, none of them 0% had satisfactory knowledge regarding nursing management with statistically significant differences between them. While, post – guidelines intervention, 76.66% of them had satisfactory knowledge. Also, there were significant differences between nurses' knowledge pre and post – guidelines regarding normal range, volume of intracranial pressure, content of skull, causes and risk factors, diagnostic measures and Nursing management. While, there were no significant differences between nurses' knowledge pre and post – guidelines regarding sign and symptoms and complications.

Table (1):Number and percentage distribution of demographic characteristics among nurses under study.

Items	(N=30)	%
Age group (years):		
20 - < 30	10	33.33
30 - <40	15	50
40 - <50	5	16.66
Mean ± SD	32.7±4.5	
Gender:		
Female	20	66.66
Male	10	33.33
Qualification:		
Bachelor degree	3	10
Diploma	24	80
Technical Institute	3	10
Years of experience:		
3 - <5	10	33.33
5 - <10	16	53.33
≥10	4	13.33
Received training courses or lectures:		
Yes	8	26.66
No	22	73.33

Table (2): Difference between satisfactory level of the studied nurses' knowledge in relation to theoretical background of increased intracranial pressure pre- & post guidelines intervention.

Items	Nurses' knowledge				χ^2	P value
	Pre (n=30)		post (n=30)			
	No.	%	No.	%		
Normal range	17	56.66	25	83.33	5.08	0.02421
volume of intracranial pressure	16	53.33	25	83.33	6.24	0.01250
Content of skull	16	53.33	27	90	9.93	0.00162
Causes and risk factors	8	26.66	25	83.33	19.46	0.00001
Sign and symptoms	15	50	21	70	2.50	0.11385
Diagnostic measures	16	53.33	25	83.33	6.24	0.01250
Complications	17	56.66	23	76.66	2.70	0.10035
Nursing management	0	0.0	23	76.66	37.30	0.0000

Table (3): Difference between satisfactory level of the studied nurses' practice in relation to maintaining a patent airway & achieving an adequate breathing pattern pre- & post guidelines intervention.

Items	Nurses' practice				χ^2	P value
	Pre (n=30)		post (n=30)			
	No.	%	No.	%		
A- maintaining a patent airway						
Suction airway with care pre oxygenated & briefly hyperventilated 100% oxygen	7	23.33	26	86.66	24.31	0.00000
Suctioning not last longer than 15 seconds 10 minutes rest interval.	13	43.33	23	76.66	6.94	0.00841
Use open suction technique	30	100	30	100	-	-
Discourage coughing	16	53.33	25	83.33	6.24	0.01250
Ascultate lung \8 hrs	8	26.66	24	80.00	17.14	0.00003
Elevate head of bed	7	23.33	26	86.66	24.31	0.00000
Total	2	6.66	22	73.33	27.78	0.00000
B- achieving an adequate breathing pattern						
Monitor respiration and its irregularities	8	26.66	23	76.66	15.02	0.00011
Monitor PaCo2 (<30 mm hg)	16	53.3	27	90.00	9.93	0.00162
Monitor pulse oximeter	10	33.3	25	83.33	15.43	0.00009
Record neurological observation	14	46.6	24	80.00	7.18	0.00738
Total	4	13.33	26	86.66	32.27	0.00000

Table (3): show difference between satisfactory level of nurses' practice regarding maintaining a patent airway pre- & post- guidelines implementation, 23.33% of them had satisfactory practice regarding suction airway with care pre oxygenated & briefly hyperventilated 100% oxygen and elevate head of bed pre guidelines implementation, while 86.66% of them had satisfactory practice regarding the previous items post guidelines implementation, with a statistically significant difference between pre – & post guidelines. In addition, this table shows satisfactory level of nurses' practice regarding achieving an adequate breathing pattern pre- & post- guidelines

implementation, 26.66% of them had satisfactory practice regarding monitoring respiration and its irregularities and 33.33% of them had satisfactory practice regarding monitoring pulse oximeter pre guidelines implementation, while 76.66% & 83.33% of them had satisfactory practice regarding the previous items post guidelines implementation, with a statistically significant difference between pre – & post guidelines.

Table (4): show difference between satisfactory level of nurses' practice regarding proper position pre- & post- guidelines implementation, 20% of them had satisfactory practice regarding use of cervical collar if necessary, 33.33% regarding elevation of head of bed (30- 45 degree) & 23.33% regarding the hold of patients' head during turning pre guidelines implementation, while 70%, 80% & 70% of them had satisfactory practice regarding the previous items post guidelines implementation, with a statistically significant difference between pre – & post guidelines regarding all items except regarding avoidance of flexion and hyper-flexion of neck & avoidance of extreme hip flexion.

In addition, this table shows nurses' practice regarding bowel and bladder regimen not measured pre- & post- guidelines implementation. Also, this table shows satisfactory level of nurses' practice regarding minimizing environmental stimuli pre- & post- guidelines implementation, 20% of them had satisfactory practice regarding avoidance of frequent arousal from sleep, while 73.33% of them had satisfactory practice regarding the previous item post guidelines implementation, with a statistically significant difference between pre – & post guidelines implementation regarding all items of nursing practice except regarding spacing nursing activities.

Table (4): Difference between satisfactory level of the studied nurses' practice in relation to optimizing cerebral tissue perfusion (Proper position, bowel and bladder regimen & minimizing environmental stimuli) pre- & post guidelines intervention

Items	Nurses' practice				χ^2	P value
	Pre (n=30)		post (n=30)			
	No.	%	No.	%		
I- Proper position						
Keep head in neutral (midline) position	16	53.33	25	83.33	6.24	0.01250
Use cervical collar if necessary	6	20.00	21	70.00	15.15	0.00010
Elevate head of bed (30- 45 degree)	10	33.33	24	80.00	13.30	0.00026
Avoid extreme rotation of the neck	16	53.33	23	76.66	3.59	0.05014
Avoid flexion and hyper-flexion of neck	15	50	19	63.33	1.09	0.29737
Avoid extreme hip flexion	16	53.33	18	60.00	0.27	0.60233
Hold patients' head during turning	7	23.33	21	70.00	13.13	0.00029
Total	0	0.0	11	36.66	13.47	0.00024
II- bowel and bladder regimen						
Avoid valsalva maneuver by:						
-stool softeners	Not measured					
- high fiber diet	Not measured					
- avoid enema	Not measured					
-avoid cathartics if possible	Not measured					
III- minimizing environmental stimuli						
Spacing nursing activities	16	53.33	20	66.66	1.11	0.29184
Avoid frequent arousal from sleep	6	20.00	22	73.33	17.14	0.00003
Maintain calm atmosphere	10	33.33	20	66.66	6.67	0.00982
Sedation before nursing activities	Not measured					
Total	6	20.00	16	53.33	7.18	0.00738
Total of optimizing cerebral tissue perfusion	3	10	20	66.66	20.38	0.00001

Table (5): shows difference between satisfactory level of nurses' practice regarding assessment of fluid status pre- & post- guidelines implementation, there were statistically significant difference between pre – & post guidelines implementation regarding all items of nursing practice except regarding skin turgor, urine osmolarity, monitoring blood pressure & Glycemic control. However, all of them had satisfactory level of nurses' practice regarding monitoring of pulse, respiration and blood pressure pre – & post guidelines implementation.

Table (5): Difference between satisfactory level of the studied nurses' practice in relation to maintaining negative fluid balance pre- & post guidelines intervention

Items	Nurses' practice				χ^2	P value
	Pre (n=30)		post (n=30)			
	No.	%	No.	%		
Administer osmotic and loop diuretics as order	Not measured					
Administer corticosteroids as doctor order	Not measured					
Restrict fluid as doctor order	Not measured					
Assess fluid status						
• Skin turgor	16	53.33	17	56.66	0.07	0.79525
• mucous membrane	6	20.00	20	66.66	13.30	0.00026
• Mucous membrane	10	33.33	23	76.66	11.38	0.00074
• Urine osmolarity	19	63.33	19	63.33	0.00	1.00000
• IV fluid administered at prescribed rate	6	20.00	23	76.66	19.29	0.00001
• Monitor pulse	30	100	30	100	-	-
• Monitor blood pressure	30	100	30	100	-	-
• Monitor respiration	30	100	30	100	-	-
• Oral hygiene	16	53.33	24	80.00	4.80	0.02846
• Glycemic control	16	53.33	22	73.33	2.58	0.10797
• Monitor serum glucose \4-6 hrs	8	26.66	23	76.66	15.02	0.00011
Total	0	0.0	11	36.66	13.47	0.00024

Table (6): Difference between satisfactory level of the studied nurses' practice in relation to monitoring of potential complications pre- & post guidelines intervention

Items	Nurses' practice				χ^2	P value
	Pre (n=30)		post (n=30)			
	No.	%	No.	%		
Frequent neurological assessment	16	53.33	20	66.66	1.11	0.29184
Assessment for early signs and symptoms of ICP						
• Assess level of consciousness	6	20.00	23	76.66	19.29	0.00001
• Assess pupil changes (size- reaction to light)	10	33.33	22	73.33	9.64	0.00190
• Assess weakness of extremity	19	63.33	21	70.00	0.30	0.58388
• Assess headache and use pain scale	6	20.00	23	76.66	19.29	0.00001
Assessment for later indicators of increase ICP						
• Decrease pulse	30	100	30	100	-	-
• Decrease respiration	30	100	30	100	-	-
• Increase temp	30	100	30	100	-	-
• Increase BP	0	0	13	43.33	16.60	0.00005
• Increase pulse pressure	11	36.66	23	76.6	9.77	0.00177
• Altered respiratory pattern	10	33.33	20	66.66	6.67	0.00982
• Projectile vomiting	10	33.33	24	80.00	13.30	0.00026
• Hemiplegia & bilateral flaccidity	16	53.3	25	83.3	6.24	0.01250
• Loss of brain stem reflexes (papillary)	6	20.00	23	76.66	19.29	0.00001
• Decortications	10	33.33	24	80.00	13.30	0.00026
• Deceleration	11	36.66	23	76.66	9.77	0.00177
Total monitoring for potential complications	0	0.0	13	43.33	16.60	0.00005

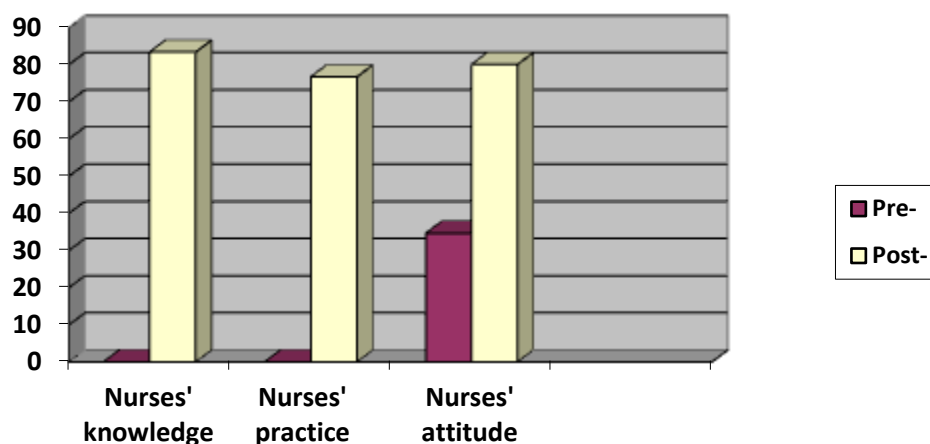


Figure (1): Difference between satisfactory level of total nurses' knowledge, practice and attitude regarding increased intracranial pressure pre- & post- guidelines intervention.

Table (6): show no statistically significant difference between satisfactory level of nurses' practice regarding frequent neurological assessment between pre – & post guidelines implementation. While, there were statistically significant difference between pre – & post guidelines implementation regarding all items of nursing practice regarding assessment of early signs and symptoms of ICP except assessment for weakness of extremity. Also, there were statistically significant difference between pre – & post guidelines implementation regarding all items of nursing practice regarding assessment of later indicators of increase ICP. However, all of them had

satisfactory level of nurses' practice regarding monitoring of pulse, respiration and blood pressure pre – & post guidelines implementation.

Figure (1) shows that 0%, 0% & 16.66 % of the studied nurses had satisfactory total knowledge, total practice and attitude regarding nursing management for patient with increased intracranial pressure pre-guidelines implementation respectively, while 83.33%, 76.66% & 80% of them had satisfactory total knowledge, total practice and attitude post guidelines implementation respectively, with highly statistically significant difference between pre- & post-guidelines implementation ($P=0.000$).

Table (7): Correlation between the studied nurses' knowledge with practice and attitude regarding nursing management for patient with increased intracranial pressure pre- & post guideline implementation pre- & post-guideline intervention.

Items (n=50)	Nurses' Practice (n=50)		Nurses' attitude (n=50)	
	r	p- value	R	p- value
Nurses' Knowledge				
Pre	0.685	0.00003	0.163	0.105
Post	0.586	0.00067	0.197	0.050
Nurses' practice				
Pre	-	-	0.071	0.485
Post	-	-	0.353	0.000

Table (7) shows that there were statistically significant positive correlations between total knowledge and practice pre- & post-guidelines intervention, between total knowledge and attitude post-guidelines intervention and between total practice and attitude post-guidelines intervention. However, there was no statistically significant

correlation between the studied nurses' knowledge and attitude and between total practice and attitude pre-guidelines intervention regarding nursing management of patients with increased intracranial pressure.

4. Discussion

Elevated intracranial pressure (ICP) has been associated with increased mortality in patients with severe traumatic brain injury (TBI) (**Chen et al., 2012**). Intracranial pressure (ICP) is the pressure within the cranial vault and is now regarded as a core monitoring parameter in the intensive care management of patients with acute brain injury (**Bhatia & Gupta, 2007**).

The aim of this study was to assess and evaluate the effect of educational nursing intervention on nurses' performance while caring for patients with increased intracranial pressure in neuro-critical care unit.

Discussion of the present study findings covered main parts:

The first part: was concerned with demographic characteristics and the knowledge of the studied nurses. **The second part:** was regarding practice and attitude when caring for patients with increased intracranial pressure in neuro-critical care unit pre and post educational guidelines implementation, **The third part:** was regarding the Correlation between the studied nurses' knowledge, practice and attitude pre- & post guideline implementation.

Part I:

Firstly, regarding demographic characteristics of the studied nurses, the results of the current study revealed that, the mean age of the nurses under the study was (32.7±4.5). This is differ from **Abd El Moteleb (2014)** who found that more than two third of the nurses their age were less than thirty years and the minority of the nurses their age were more than thirty years. While, concerning gender,, the results of the current study showed that, more than two thirds of the nurses were females, this might be due to nursing education for male begins recently. This result is in the same line also with **Abd El Moteleb (2014)** who found that the majority of the nurses under study were females.

Regarding qualification of nurses in this study, the present study showed that the most of them were diploma nurses, while only one tenth were have Bachelor degree, this is in agree with **Maarouf(2012)** who found that more than half of the nurses had secondary school nursing diploma, while the minority of nurses had Bachelor in Nursing Science.

Secondly, regarding nurses' knowledge pre – guidelines, the present study revealed that, none of them had satisfactory knowledge regarding nursing management. While post – guidelines intervention, the most of them had satisfactory knowledge .Also, there were significant differences between nurses' knowledge pre and post – guidelines intervention.

This result was supported with **Pellico (2013)** who reported that, there was a highly statistically significant difference about nurses' total level of Knowledge related to nursing intervention of patient with increased intracranial pressure pre and post – guidelines intervention.

In the same context, **Kolias, Guilfoyle, Helmy, Allanson and Hutchinson, (2013)** who reported that, today's, nurse must possess the ability to correlate broad physiologic / patho-physiologic processes to specific clinical problems. In advanced nursing management, physiologic principles and human responses are applied to injury, enabling the nurse to move beyond the traditional roles and responsibilities of the nurse caring for patients with increased intracranial pressure. The nursing practice encompasses comprehensive knowledge for proper decision making, and knowledge of bioethical considerations in caring for patients with increased intracranial pressure.

The current study showed that, there is a statistically significant difference between pre – post guidelines implementation regarding all items of nurses' knowledge regarding nursing care for patients with increased intracranial pressure. In the same line, **Mc Nett & Gianekis (2010) & Slazinski et al. (2011)** mentioned that, the quality of nursing care is influenced by the knowledge, judgment, skills and values of those participating in the care of patients and the nurses' cognitive ability to decide on a plan of action that depends upon their knowledge.

Part II:

Regarding the nurses' practice when caring for patients with increased intracranial pressure in neuro-critical care unit pre and post educational guidelines intervention. These included the nurses' practice regarding I- Maintaining a patent airway, II- Achieving an adequate breathing pattern, III- Optimizing cerebral tissue perfusion (*which included:- proper positioning, bowel and bladder regimen & minimizing environmental stimuli*), IV- Maintaining negative fluid balance, V-Monitoring for more increase in ICP and potential complications.

Regarding maintaining a patent airway, the present study revealed that all of the studied nurses use open suction technique pre and post guidelines implementation. This might be related to unavailability of closed suction technique in neuro-critical unit. This is differ from **Oddo et al., (2010) and Altun & Aksoy (2012)** who found that both suctioning techniques significantly increased ICP and HR. However, closed suction technique had fewer effects on ICP than open suction technique did, which implies that closed suction technique can be safely performed in this patient group.

The present study also revealed that near quarter of the studied nurses had satisfactory practice regarding hyperventilated 100% oxygen before suctioning and elevating head of bed pre- guidelines intervention, while, most of them had satisfactory practice post guidelines intervention with a statistically significant difference. This is in the same line with **Kahraman et al., (2010) and Tume, Baines & Lisboa (2011)** who found that hyperventilation has been shown to reduce the ICP response in adult head-injured patients during suctioning, so it is important to the nurse to do it correctly.

Additionally, the present study revealed that, less than half of the studied nurses had satisfactory practice regarding suctioning not last longer than 15 sec and 10 minutes rest interval pre- guidelines implementation intervention, while, three quarter of them had satisfactory practice post guidelines intervention with a statistically significant difference. This is in agree with **Heluain et al. (2011); Mathieu et al. (2013) and Galbiati & Paola, (2015);** who found that after tracheal suctioning both open suction or closed suction system, parameters require up to 10 minutes to return to baseline levels; thus, it would be appropriate for neurosurgical intensive care nurses to leave an interval of at least 10minutes after tracheal suctioning before performing any other operations.

In relation to achieving adequate breathing pattern, the present study revealed that quarter of the studied nurses had satisfactory practice regarding monitoring respiration and its irregularities and one third of them had satisfactory practice regarding monitoring pulse oximeter pre guidelines intervention, While most of them had satisfactory practice regarding the previous items post guidelines intervention with a statistically significant difference. This is in agreement with **Cerqueira-Neto, et al.,(2010) and Badri (2012)** who pointed that, the importance of these practices were neglected by the nursing and medical staff caring for patients with ICP due to acute traumatic brain injuries rationalizing that the pulse, respiration and blood pressure are affected only once the medulla is compressed and stated that to wait for these changes as an indication for operation in acute cerebral injury.

Concerning proper patient's position, the present study showed that one third of the studied nurses had satisfactory practice regarding elevation of head of bed (30- 45 degree) and holding patients' head during turning pre guidelines intervention, while most of them had satisfactory practice regarding the previous items post guidelines intervention with a statistically significant difference. This is in the same line with **Tume, Baines & Lisboa (2011) and Oddo, Villa & Citerio (2012)** who found that in nearly 70% of patients, the ICP exceeded 20 mmHg during

turning, with nearly 10% of them exceeding 30 mmHg without elevation of head of bed during turning.

Regarding nurses' practice in avoidance of valsalva maneuvers as a part of bowel and bladder regimen pre and post implementation guidelines including the use of stool softeners, giving high fiber diet to the patient and avoidance of enema, These didn't be measured in the present study because the nurse follow the hospital policy that it isn't their responsibilities but follow the physician prescription. In the same context, **Hickey (2002)and Allan, Fawcett & Runcuman (2006)** who made comparisons between patients with head injury who benefited and those who did not benefit from bowel and bladder regimen. They found that nursing management of the bowel is important in patients with raised ICP. Constipation increases intra-abdominal pressure and causes straining when defecating, therefore raising ICP.

Additionally, the result of current study showed that quarter of the studied nurses had satisfactory practice regarding avoidance of frequent arousal from sleep pre- guidelines intervention. While, about three quarter of them had satisfactory practice post-guidelines intervention with a statistically significant difference. However, regarding sedation before nursing activities pre and post guidelines intervention didn't be measured in the present study because the nurse follow the hospital policy that it isn't their responsibilities but follow the physician prescription. In the same context, **Huanga, et al.(2006)** encompass that alternative sedative techniques and different sedative drugs were considered as the treatment of ICP in NICU and minimizing environmental stimuli is important during nursing management for those patients.

The result of current study showed that half of the studied nurses had satisfactory practice regarding oral hygiene pre-guidelines intervention and the majority of them had satisfactory practice post guidelines intervention. This is in agreement with **Szabo (2011); Szabo & Munro(2011); Usraz & Aksoy (2012)and Christina et al.,(2014) and Szabo et al.,(2014)**who provided evidence that nurse can administered oral care, regardless of intensity and duration, is safe and does not adversely affect ICP.

Regarding monitoring for complications, the present study revealed that there was statistically none significant difference between level of nurses' practice regarding neurologic assessment pre and post implementation guidelines. this might be due to, the neurological assessment is mainly a main responsibilities of the physician according to the hospital policy. In the same line, **Lee and Armstrong (2008)** emphasized that proper nursing assessment and comparing between patients with increased ICP who

undergoing neurologic assessment including; documentation complete, concise, neurologic assessment and detect neurologic changes, those patients had less hospital stay and better outcomes.

Also, regarding nurses' role in monitoring ICP level, it can't be assessed due to unavailability of monitoring devices in NICU. Also, **Blissitt (2012)** showed that, despite progress in the management of adults with severe TBI, several controversies persist. Among the unresolved issues of greatest concern to neuro-critical care clinicians and scientists as the best use of technological advances and the data obtained from multimodality monitoring is important to assess the effect of the care given and patient's response and prognosis.

The result of the current study showed that all of the studied nurses had satisfactory practice regarding temperature, pulse and blood pressure measurement as a routine care in NICU not as an important indicators for complications pre and post guidelines implementation respectively. This is considered in the same line with **Josephson (2004)** who proved that it is estimated that for every 1-degree increase in temperature above normal (centigrade degrees) the brains metabolism and oxygen consumption increases by 7%, an increase in temperature can also shift the oxy-hemoglobin curve to the right, decreasing the amount of oxygen the hemoglobin molecule carries, and decreasing the oxygen available to the cerebral tissues. So, it is important to the nurse to keep in mind that temperature measurement for those patients is an important indicator for complications not only a part of routine care in NICU.

The present study revealed that there was statistically significant difference between level of nurses' practice regarding monitoring ICP indicators pre and post implementation guidelines. This is in the same line with **Messerer, et al.,(2012) and Luca et al., (2015)** who made Comparisons in terms of the number of days admitted in the ICU and mortality between patients with head injury who benefited and those who did not benefit from ICP monitoring. They found that monitoring ICP is essential because of haemodynamic and physiological imbalances. Secondary brain injuries lead to significant worsening of clinical status and, thus, to increased mortality.

Part III:

Regarding attitude of the studied nurses, this study revealed that the minority of them had satisfactory level of attitude pre guidelines implementation. This might be due to their convenes that medical or surgical intervention only will affect and cause improvement in patient's condition. While, there was highly statistically significant difference

among pre – post-guidelines implementation. This might be due to the effect of educational guidelines.

The previous discussed results in relation to nurses' attitude is in the same line with **Mark and Simon (2010)** who found that the attitudes members of the nursing profession hold towards survivors of brain injury have impact on the level of help and degree of involvement they are willing to have and the subsequent impact this may have on the caring role either contributed, or did not contribute, to their injury. Also, **Redpath et al. (2010)** reported that increased attitudes of qualified staff are related to a decrease in intended helping behavior, which has the potential to impact negatively on an individual's recovery post-injury while studying healthcare professionals' attitudes towards traumatic brain injury (TBI): The influence of profession, experience, etiology and blame on prejudice towards survivors of brain injury.

The present study revealed that there was statistically significant correlation between level of nurses' practice and knowledge pre- and post-guidelines intervention. This is in the same line with **McNett, Doheny, Sedlak & Ludwick R. (2010), Noble (2010) and Oddo et al. (2012)**:who proved that a comprehensive review of intracranial pressure related information and an updated review of possible treatment strategies can prepare the nurse for new treatment modalities for caring the neurosurgical patient with increased ICP.

Concerning correlation between the studied nurses' practice and attitude regarding care of patients with ICP pre- & post- guideline intervention, the study results showed that, there was no statistically significant correlation between the studied nurses' practice and attitude pre- guidelines intervention. While, there was a statistically significant correlation between them post- guidelines intervention. This finding might be due to nurses' increased understanding would increase their confidence and also motivation to give better care for those patients more frequently and increased empowerment of critical care staff in decision-making, therefore increasing the standard of care and ultimately improved patients' outcomes.

Conclusion:

Based on findings of the present study, it can be concluded that:

Educational guidelines regarding care of patients with increased intracranial pressure in neuro-critical care unit had positive effect on nurses' knowledge, practice and attitude with a statistically significant difference between pre- and post- guidelines intervention.

Recommendation:

Based on the finding of the present study, the researcher recommended:

- 1- The importance of implementing orientation and periodic in-service training program for nurses regarding care of patients with increased intracranial pressure in neuro-critical care unit for continuous updating their knowledge and practice.
- 2- Further studies are recommended to evaluate the reflection of in-service training program focusing on prevention of complications related to care of patients with increased intracranial pressure.
- 3- Establishing standards of nursing care regarding care of patients with increased intracranial pressure.
- 4- The study should be replicated on large sample and different hospitals setting in order to generalize the results.

References

1. Abd El- Moteleb. H. (2014): Effect of Training Program on Nurses' Performance for Caring of Patients with Traumatic Brain Injury. Doctorate Thesis in Medical Surgical Nursing Faculty of Nursing. Ain Shams University
2. Allan, D., Fawcett, J.N. & Runciman, P.J. (2006): Disorders of the nervous system. In Alexander MF, Nursing Practice: Hospital and Home. (3rd ed.), Edinburgh, Churchill Livingstone, 395-442.
3. Altun, G. L. & Aksoy, G. L. (2012): Endotracheal Suctioning on Intracranial Pressure and Cerebral Perfusion Pressure: A Crossover, Single-Blind Clinical trial. *Journal of Neuroscience Nursing*, 44 (6), 233-239.
4. Bhatia, A. & Gupta, A. (2007): Neuro-monitoring in the intensive care unit. Intracranial pressure and cerebral blood flow Monitoring. *Intensive Care Med*, 33:1263–1271. DOI 10.1007/s00134-007-0678-z.
5. Blissitt, P.A. (2012): Controversies in the management of adults with severe traumatic brain injury. *AACN Adv Crit Care*; 23(2):188-203. Harborview Medical Center, Seattle, WA 98104, USA. pbliss@u.washington.edu.
6. Burke, K., Lemon, P.& Brown, E. (2014): Pearson new international edition medical surgical nursing care, (3rd ed.), Pearson education, USA, p.p: 209, 295, 938-942.
7. Burns, S.M. (2014): AACN Essentials of Critical Care Nursing, (3rd ed.), New york, McGraw Hill Co., 322-336.
8. Cerqueira-Neto, M. L., Moura, A. V., Scola, R. H., Aquim, E.E., Rea-Neto, A., Oliveira, M. C., & Cergueira, T. C. (2010): The effect of breath physiotherapeutic maneuvers on cerebral hemodynamics. *Arquivos de Neuro-psiquiatria*,68(4), 567-572.
9. Chen, J., Barber, J., Temkin, N.R., Sureyya, S., Chesnut, R.M., Deem, N., Yanez, D. & Treggiari, M.M. (2012): Mortality and long-term functional outcome associated with intracranial pressure after traumatic brain injury. *Intensive Care Med*, 38:1800–1809. DOI 10.1007/s00134-012-26554.
10. Christina, R.M., Cook, B.P., McNicholl, B.P. and Byrness, D.P. (2014): Management of brain and spinal cord injuries. *Crit Care Clin*, 20(1): 25-26.
11. Dang, Q., Simon, J., Catino, J., Puente, I., Habib, F. & Zucker, L. (2015): More fateful than fruitful? Intracranial pressure monitoring in elderly patients with traumatic brain injury is associated with worse outcomes. *J Surg Res*, 198 (2), 482-488.
12. Galbiati, G., & Paola, C. (2015): Effects of Open and Closed Endotracheal Suctioning on Intracranial Pressure and Cerebral Perfusion Pressure in Adult Patients With Severe Brain Injury: A Literature Review, *Journal of Neuroscience Nursing*, 47 (4), 264-272.
13. Hickey, J.V. (2002): Intracranial hypertension: theory and management of increased intracranial pressure. In Hickey JV. The Clinical Practice of Neurological and Neurosurgical Nursing. (5th ed.), Philadelphia, Lippincott Williams & Wilkins, 285-318.
14. Heluain, P., Demailly, A., Fourrier, L., Soury-Lavergne, A., & Robriquet, L. (2011): Endotracheal suctioning in the ICU adult intubated patient. *Re´animation*, 20 (1), 62-67.
15. Huang, S.J., Shieh, b.J. & Kaoca, M.C. (2006): logic control for intracranial pressure via continuous propofol sedation in a neurosurgical intensive care unit. *Medical Engineering & Physics*, 28:639–647.
16. Ignatvicius, D. & Workman, M. (2010): Medical surgical nursing patient-centered collaborative care. (6th ed.), USA, El-Servier Sanuders, p.p. 610-621.
17. Josephson, L. (2004): Management of Increased Intracranial Pressure. A Primer for the Non-neuro Critical Care Nurse. *Journal of Critical Care Nursing*, 23(5), 221-229.
18. Kahraman, S., Dutton, R.P., HuP-Xiao, Y., Aarabi, B., Stein, D.M. & Scalea, T.M. (2010): Automated measurement of “pressure times time dose” of intracranial hypertension best predicts outcome after severe traumatic brain injury. *Journal of Trauma*, 69:110–118.
19. Koenig MA. (2011): Cerebral edema and intracranial hypertension. In Handbook of Neuro-critical Care. 2nd ed. Edited by Bhardwaj

- A, Mirski MA. New York: Springer Science, Business Media, LLC., 73-88.
20. Koliass, A. G., Guilfoyle, M.R., Helmy, A., Allanson, J. and Hutchinson, P.J. (2013): Traumatic brain injury in adults, Division of Neurosurgery, Department of Clinical Neurosciences, Adden brooke's Hospital and University of Cambridge, Cambridge, UK.
 21. Lee, E.L. & Armstrong, T.S. (2008): Increased Intracranial Pressure Diagnostic Reasoning. *Clinical Journal of Oncology Nursing*, 12(1), 191-199.
 22. Lewis, S., Heitkemper, M., Dirksen, S., Bucher, L. & Camera, I. (2011): Medical Surgical Nursing Assessment and Management of Clinical Problems. (8th ed.), China, El-Servier Mosby Co., 588-609.
 23. Luca, L., Rogobete, A.F., Bedreag, O.H., Sarandan, M., Cradigati, C.A., Papurica, M.,..., Sandesc, D. (2015): Correlation between Optimised Intensive Therapy According to Intracranial Pressure Parameters and Clinical Picture. Turkish Anaesthesiology and Intensive Care Society - Available online at www.jtaics.org.
 24. Maarouf, D.M. (2012): Nurses' performance for patients with traumatic head injury during Golden Hour. Cairo, Egypt: Faculty of Nursing, Ain Shams University.
 25. Mark, A. L. (2010): A comparative study of nursing attitudes towards young male survivors of brain injury: A questionnaire survey *International journal of nursing studies*, 48(1):62-9.
 26. Mathieu, A., Guillon, A., Leyre, S., Martin, F., Fusciardi, J., & Laffon, M. (2013). Aerosolized lidocaine during invasive mechanical ventilation: In vitro characterization and clinical efficiency to prevent systemic and cerebral hemodynamic changes induced by endotracheal suctioning in head-injured patients. *Journal of Neurosurgical Anesthesiology*, 25(1), 8-15.
 27. McNett, M.M. & Gianakis, A. (2010): Nursing interventions for critically ill traumatic brain injury patients. *J Neurosci Nurs.*; 42(2):71-77.
 28. McNett, M., Doheny, M., Sedlak C. and Ludwick R. (2010): Judgments of Critical Care Nurses about Risk for Secondary Brain Injury; *Am J. Crit Care*; 19(3): 250-260.
 29. Messerer, M., Daniel, R.T., Oddo, M. (2012): Neuro-monitoring after major neurosurgical procedures. *Minerva Anestesiol*, 78:810-822.
 30. Morton, P.G. & Fontaine, D.K. (2013): Critical Care Nursing (A Holistic Approach), (10th ed.), Philadelphia, Lippincott Co. 744-761.
 31. Noble, K.A. (2010): CONTINUING EDUCATION, Traumatic Brain Injury and Increased Intracranial Pressure, *Journal of Peri Anesthesia \ Nursing*, 25(4): pp 242-250.
 32. Oddo, M., Levine, J.M., Frangos, S., Maloney-Wilensky, E., Carrera, E., Daniel, R.T.,..., LeRoux, P.D. (2012): Brain lactate metabolism in humans with subarachnoid hemorrhage. *Stroke*, 43:1418-1421.
 33. Oddo, M., Nduom, E., Frangos, S., MacKenzie, L., Chen, I., Maloney-Wilensky, E., LeRoux, P.D. (2010): Acute lung injury is an independent risk factor for brain hypoxia after severe traumatic brain injury. *Neurosurgery*, 67:338-344.
 34. Oddo, M., Villa, F., Citerio, G. (2012): Brain multimodality monitoring: an update. *Curr Opin Crit Care*, 18:111-118.
 35. Olson, D.M., Lewis, L.S., Bader, M.K. (2013): Significant practice pattern variations associated with intracranial pressure monitoring. *J Neurosci Nurs.*; 45 (4):186-193.
 36. Olson, D.M., McNett, M.M., Lewis, L.S., Riemen, K.E., Bautista, C., & Bader M.K. (2013): Effects of Nursing Interventions on Intracranial Pressure. *AJCC AMERICAN JOURNAL OF CRITICAL CARE*, 22 (5), 431-437. American Association of Critical-Care Nursedoi:<http://dx.doi.org/10.4037/ajcc2013xxx>.
 37. Pellico, L.H. (2013): Focus on adult health medical surgical nursing, London, Lippincott Williams and Wilkins, pp. 1184-1200.
 38. Potter, P.A., Perry, A.G., Stockert, P.A. & Hall, A. (2011): Basic Nursing. (7th ed.) Canda, Mosby Com., p. 1163.
 39. Ramont, R., Niedringhaus, D. & Towel, M. (2012): Comprehensive nursing care (2nd ed.), New Jersey, Person co., p. 1110-1112, 1659.
 40. Redpath, S. J., Williams, W. H., and Hanna, D: (2010). Healthcare professionals' attitudes towards traumatic brain injury (TBI): The influence of profession, experience, aetiology and blame on prejudice towards survivors of brain injury. Volume 24, 802-811.
 41. Slazinski, T., Anderson, T. A., Cattell, E., Eigsti, J. E., Heimsoth, S., Holleman, J. I., & Zakrzewski, P. (2011): Care of the patient undergoing intracranial pressure monitoring/external ventricular drainage or lumbar drainage. In H. J. Thompson, *AANN Clinical Practice Guideline Series*. Glenview, IL: American Association of Neuroscience Nurses.
 42. Smeltzer, S.C., Bare, B.G., Hinkle, J.L. and Cheever, K.H. (2010): Text book of Medical Surgical Nursing, (12th ed.). New York: Lippincott Williams & Wilkins. 1864-1876.

43. Szabo, C. M. (2011): The effect of oral care on intracranial pressure: A review of the literature. *Journal of Neuroscience Nursing*, 43: 1-9. doi:10.1097/JNN.0b013e318227f1e5.
44. Szabo, C., & Munro, C. L. (2011): Oral care practices of neuroscience nurses. *Southern Online Journal of Nursing Research*, 11(2). Retrieved from http://www.resourcecenter.net/images/SNR_S/Files/2011/AnnMtg/AbstractProceedings/start.html.
45. Szabo, C.M., Grap, M.J., Munro, C.L., Starkweather, A. & Merchant, R.E. (2014): The Effect of Oral Care on Intracranial Pressure in Critically Ill Adults. *American Association of Neuroscience Nurses*, 46(6), 26-32.
46. Tume, L.N., Baines, P.B. & Lisboa, P.J. (2011): effect of nursing interventions on the intracranial pressure in paediatric traumatic brain injury Nursing in Critical Care, *British Association of Critical Care Nurses*, 16(2), 86-94.
47. Ugras, G. A. (2014): Factors Affecting Intracranial Pressure and Nursing Interventions. *J Nurs Care.*, 1(1), 3. nursingcare.jacobspublishers.com.
48. Usraz, G. A., & Aksoy, G. (2012): The effects of open and closed endotracheal suctioning on intracranial pressure and cerebral perfusion pressure: A crossover, single-blind clinical trial. *Journal of Neuroscience Nursing*, 44(6), 41-48.
49. Zomorodi, M. (2011): Nursing management acute intracranial problems. In *Medical Surgical Nursing Assessment and Management of Clinical Problems*. (8th ed.). Edited by Lewis SL, Dirksen SR, Heitkemper MM, Bucher L, Camera IM. St. Louis: Elsevier Mosby., 1425-1458.