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Research paper

Role of the nurse in preventing or reducing increase intracranial pressure following craniotomy

Rasha Ali Ahmed Abdelmowla [1]*, Abdelhakeem Essa [2], Esmat Sayed Abdelmaged [1]

[1]Department of Medical Surgical Nursing, Faculty of Nursing, Assiut University, Egypt
[2]Department of Neurosurgery, Faculty of Medicine, Assiut University, Egypt
**Corresponding author E-mail:rashaali249@yahoo.com*

Abstract

Background: Increase intracranial pressure following craniotomy is common and different measures should be taken to prevent or treat it promptly. **Aim**: Preventing or reducing increase intracranial pressure following craniotomy. **Research design**: Quasi-experimental. **Subjects and methods**: All nurses (26) in neurosurgery department at Assiut Neurological, Psychiatric and Neurosurgery University Hospital, in addition to a sample of 124 patients after craniotomy. Control group (62 adult patients before implementing the nursing educational program) and study group (62 adult patients after implementing the nursing educational program). Nurses' knowledge and practice were assessed before and after implementation of the nursing educational program. Tools: Structured questionnaire to assess nurses` demographic data and knowledge about intracranial pressure, observation checklist for nurses` practice, patients' assessment sheet, and teaching booklet for nurses about postoperative increase intracranial pressure. **Results**: Highly significant differences were found as regarding nurses` knowledge and nurses` practice pre and post implementing the nursing educational program. Significant difference was found between study and control groups as regarding increase intracranial pressure following craniotomy. **Conclusion**: Nursing educational program had a significant effect on preventing or reducing postoperative increase intracranial pressure. **Recommendation**: Nurses should have continuous education through programs, workshops, seminars and/or training courses to maintain high quality care.

Keywords: *Craniotomy, Increase Intracranial Pressure, Nursing Educational Program.*

1. Introduction

Craniotomy is a surgical approach to treat brain lesion that involves removing a flap of skull bone and surgically opening the dura matter to gain access to the brain tissue. Some patients following craniotomy at high risk for an increase intracranial pressure (Stannard and Krenzischek 2012). In normal adult, the skull is a rigid bony structure and contains brain, cerebrospinal fluid, and blood. The intracranial contents account for about 80% brain, 10% blood, and 10% cerebrospinal fluid. Expansion of any of these compartments or the addition of a space occupying lesion can lead to intracranial pressure elevation (March and Hickey 2014).

Raised intracranial pressure following craniotomy is likely to be caused by postoperative hematoma formation, cerebral edema or postoperative hydrocephalus (Roytowski and Figaji 2013). Patients must be assessed for signs and symptoms of an increase intracranial pressure which included the following: change level of consciousness, headache, vomiting, restlessness, irritability, increase blood pressure, visual disturbances, and/or irregular breathing (Sadoughi et al. 2013).

Risk factors for the postoperative increase intracranial pressure may include the following: hypercarbia, hypoxemia, improper positioning, factors increasing cerebral metabolism such as seizures and hyperthermia, suctioning, pain, noxious stimuli, valsalva maneuver such as vomiting, constipation, coughing and straining, and/or clustering of nursing activities within the same time period (Ugras and Yuksel 2015).

Increase intracranial pressure following craniotomy can be detected through neurological assessment. Clinical manifestations and computed tomography may be necessary to confirm the diagnosis. Furthermore, lumbar puncture may be used to observe the pressure of cerebrospinal fluid (Zomorodi 2011).

There are many postoperative nursing and medical measures can be used to prevent or reduce increased intracranial pressure following craniotomy. The head of the bed should be raised 30-40 degree to aid venous drainage from the head. Careful positioning for patients; the chin and sternum are aligned. Shoulders should be aligned with the patients` ears (Brain Trauma Foundation 2007).

Chest physiotherapy, coughing and deep tracheal suctioning are activities, which greatly increase intracranial pressure thus they should only be performed when necessary and not for long periods. By pacing the nursing activities to reduce the number of times that the patients are stimulated. Constipation and hyperthermia should be prevented as possible. Pain should be treated because this can contribute to patients` unease and increase both blood pressure and intracranial pressure (Ugras and Yuksel 2015).

Craniotomy patients` require a good oxygen supply and sufficient carbon dioxide to stimulate respiration without increase vasodilatation. Care should be taken to protect patients from

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anxiety. Adequate analgesia and sedation reduce agitation, valsalva and metabolic demand. Administer prescribed anticonvulsants if there is a risk of seizures (Ugras and Yuksel 2015).

The nurse should be familiar with changes and trends providing early recognition of increased intracranial pressure. Nurse should administer prescribed medication such as mannitol to reduce postoperative increased intracranial pressure. Postoperative increased intracranial pressure caused by postoperative hematoma formation or postoperative hydrocephalus usually treated surgically to relieve the cause. It is necessary to nurses to have knowledge regarding preoperative and postoperative patients' status. Careful assessment by the nurse allows prevention and early recognition of postoperative increased intracranial pressure (Jaddoua 2014).

1.1. Aims

1.1.1. General objective

Evaluate the effect of implementing the nursing educational program on preventing or reducing increase intracranial pressure following craniotomy.

1.1.2. Specific objectives

1) Identify risk factors for increase intracranial pressure following craniotomy.
2) Prevent, reduce or early recognition of increase intracranial pressure following craniotomy.

1.2. Research hypothesis

Nursing role will be more efficient in preventing, reducing, or early recognition of increase intracranial pressure following craniotomy after implementing the nursing educational program.

2. Subjects and methods

2.1. Research design

Quasi- experimental.

2.2. Sample and setting

All available nurses (26) working in neurosurgery department at Assiut Neurological, Psychiatric and Neurosurgery University Hospital were included in the study, in addition to a sample of 124 patients following craniotomy from both sexes; their age ranged from 18- 65 years through a period of 6 months. Control group (62 adult patients before implementing the nursing educational program) and study group (62 adult patients after implementing the nursing educational program). Unconscious patients and patients with previous cranial or sphenoid surgeries were excluded.

2.3. Tools

2.3.1. Tool I: Structured pre/posttest questionnaire for nurses

It was developed by the researchers after reviewing extensive literatures to assess some selected demographic data in addition to nurses` knowledge about postoperative increase intracranial pressure. Twenty five multiple-choice questions were included to assess their knowledge about an increase intracranial pressure which concerned with definition of craniotomy and intracranial pressure, causes, risk factors, clinical manifestations, complications and nursing role to prevent or reduce postoperative increase intracranial pressure. One degree was given for each correct answer. Total score was 25. A score of <50% was considered unsatisfactory and ≥50% was considered satisfactory.

2.3.2. Tool II: Observation checklist for nurses:

It was developed by the researchers after reviewing extensive literatures. It included 20 items used to investigate nurses' role in preventing and management of postoperative increase intracranial pressure. Three point scale ranged from 1 to 3 used to assess their practice, 3 = done correctly, 2 = done incorrectly, and 1 = not done. Practice items included risk assessment, maintaining adequate oxygenation, appropriate head and body positioning, minimizing noxious stimuli, nursing interventions to minimize valsalva maneuver, minimizing or preventing conditions associated with increased cerebral metabolism and management of educational program for nurses. Adequate level of practice was considered at score of ≥75%.

2.3.3. Tool III: Patients` assessment sheet

It was developed by the researchers after reviewing current literatures to assess demographic data for patients, causes, risk factors, clinical manifestations, and complications of postoperative increase intracranial pressure, level of consciousness (Glasgow coma scale) and patients` prognosis.

2.3.4. Nursing educational program for nurses caring for patients following craniotomy (teaching booklet)

It was planned to cover knowledge and practice in order to prevent or reduce postoperative increase intracranial pressure following craniotomy. It was developed by the researchers after reviewing current literatures and the content of the program was translated into Arabic language.

Nursing educational program covered knowledge about definition of intracranial pressure and craniotomy, causes and risk factors of postoperative increase intracranial pressure, clinical manifestations, diagnosis and complications of increase intracranial pressure and prevention or early detection and management of postoperative increase intracranial pressure (adequate patients` oxygenation, assess level of consciousness (Glasgow coma scale), appropriate head and body positioning, minimizing noxious stimuli, nursing interventions to minimize valsalva maneuver, minimize or prevent conditions associated with increase cerebral metabolism and by pacing nursing activities).

2.4. Methods

Official permission was obtained from the head of neurosurgery department and local ethical committee. Informed consent was obtained from each subject after explanation to the nature of the study. Content validity was done by 5 expertise; 3 expertise from medical-surgical nursing staff and 2 from neurosurgery staff. Content is valid and reliable. Reliability was assessed by correlation coefficient (0.8).

Pilot study was conducted on 10% of study sample in neurosurgery department at Assiut Neurological, Psychiatric and Neurosurgery University Hospital for testing clarity, applicability, and feasibility of study tools. No changes were done to study tools, so the 10% of study sample was included in this study.

The researchers explain nature and purpose of this study. Nurses were asked to fill out the structured pre/post test questionnaire (tool I) to assess their knowledge before implementing the nursing educational program. The researchers fill out the observation checklist to assess nurses` practice before implementing the nursing educational program (tool II). Scheduled with nurses the teaching sessions, nurses were divided into small groups (each group 2 - 3 nurses). Each group of nurses

was choosing the optimal time for receiving the teaching sessions when they have minimal workload.

Each group of nurses received 4 sessions. The duration of each session was 40 minutes, including 20-30 minutes for discussion. Teaching booklet was introduced to each nurse. Reinforcement of teaching was performed according to nurses` needs to ensure understanding. Nurses` knowledge and practice were assessed immediately after implementing the nursing educational program and for a period of 3 months which was the time of data collection for study group patients, nurses were asked to fill out (tool I) to assess their knowledge and the researchers fill out (tool II) to assess their practice to evaluate the effect of the nursing educational program on nurses` knowledge and practice.

For patients, the researchers collected data throughout two phases of assessment (tool III). First phase of assessment was collected before conducting the nursing educational program (control group) and second phase of assessment was collected after implementing the nursing educational program (study group) to evaluate the effect of the conducted educational program to nurses` on preventing or minimizing postoperative increase intracranial pressure for patients following craniotomy.

Statistical analysis

SPSS 18.0 was used for statistical analysis of the collected data, t-test used to analyze quantitative data, and Pearson chi square test used to analyze qualitative data. Statistical significance was considered at p-value ≤ 0.05

3. Results

Table (1): Mean age of nurses was (31.42± 12.56). Females were the majority (88.46 %). Majority of nurses (88.46%) were having diploma degree and majority of them (73.07%) were having more than 10 years of experience.

Figure (1): Demonstrated highly statistical significant difference between nurses` knowledge about care of patients following craniotomy to prevent or reduce increase intracranial pressure pre and post implementing the nursing educational program. All nurses in neurosurgery department were having satisfactory level of knowledge (100%) post implementing the nursing educational program.

Figure (2): Demonstrated highly statistical significant difference between nurses` practice pre and post implementing the nursing educational program. The majority of nurses (88.46%) were having adequate level of practice post implementing the nursing educational program.

Table (2): More than half of patients in study and control groups were males with mean age (39.2±16.5 and 37.5±18.6 respectively) and majority of them were married.

Table (3): Highly statistical significant difference between study and control groups related to risk factors for increase intracranial pressure following craniotomy. The majority of patients in control group were having improper positioning following craniotomy (prone position without elevating head of the bed 30 degree) and nursing activities clustering within the same time period (83.87% and 87.09% respectively).

Table (4): There was no statistical significant difference (P=0.142) between study and control groups as regarding Glasgow coma scale with a mean value of (13.57±2.53) pre and (14.36±1.21) post implementing the nursing educational program.

Table (5): There was significant difference between both groups as regarding increased intracranial pressure following craniotomy $p < 0.01$. Cerebral edema was the main cause for postoperative increase intracranial pressure. Hundred percent of study group showed early improvement while in control group (29.16%) showed early improvement, (50%) showed delayed improvement and (20.83%) showed clinical deterioration.

Table (6): There was highly statistical significant relation between risk factors for increase intracranial pressure and increased intracranial pressure following craniotomy.

Table 1: Frequency Distribution of Demographic Characteristics for Nurses

Characteristics	No.(n=26)	%	X± S.D
Age:			
17 < 20years	3	11.5	
20 < 40 years	21	80.76	31.42± 11.56
> 40 years	2	7.69	
Sex:			
Male	5	19.23	
Female	21	80.76	
Education:			
Diploma degree	23	88.46	
Bachelor degree	3	11.53	
Nurses` years of experience:			
1 <5	4	15.38	
5 <10	3	11.5	
≥10	19	73.07	

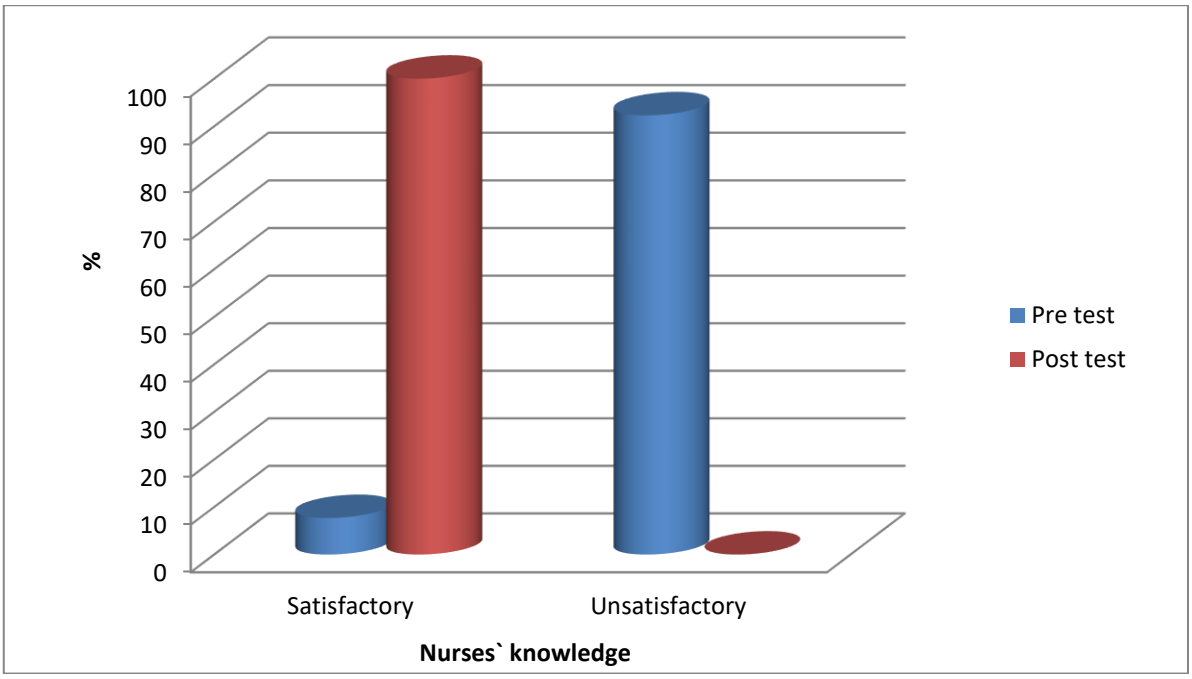


Fig. 1: Nurses` Knowledge Pre and Post Implementing the Nursing Educational Program.

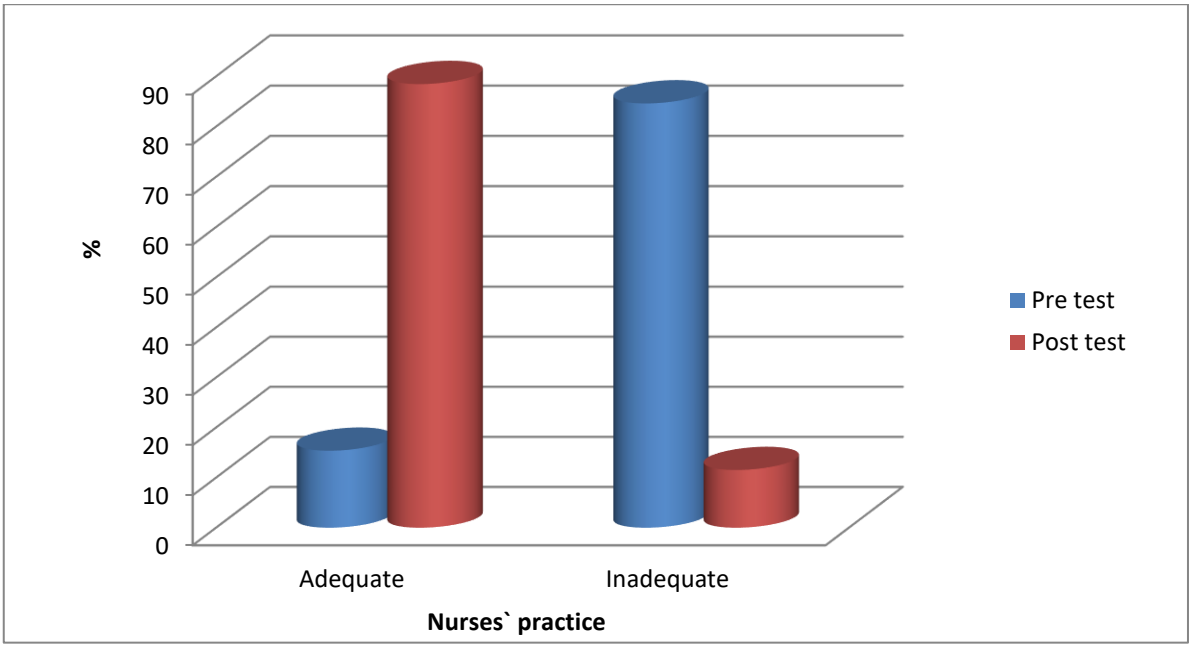


Fig. 2: Nurses` Practice Pre and Post Implementing the Nursing Educational Program.

Table 2: Demographic Characteristics of Patients Following Craniotomy

Characteristics	Control group (n =62)			Study group (n =62)		
	No.	%	X ± SD	No.	%	X ± SD
Age:						
18 < 35 years	19	4.1	39.2± 16.5	18	2.7	37.5± 18.6
35 < 50 years	37	13.7		34	17.8	
50-65 years	6	82.2		10	79.45	
Sex:						
Male	39	62.90		42	67.74	
Female	23	37.09		20	32.25	
Marital status:						
Single	6	9.67		11	17.74	
Married	56	90.32		51	82.25	

Table 3: Risk Factors for Increase Intracranial Pressure Following Craniotomy

Risk factors (More than one)	Control group (n =62)		Study group (n =62)		P-value
	No.	%	No.	%	
Hypercarbia	3	4.83	1	1.6	
Prone position without elevating head of the bed 30 degree	54	87.09	-	-	
Hypoxemia	2	3.22	2	3.22	
Suctioning	8	12.9	9	14.5	
Valsalva maneuver:					
Vomiting	11	17.74	8	12.9	P<0.0001***
Coughing and straining	8	12.9	10	16.12	
Constipation	7	11.29	3	4.8	
Noxious stimuli (lumbar puncture)	4	6.45	3	4.83	
Factors increasing cerebral metabolism:					
Seizures	15	24.19	19	30.64	
Hyperthermia	13	20.96	17	27.41	
Clustering of nursing activities within the same time period	52	83.87	4	6.45	

Table 4: Glasgow Coma Scale for Patients Following Craniotomy

Item	Control group (n = 62)	Study group (n = 62)	P- value
	X ±SD	X ±SD	
Glasgow coma scale	13.57±2.53	14.36±1.21	P= 0.142

Table 5: Increased Intracranial Pressure for Patients Following Craniotomy

Items	Control group (n =62)		Study group (n =62)		P-value
	No.	%	No.	%	
Increase intracranial pressure following craniotomy:					
Yes	24	38.7	3	4.8	
No	38	61.29	59	95.16	
Patients with increased intracranial pressure following craniotomy:	**Control group (n =24)**		**Study group (n =3)**		P<0.01*
- Causes of postoperative increase intracranial pressure: (More than one)	**No.**	**%**	**No.**	**%**	
Hematoma	11	45.8	3	100	
Cerebral edema	24	100	3	100	
Postoperative hydrocephalus	2	8.3	-	-	
Central nervous system infection	-	-	-	-	
- Clinical manifestations of increase intracranial pressure: (More than one)					
Confusion as pressure worsens	24	100	3	100	
Headache	24	100	3	100	
Vomiting	9	37.5	3	100	
Double vision	6	25	1	33.33	
Elevation of blood pressure	12	50	3	100	
Papilledema	3	12.5	-	-	
Restlessness and irritability	13	54.16	1	33.33	
Shallow breathing	4	16.66	1	33.33	
Pupils that don't respond to changes in light	2	8.3	-	-	
- Complications of increase intracranial pressure:					
Seizures	15	62.5	3	100	
Loss of vision	1	4.16	-	-	
Brain herniation	1	4.16	-	-	
- Medical management	22	91.66	3	100	
- Surgical intervention	5	20.83	-	-	
- Patients` prognosis:					
Early improvement	7	29.16	3	100	
Delayed improvement	12	50	-	-	
Deterioration	5	20.83	-	-	

Table 6: Relationship between Risk Factors for Increase Intracranial Pressure and Increased Intracranial Pressure Following Craniotomy

Risk factors for increased intracranial pressure (More than one)	Increased intracranial pressure following craniotomy				P-value
	Control group (n =24)		Study group (n =3)		
	No.	%	No.	%	
Hypercarbia	3	12.5	-	-	
Prone position without elevating head of the bed 30 degree	24	100	-	-	
Hypoxemia	2	8.3	-	-	
Suction	8	33.33	2	66.66	
Valsalva maneuver:					
Vomiting	11	45.83	3	100	P<0.0001***
Coughing and straining	8	33.33	3	100	
Constipation	7	29.16	1	33.33	
Noxious stimuli (lumbar puncture)	4	16.66	3	100	
Factors increasing cerebral metabolism:					
Seizures	9	37.5	1	33.33	
Hyperthermia	6	25	3	100	
Clustering of nursing activities within the same time period	24	100	3	100	

4. Discussion

Increase intracranial pressure is a serious complication in neurosurgery. Prompt diagnosis and careful monitoring and therapy of this problem are essential for successful management (Sadoughi et al. 2013).

This study showed that the majority of nurses were aged from 20 < 40 years and the majority of them were females.
This study revealed that majority of nurses had unsatisfactory level of knowledge about care of patients following craniotomy to prevent or reduce increase intracranial pressure before implementing the nursing educational program. This could be due to those courses in their undergraduate curriculum concerning neurosurgery nearly absent.

Nurses said that their knowledge was gained while working with patients in neurosurgery department. Also this may be due to lack of continuous education and absence of workshops, seminars and/or training programs.
This similar to the study of (Jaddoua 2014) who reported that nurses` knowledge concerning Glasgow coma scale was inadequate.

Nurses should have a solid foundation of knowledge and develop a positive attitude towards to assess patients' conditions and to deliver individualized care to each one (Al-Shaer et al. 2011).

After implementation of the nursing educational program nurses` knowledge was significantly improved. This might be due to all nurses in all age group have a strong desire to learn new knowledge.

Science of neurosurgery nursing requires advanced knowledge and practice to provide high quality care for patients who have experience cranial surgery (Yildiz et al. 2014).

There was inadequate level of nurses` practice caring for patients following craniotomy before implementation of the nursing educational program.

All nurses in neurosurgery department didn't perform adequate assessment and care for patients following craniotomy. This might be due to that neurosurgery nurses didn't have enough information regarding care of patients following craniotomy and measures taken to prevent or reduce increase intracranial pressure.

Adequate level of nurses` practice was observed after implementation of the nursing educational program. Skills can improve easily, especially if linked with relevant scientific base of knowledge.

Obvious improvement in nurse`s knowledge and practice was observed after attendance of continuous nursing educational sessions (Youssef 2007).

Undergraduate nursing programs prepare generalists rather than specialists. The mandate for competency and quality care coupled with knowledge explosion supports differentiated and specialty practice for the foreseeable future. Nurses can be taught the principles of critical thinking in undergraduate programs and through graduate and continued educational programs, but these skills are honed in clinical practice. Neuroscience nursing specialty practice is set within the context general professional nursing practice. Nurses engaged in neuroscience nursing must be competent in general practice before engaging in specialty practice. Specialty practice builds on the knowledge of basic nursing science and then adds the in-depth knowledge and competencies required to provide specialized care to neuroscience patients (Hickey 2013).

In the present study more than half of patients in study and control groups were males with mean age (39.2± 16.5 and 37.5± 18.6 respectively).

Intracranial surgeries are more common in males than females with mean age of 47 years old (Bin-Madhi 2012).

Risk factors and complications of increased intracranial pressure following craniotomy are common in control group. Majority of patients in control group were having improper positioning following craniotomy (prone position without elevating the head of the bed 30 degrees) and clustering nursing activities within the same time period.

This due to the effect of the nursing educational program (improvement of nurses` knowledge and practice).

Certain risk factors can be prevented by proper nursing management such as proper positioning, do not clustering nursing activities within the same time, adequate oxygenation, prevent constipation, prevent hyperthermia, proper suctioning, reduce pain, perform neurological assessment and early recognition for signs and symptoms of increase intracranial pressure (Hickey and Olson 2009).

There was significant relation between risk factors for increased intracranial pressure and the occurrence of increased intracranial pressure following craniotomy. More than one-third of control group patients were having clinical manifestations of increased intracranial pressure following craniotomy. Postoperative cerebral edema, hematoma formation and hydrocephalus were found to be the causes of increased intracranial pressure following craniotomy. All patients with increased intracranial pressure following craniotomy were initially suffered from confusion as the pressure worsens, headache and papilledema.

All patients with increased intracranial pressure following craniotomy in study group showed early clinical improvement while less than one-third of patients with increased intracranial pressure following craniotomy in control group showed early clinical improvement, half of them showed delayed clinical improvement and less than one-third showed clinical deterioration and require surgical intervention to relieve hematoma.

This obviously showed the effect of the nursing educational program; improving nurses` knowledge and practice had a positive effect on preventing or reducing increased intracranial pressure following craniotomy.

Nurses must closely monitor neurosurgery patients who may be at risk for increase intracranial pressure. This allows nurses to recognize any changes promptly and therefore, enhance patients' prognosis by early interventions. Nurses should be alert to signs and symptoms of increase intracranial pressure which can be detected through regular neurological assessment for patients (Layon et al. 2013).

5. Conclusion and recommendations

Nurses` knowledge and practice can be improved through educational program, continued education and follow up and this will be reflected on enhancing patients` outcomes; prevent or reduce increase intracranial pressure and promote early improvement. Neurosurgery educational programs must be developed and shared nationally. Nurses must be certified in neurosurgery nursing practice to demonstrate high level of knowledge and commitment to patients care. Neurosurgery nurses must be prepared for the increased and intense complexity of the future and actively participate in the redesign of the new health care system.

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