

Impact of a Nursing Educational Program on the Expected Post Operative Outcomes of Patients Undergoing Brain Surgeries

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Abstract

One of the most critical surgeries performed on the human body is brain surgery. **Objective:** Determine the impact of a nursing educational program on the expected post operative outcomes of patients undergoing brain surgeries. **Setting:** The study was conducted in the Neurosurgery Inpatient and Outpatient Clinics including Oncology Clinics of Alexandria Main University Hospital, Egypt. **Subjects:** A convenience sample of 70 adult male and female patients undergoing brain surgery was included in the study and all nurses providing direct care for patients undergoing brain surgeries, their number was a total of 24 nurses. **Tools:** Five Tools were used for data collection; Tool I: Brain surgery patients' assessment sheet, Tool II: Postoperative brain surgery patients' expected outcomes, Tool III: Nurses knowledge assessment questionnaire, Tool IV: Nurses' performance observation checklist for patients undergoing brain surgeries, Tool V: The nursing educational program for patients undergoing brain surgeries. **Results:** The study subjects had positive outcomes after implementation of the nursing educational program, more than half of the studied patients achieved satisfaction toward provided nursing care, the knowledge and the performance began to be satisfactory by all nurses caring for the study subjects after application of the nursing educational program. **Conclusion:** The study concluded that the majority of patients had positive outcomes after the application of the nursing educational program, there were a statistical significant differences between nurses' knowledge and skills before and after application of the nursing educational program. **Recommendations:** The developed educational program should be given to all patients undergoing brain surgery, and pre-service training program should be provided to the newly appointed nurses

Keywords: Nursing educational program; Expected post operative outcomes; Brain surgeries.

Introduction

Brain surgery is a critical and complicated process. The type of brain surgery done depends highly on the condition being treated. There is a wide range of neurosurgical techniques that has been developed (burr holes, craniotomy and craniectomy) to treat patients with brain disorders⁽¹⁾.

The postoperative period is the weakest and the most vulnerable phase of a patient's life. The neurosurgical brain

procedures are relatively frequent in the daily practice and a wide range of neurosurgical techniques has been developed (burr holes, craniotomy and craniectomy) to treat patients with brain disorders⁽²⁾.

Educational programs for brain surgeries are considered an important step-toward assuring quality of nursing care. Its focus is to provide a framework within which the multiple activities of nursing care are performed and the needs are to be determined. A very commonly used framework for organizing an educational

program is the structure, process and outcome attributes in evaluating quality of care. It provide guidelines used to determine what a nurse should or should not do⁽³⁾.

An informed and educated patient can actively participate in his or her own treatment, improve outcomes, help identify errors before they occur, and reduce his or her length of stay in the hospital⁽³⁾.

Complications after brain surgery may include intracranial bleeding, cerebral edema, further neurological impairment, behavioral changes, electrolyte imbalance, infection, seizures, venous thrombosis or hydrocephalus. Hemorrhage at the operative site can occur within hours after surgery. Bleeding may occur in the subdural or subarachnoid space or within the ventricles or at the bed of the lesion⁽⁴⁾.

Postoperative care after brain surgery might not end soon in some cases; it could last for months or even years⁽⁵⁾. The desired positive outcomes of brain surgery patients include absence or decreased post operative complications, good neurological status, the ability of the care givers to deal with post operative seizures, stability of vital signs, stability of laboratory investigations, reduction of anxiety level, improvement in patients' satisfaction and absence of patient problems⁽⁶⁾.

Aim of the Study

The present study aim is to determine the impact of a nursing educational program on the expected post operative outcomes of patients undergoing brain surgeries.

Research Hypothesis

Nurses caring patients undergoing brain surgeries who will receive the nursing educational program demonstrate better knowledge after implementation of the educational program, than before, also nurses caring for patients undergoing brain surgeries who will receive the nursing educational program exhibit better performance after implementation of the

educational program, than before and patients undergoing brain surgeries and cared for by nurses, who will receive the nursing educational program exhibit better outcomes than those who receive routine hospital nursing interventions.

Materials and Method

Materials

Design: A quasi experimental research design was utilized to achieve the aim of this study.

Setting: The study was conducted in the Neurosurgery inpatient and outpatient clinics including oncology clinics of Alexandria Main University Hospital, Egypt.

Subjects: Subjects of the study comprised two groups, seventy adult male and female patients undergoing brain surgery aged from 21 to less than 65 years, able to communicate verbally, alert and able to follow instructions, free of associating illnesses, admitted at least one day prior to surgery and willing to participate. Another group of nurses providing direct care for patients undergoing brain surgeries throughout the period of data collection, were recruited. Their number was a total of 24 nurses.

Tools: Five tools were used to collect the necessary data:

Tool I: Brain Surgery Patients' Health Status Assessment

This tool was developed based a thorough review of related literature to assess the brain surgery patients' health status. It consists of five parts as follows: Part I: Socio-demographic characteristics of patients. Part II: Patients' clinical data. Part III. Neurological assessment. Part IV. Laboratory investigations. Part V. Brain surgeries patients' headache assessment.

Tool II: Postoperative Brain Surgery Patients' Expected Outcomes Assessment

This tool contained two parts, Part I: includes an assessment of the postoperative brain surgery patients' expected outcomes. Every achieved expected outcome was scored as one. The total score for each patient was calculated then converted to percentage as follows: "Negative outcomes" 50 -64% "Moderate level of positive outcomes" 65-84% and "positive outcomes" 85-100%. Part II: Postoperative brain surgery patients' satisfaction toward provided nursing interventions. This part was developed by Chunlaka (2011) It is composed of 20 items in the form of statements grouped into 5 dimensions namely assurance, empathy, reliability, responsiveness, and tangibility. Each dimension contains 4 statements. The total scores for every patient was calculated then converted to a percentage as follows: "Lowest level of satisfaction" 33-55%, "Moderate level of satisfaction" 55-77%, and "highest level of satisfaction" 77-100%.⁽⁷⁾.

Tool III: Nurses Knowledge Assessment Questionnaire

This tool included a group of open and closed ended questions about the meaning of brain surgery, pre and postoperative precautions, perioperative care and warning signs/complications to report the doctor, how to deal with seizure(s), knowledge related to prescribed medication, dietary measures as well as knowledge related to infection control measures. Each right answer was given one score. Those who obtained less than (60%) were considered having "unsatisfactory" level of knowledge. Above (60%) was considered having "satisfactory" level of knowledge.

Tool IV: Nurses' Performance Observation Checklist for Patients Undergoing Brain Surgeries

This tool is composed of a checklist of nurses activities provided for brain surgery assessment as care of wound site, care of wound drain, perioperative care, pain management measures, how to deal with

post operative seizures, infection control measures, providing health teaching for patient about life style modifications. The observations were checked by the researcher until, completion of all parts of the nurses' performance. Each practice involving sub nursing competencies were checked and scored as follows: "Done adequately" was scored as (2), "done in adequately" was scored as (1), or "not done" was scored as (0). The level of nurses practices performances were categorized as follows: Good practice: 75-100%, satisfactory practice: 50 <75%, poor practice: <50.

Tool V: The Nursing Educational Program for Patients Undergoing Brain Surgeries

Program contents covered the following areas: brief anatomy of the brain structure, definition and indications for brain surgery, various diagnostic procedures and patient preparation, benefits of surgical management and types of brain surgeries, neurological assessment systemic and neurosurgical postoperative complications after brain surgery, medical therapy after brain surgery and the nursing role, pursed lip breathing exercise, infection control measures and routine follow up and when it is necessary to seek medical.

Method

- The study protocol was approved by the Post graduate and Ethical Research committees, faculty of nursing and Alex University.
- An official letter from Alexandria University, Faculty of Nursing was submitted to the general directors of Main University Hospital and the head of the Neurosurgery Department.
- Reliability testing for the study tools was estimated using the Cronbach's Alpha test of the study tools. Results indicated that the tool I had Cronbach's Alpha coefficient of: 0.85. Tool II had Cronbach's Alpha coefficient of: 0.73. Tool III had

Cronbach's Alpha coefficient of: 0.77
Tool III had Cronbach's Alpha coefficient of: 0.891.

- A pilot study was conducted on 7 adult patients and four nurses.

- **The study was carried out on four phase:**

- **Assessment phase:**

The initial assessment was carried out 24 hrs preoperatively using the tools I and II for both group subjects patients. For nurses' assessment was carried out to assess their knowledge and performances regarding brain surgery patients' routine care, using tools III and IV, before application of the nursing educational. The subsequent assessment for the patients was done on discharge, one and three months postoperatively in order to evaluate the impact of the nursing educational program on post operative outcomes. Nurses were reassessed for knowledge using tool III and watched for their performances and clinical skills regarding brain surgery patients' care, using tools IV on the first day after discharge from ICU, and on discharge, as the third observation.

- **Planning phase:**

The nursing educational program contents were developed based on a review of related literature as well the assessment phase findings. Audiovisual materials (in the form of the program booklet was provided for the enrolled nurses

- **Implementation phase:**

The developed educational program was initially introduced individually for each nurse and the teaching sessions to cover the program content for both theory and practice were scheduled. These

nurses were divided, thereafter into small groups, 4 to 5 nurses, each.

- **Evaluation phase:**

This phase was carried out using study tools one and three months post discharge for patient.

'Nurses were evaluated using tools III and IV.

Ethical considerations:

Written consents of the enrolled patients and nurses to participate in the study were obtained, privacy was maintained and confidentiality was secured. Participant's right to be withdrawn at any time of the study was considered and respected.

Statistical Analysis

Data were analyzed using "SPSS" software version 20. Cronbach's alpha reliability test, was used to measure the reliability of the developed tools. Comparisons between both groups were carried out using Mann-Whitney U test for the quantitative variable while Chi-Square (χ^2) and Monte Carlo testes for qualitative variables. T-test was used to test association between two quantitative variables. Fisher's exact (FET) test was used for comparisons between the distributions of two qualitative variables.

Results

Table (1) shows that more than half of study and control groups (57.1%, 54.3%, respectively) were "males". Less than half of study and control subjects (42.9%) were aged between "40-50"years old. The majority the study and control group subjects i.e. 85.7%, 88.6, respectively were "married".

Table (2) shows that the majority of both study and control group subjects (77.1%, 68.6%, respectively) had brain tumors, all of the study and control group subjects (100%) were on "anticonvulsants, analgesics, antibiotics and steroids". Also the majority of the study and control subjects (82.9%,

85.7%, respectively) had craniotomy. Less than half of the two group subjects (34.28%, 28.57% of the study and their controls, respectively were "smoker".

Table (3) shows that all of the studied subjects (100%) reported that they initiated necessary "lifestyle changes" and the majority i.e. 94.3%, 97.1, respectively) reported that the "headache" was relieved. The same table shows that more than half of the study subjects (57.1%) demonstrated positive outcomes compared to their controls, none of them demonstrated positive outcomes and more than half of the control subjects (74.3 %) demonstrated negative outcomes. Statistical significant differences were revealed between the two group subjects regarding "postoperative expected outcomes" where $p < 0.001^*$.

Table (4) shows that (100.0%) of the studied patients demonstrate the lowest level of satisfaction before the application of the nursing educational program compared with three months later, where (82.9%) of the studied subjects indicated "highest level of satisfaction". Statistical significant differences between the study and control subjects were elicited where ($P < 0.001^*$).

Table (5) displays that more than half of nurses caring for the study subjects i.e. 66.7% were in the age group of "30>45" years old. All nurses caring for the study and control subjects (100%). were currently married and their experiences more than six years. The majority of nurses caring for the study subjects (91.6%) were diploma graduates. Almost all of the nurses caring for the study and control subjects (91.7%) had no "previous attendance of training programs" related to brain surgery.

Table (6) shows that the overall knowledge of the nurses caring for the study subjects preoperatively was "unsatisfactory" i.e. 91.7% which began to improve to be "satisfactory" by 100% after application of the nursing educational program, compared with their controls (83.3%) who had "unsatisfactory level of

knowledge" with routine nursing care. Statistical significant differences between the two groups where (p_2 and $p_3 = 0.001^*$).

Table (7) shows that more than the half of the nurses caring for the study subjects 66.7% had "poor" level of performances pre operatively, which improved to be "good" by (75%) after application of the nursing educational program, while caring for the controls were demonstrating "poor" level with routine nursing care.

Discussion

Ongoing educational programs are necessary for consistent promotion of self-management practices, controlling symptoms and prevention of complications. The findings of the current study revealed that more than half of study and control patients were males from 40-50 years old and the majority of them were married. These results agree with a study by Bin-Madhi, (2012) entitled as "Brain tumors excision guided by neuronavigation: Practical application and results" which revealed that brain surgery is more frequently undergone in males than females with a mean age of 47 years old⁽⁸⁾.

It was observed that the highest percentage of both study and control subjects were illiterate. Dankner (2009) reported that that the highest percentage of his study subjects who had neurological diseases were illiterate or had primary education⁽⁹⁾, the results revealed that the majority of both study and control subjects had been diagnosed with brain tumors. In this regard Amit (2019) reported that the indications for brain surgery include brain tumors, bleeding (hemorrhage) or blood clots (hematomas) from injuries⁽¹⁰⁾.

The results revealed that all of the study and control subjects (100%) were on anticonvulsants, analgesics, antibiotics and steroids. White et al. (2013) recommended that patients after brain surgery require a variety of medical treatment⁽¹¹⁾. The findings of the current study revealed that more than half of study and control subjects had

undergone craniotomy. Van de Beek et al (2010) stated that craniotomy is widely used in neuroscience for accessing brain tissue that must be removed⁽¹²⁾. Also many of both study and control subjects were found to have history of smoking. In this context, Mandelzweig et al. (2009) reported that smoking is a risk factor for brain tumors especially gliomas⁽¹³⁾.

The current study findings revealed that around one quarter of the study subjects had headache and visual disturbances. Urden et al., 2010 and Krucik, 2012 indicated that the more common clinical manifestations of brain tumors, brain abscess, subdural hematoma and cystic lesion within the intracranial cavity are headache, drowsiness, visual disturbances, changes of conscious level, seizures and motor deficit^(14,15). The study findings revealed that all the study and control subjects were conscious. No doubt, these post brain surgery patients were clinically improved due to the relieved pressure of the tumor, haematoma, abscess or cyst⁽¹⁶⁾.

The results of the present study revealed that the majority of both of the study and control subjects were normotensive and had no post operative vomiting nor nausea or myocardial infarction. Interestingly Buttaro (2013) demonstrated that unmanaged stress is linked hypertension and heart diseases after brain surgery⁽¹⁷⁾.

The findings of the present study revealed that the study and control subjects suffered from headache before surgery which improved throughout the follow up periods. Lindsay et al. (2004) reported that headache is an associating symptom of increased ICP due to compression of pain sensitive structures within the intracranial compartment and the most important factor that should be considered after brain surgery is avoiding of the straining factors that lead to increase of the ICP⁽¹⁸⁾.

Few of the current study group patients were found having seizures in the

preoperative phase. This patient number (4), was considerably lowered in the postoperative assessment following the nursing program instructions, could be probably be a factor for the formational study findings. According to Westcarth (2007) seizures are common brain tumor symptoms, occurring in (60%) of all brain tumor patients and they may be the first indication of brain tumor surgery and also the most common complications after intracranial surgery, so it should be avoided by follow the postoperative instructions that given from the nurses and the surgeon⁽¹⁹⁾.

The findings of the present study revealed that all studied patients (100%) initiated necessary lifestyle changes and most of them reported that headache was relieved and demonstrated stabilized vital signs as well as within normal laboratory studies. In this context, Spears (2005) reported that patient' outcomes were improved after application of educational programs for the nurses staff⁽²⁰⁾.

The present study results displayed that the highest percent of the studied nurses were Diploma of the Secondary School of Nursing graduates. These results were supported by Elreefay (2012) had similar findings⁽²¹⁾. Also the majority of nurses caring for both study and control subjects had not been enrolled in previous training programs related to brain surgery. Annette (2007) reported that in service training in nursing is considered as a necessary component to help professional nurse keep up to date on the most recent developments in nursing and to be able to manage the demands of nursing practice⁽²²⁾.

The current study revealed that, the most of studied nurses had unsatisfactory level of knowledge. Also there was a notable statistical significant difference between nurses' knowledge before and after receiving the nursing educational program. Aiken et al (2012) and Shrestha (2013) noted that negative patient outcomes often were due to lack of training and direction from one that is responsible of nursing services.^(23,24).

No Arabic source for updating and continuing nurses education were available. Also this may be attributed to lack of continuous education and absence of pre-service and training program.

The present results pointed out that, there were statistical positive significant differences in nurses' performance before and after receiving the nursing educational program. Ookalkar (2009) claimed that the in service training has a beneficial effect in improving the nurse's knowledge and skills. Those educational programs should be organized according to the needs of nurses with continuing evaluation⁽²⁵⁾.

Educational programs contributed to positive outcomes since nursing interventions for patients undergoing brain surgery can improve the health outcomes and reduce the risk of complications. It is important for nurses to meet the care needs of patients through education, support, supervision, and reinforcement.

Conclusion

Based on the findings of the present study, it can be concluded that the majority of patients had positive outcomes after the application of the nursing educational program.

Recommendations

• Recommendations for patients:

- The developed booklet should be available and distributed to all patients undergoing brain surgery in the study setting, and outpatient clinics.
- The developed educational program should be given to all patients undergoing brain surgery.

• Recommendations for nurses

- Pre-service training program should be provided to the newly appointed nurses before assuming independent

responsibilities for brain surgery's patients' care.

- Developed competencies handout about care for patient undergoing brain surgery should be available for all staff nurses that caring these patients.
- Reasonable nurse/patient ratio should be properly distributed in all shifts for maintaining good quality nursing care.

• Recommendations for the administrators:

- Administrative staff should plan for periodic patient teaching programs about brain disorders and its management as one of hospital policies, and procedures
- Preservice and inservice programs, for newly employed nurses about care needed for brain surgery patients, are needed.

• Further recommended researches

- Exploring the impact of educational programs for patients undergoing brain surgery on their quality of life
- Exploring the effect of implementing developed nursing rehabilitation programs for brain surgery's patients on their physical and psychological status.

Table (1): Frequency distribution of the study and control subjects according to their socio-demographic characteristics

Socio-demographic characteristics of patients	Study (n = 35)		Control (n = 35)		Test of Sig.	P
	No.	%	No.	%		
Sex						
Male	20	57.1	19	54.3	$\chi^2=$ 0.058	0.810
Female	15	42.9	16	45.7		
Age						
20 <30 years	5	14.3	4	11.4	$\chi^2=$ 0.302	MC p= 1.000
30 <40 years	6	17.1	7	20.0		
40 <50 years	15	42.9	15	42.9		
50 ≥ 60 years	9	25.7	9	25.7		
Level of education						
Illiterate	21	60.0	20	57.1	$\chi^2=$ 3.681	MC p= 0.470
Reads and writes	5	14.3	6	17.1		
Primary & Preparatory	5	14.3	2	5.7		
Secondary	2	5.7	6	17.1		
Higher education	2	5.7	1	2.9		
Marital status						
Single	5	14.3	4	11.4	$\chi^2=$ 0.128	FE p= 1.000
Married	30	85.7	31	88.6		
Occupation						
Professional work	4	11.4	5	14.3	$\chi^2=$ 0.372	MC p= 1.000
Manual work	11	31.4	10	28.6		
Housewife	13	37.1	12	34.3		
Pension	7	20.0	8	22.9		
Residence area						
Urban	15	42.9	13	37.1	$\chi^2=$ 0.238	0.626
Rural	20	57.1	22	62.9		

χ^2 : Chi square test

t: Student t-test

MC: Monte Carlo

FE: Fisher Exact

Table (2): Frequency distribution of the study and control subjects according to their clinical data

Patient's clinical data	Study (n = 35)		Control (n = 35)		χ^2	P
	No.	%	No.	%		
Diagnosis						
Brain tumor	27	77.1	24	68.6	$\chi^2 = 0.979$	^{MC} p= 0.875
Left parietal cystic lesion	4	11.4	6	17.1		
Sub-dural hematoma	2	5.7	3	8.6		
Obstructed hydrocephalus	2	5.7	2	5.7		
Previous neurological surgery						
No	34	97.1	32	91.4	$\chi^2 = 1.061$	^{FE} p= 0.303
Yes	1	2.9	3	8.6		
Family history of brain disease or brain surgery?						
No	34	97.1	32	91.4	1.061	^{FE} p=0.303
Yes	1	2.9	3	8.6		
Medical treatment after surgery						
Anticonvulsants	35	100.0	35	100.0	-	-
Analgesics	35	100.0	35	100.0	-	-
Antibiotics	35	100.0	35	100.0	-	-
steroids	35	100.0	35	100.0	-	-
Type of surgery						
Craniotomy	29	82.9	30	85.7	0.338	^{MC} p=1.000
Craniectomy	2	5.7	2	5.7		
Borehole	4	11.4	3	8.6		
Patient smoking habits						
smoker	12	34.28	10	28.57	0.057	0.811
not smoker	23	65.72	25	71.43		
Previous neurological problems						
Headache	10	28.6	18	51.4	3.810	0.051
Change in consciousness	1	2.9	2	5.7	0.348	^{FE} p=1.000
Visual disturbances	10	28.6	3	8.6	4.629*	0.031*
Dizziness	5	14.3	5	14.3	0.00	1.000
Seizures	3	8.6	5	14.3	0.565	^{FE} p=0.710
Radiological examination						
CT	6	17.1	5	14.3	0.108	0.743
MRI	29	82.9	30	85.7		

p: p value for comparing between the two studied groups

Table (3): Distribution of the study and control subjects according to postoperative patient's expected outcomes

Q	Postoperative patient's expected outcomes	Study subjects (n = 35)				Control subjects (n =35)				χ^2	p
		Not achieved		Achieved		Not achieved		Achieved			
		No.	%	No.	%	No.	%	No.	%		
1	Reports headache is relieved or decreased	2	5.7	33	94.3	22	62.9	13	37.1	25.362*	<0.001*
2	Patient and/or a family member report how to deal with patient if seizure occur	15	42.9	20	65.7	30	85.7	5	14.3	14.000*	<0.001*
3	Demonstrates use of therapeutic interventions (e.g., relaxation skills) to relieve pain	17	48.6	18	65.7	24	68.6	11	31.4	2.885	0.089
4	Demonstrates stabilized vital signs	1	2.9	34	97.1	8	22.9	27	77.1	40.238*	<0.001*
5	Demonstrates stabilized laboratory investigations	10	28.6	25	71.4	21	60.0	14	40.0	7.006*	0.008*
6	Verbalizes understanding of condition, prognosis	0	0.0	35	65.7	22	62.9	13	37.1	32.083*	<0.001*
8	List signs/symptoms requiring medical follow-up	1	2.9	34	65.7	8	22.9	27	77.1	6.248*	^{FE} p=0.028*
Initiate necessary lifestyle changes as											
9.1	Diet	0	0.0	35	100	25	71.4	10	28.6	38.889*	<0.001*
9.2	Exercises	0	0.0	35	100	23	65.7	12	34.3	34.255*	<0.001*
9.3	Smoking reduction	0	0.0	35	100	26	74.3	9	25.7	41.364*	<0.001*
10	Recognizes need for seeking assistance with some activity as his condition as needed	12	34.3	23	65.7	23	65.7	12	34.3	6.914*	0.009*
11	Demonstrates satisfaction with the educational program	11	31.4	24	68.57	26	74.3	9	25.7	12.899*	<0.001*
Postoperative patient's expected outcomes		No.		%		No.		%			
Negative outcomes" 50 -64%		10		28.6		26		74.3			
Moderate level of positive outcomes" 65-84%		5		14.3		9		25.7		28.254*	
Positive outcomes "85-100%		20		57.1		0		0.0			
Total score											
Min. – Max.		5.0 – 12.0				1.0 – 10.0					
Mean ± SD.		10.03 ± 2.42				4.09 ± 3.53					
% score										t=8.222*	
Min. – Max.		41.67 – 100.0				8.33 – 83.33				<0.001*	
Mean ± SD.		83.57 ± 20.16				34.05 ± 29.38					

*: Statistically significant at $p \leq 0.05$

Table (4): Study subjects satisfaction before and after implementation of nursing educational program (n = 35)

Study subjects items	Before implementation of nursing educational program						After implementation of nursing educational program						MH p
	Lowest level of satisfaction		Moderate level of satisfaction		Highest level of satisfaction		Lowest level of satisfaction		Moderate level of satisfaction		Highest level of satisfaction		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Assurance	33	94.3	2	5.7	0	0.0	0	0.0	10	28.6	25	71.4	<0.001*
Empathy	29	82.9	5	14.3	1	2.9	0	0.0	15	42.9	20	57.1	<0.001*
Reliability	28	80.0	7	20.0	0	0.0	0	0.0	10	28.6	25	71.4	<0.001*
Responsiveness	30	85.7	5	14.3	0	0.0	0	0.0	10	28.6	25	71.4	<0.001*
Tangibility	28	80.0	6	17.1	1	2.9	0	0.0	8	22.9	27	77.1	<0.001*
Overall satisfaction	35	100.0	0	0.0	0	0.0	0	0.0	6	17.1	29	82.9	<0.001*

MH: Marginal Homogeneity Test

p: p value for comparing between before and after in the study group

*: Statistically significant at $p \leq 0.05$

Table (5): Socio-demographic data of nurses caring for the study and control subjects

Nurse's Socio demographic data	Nurses caring for the study subjects (n = 12)		Nurses caring for the control subjects (n = 12)		χ^2	P
	No.	%	No.	%		
Age (years)						
20 >30	3	25.0	0	0.0	7.738*	MC p= 0.014*
30>45	8	66.7	12	100.0		
>45	1	8.3	0	0.0		
Educational qualification					2.274	FE p= 0.317
Bachelor	0	0.0	0	0.0		
Technical	1	8.4	0	0.0		
Diploma	11	91.6	12	100.0		
Other	0	0.0	0	0.0		
Years of experience (years)						
>1	0	0.0	0	0.0	-	-
1>3	0	0.0	0	0.0		
3>6	0	0.0	0	0.0		
>-6	12	100.0	12	100.0		
Social status						
Single	0	0.0	0	0.0	-	-
Married	12	100.0	12	100.0		
Divorce	0	0.0	0	0.0		
Widow	0	0.0	0	0.0		
Previous attendance of a training program						
No	11	91.7	11	91.7	1.043	FE p= 1.000
Yes	1	8.3	1	8.3		

χ^2 : Chi square test

MC: Monte Carlo

FE: Fisher Exact

p: p value for comparing between study and control group

*: Statistically significant at $p \leq 0.05$.

Table (6): Knowledge of nurses caring for the study and control subjects, pre-operatively, one month and three months after

Knowledge items	Nurses caring for the study subjects (n = 12)												Nurses caring for the control y subjects (n = 12)												χ^2 (^{FE} p ₁)	χ^2 (p ₂)	χ^2 (p ₃)
	Pre-operative				After one month				After three month				Pre-operative				After one month				After three month						
	Unsatisfactory		Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory		Satisfactory				
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%				
Knowledge related to brain anatomy and surgery	12	100.0	0	0.0	5	41.7	7	58.33	3	25.0	9	75.0	12	100.0	0	0.0	11	91.7	1	8.3	11	91.7	1	8.3	-	10.971 (^{FE} p 0.001 [*])	10.971 (^{FE} p 0.001 [*])
Knowledge related to postoperative precautions	11	91.7	1	8.3	2	16.7	10	83.3	2	16.7	10	83.3	10	83.3	2	16.7	10	83.3	2	16.7	10	83.3	2	16.7	0.381(^{McN} p 1.000)	10.667 [*] (^{FE} p 0.001 [*])	10.667 [*] (^{FE} p 0.001 [*])
Knowledge related to infection control measures	7	58.3	5	41.7	2	16.7	10	83.3	2	16.7	10	83.3	10	83.3	2	16.7	8	66.7	4	33.3	8	66.7	4	33.3	1.815(^{McN} p 0.371)	6.171 [*] (^{FE} p 0.013 [*])	6.171 [*] (^{FE} p 0.013 [*])
Knowledge related to warning signs	12	100.0	0	0.0	1	8.3	11	91.7	1	8.3	11	91.7	12	100.0	0	0.0	12	100.0	0	0.0	12	100.0	0	0.0	-	20.308 [*] (^{FE} p <0.001 [*])	20.308 [*] (^{FE} p <0.001 [*])
Knowledge related to dealing with seizures	11	91.7	1	8.3	4	33.3	8	66.7	4	33.3	8	66.7	11	91.7	1	8.3	11	91.7	1	8.3	11	91.7	1	8.3	0.000(^{McN} p 1.000)	8.711 [*] (^{FE} p=0.009 [*])	8.711 [*] (^{FE} p=0.009 [*])
Overall knowledge	11	91.7	1	8.3	0	0.0	12	100.0	0	0.0	12	100.0	12	100.0	0	0.0	10	83.3	2	16.7	10	83.3	2	16.7	1.043(^{FE} p 1.000)	17.143 [*] (^{FE} p <0.001 [*])	17.143 [*] (^{FE} p <0.001 [*])

χ^2 : Chi square test FE: Fisher Exact McN: McNemar test
 p₁: p value for comparing between the studied groups in before application of the program
 p₂: p value for comparing between the studied groups in after application of the program
 *: Statistically significant at p ≤ 0.05

Table (7): Comparisons between the two study nurses groups in relation to nurses' performance of patients undergoing brain surgeries, pre-operatively, one day after discharge from ICU and on discharge day

Nurses performances of patients undergoing brain surgery	Nurses caring for the study subjects (n = 12)									Nurses caring for the control subjects (n = 12)									$\chi^2(p_1)$	$\chi^2(p_2)$	$\chi^2(p_3)$	
	1 st observation			2 nd observation			3 rd observation			1 st observation			2 nd observation			3 rd observation						
	Poor	Fair	Good	Poor	Fair	Good	Poor	Fair	Good	Poor	Fair	Good	Poor	Fair	Good	Poor	Fair	Good				
Assessment the neurological status	No. %	12 100	0 0.0	0 0.0	5 41.7	4 33.3	3 25.0	4 33.3	3 25.0	5 41.7	12 100	0 0.0	0 0.0	12 100.0	0 0.0	0 0.0	12 100.0	0 0.0	0 0.0	-	9.117 [*] (^{FE} p=0.005 [*])	11.402 [*] (^{FE} p=0.002 [*])
Providing preoperative care	No. %	8 66.7	3 25.0	1 8.3	3 25.0	3 25.0	6 50.0	1 8.3	3 25.0	8 66.7	11 91.7	1 8.3	0 0.0	9 75.0	2 16.7	1 8.3	9 75.0	2 16.7	1 8.3	2.326 (^{FE} p=0.306)	6.571 [*] (^{FE} p=0.034 [*])	12.181 [*] (^{FE} p=0.002 [*])
Providing post-operative care	No. %	- -	- -	- -	4 33.3	2 16.7	6 50.0	1 8.3	2 16.7	9 75.0	- -	- -	- -	10 83.3	1 8.3	1 8.3	8 66.7	3 25.0	1 8.3	-	6.305 (^{MC} p=0.052)	12.181 [*] (^{MC} p=0.001 [*])
Care of wound incision	No. %	- -	- -	- -	1 8.3	3 25.0	8 66.7	0 0.0	1 8.3	11 91.7	- -	- -	- -	9 75.0	3 25.0	0 0.0	7 58.3	3 25.0	2 16.7	-	15.125 [*] (^{MC} p<0.001 [*])	14.512 [*] (^{MC} p<0.001 [*])
Care of wound drain	No. %	- -	- -	- -	0 0.0	2 16.7	10 83.3	0 0.0	1 8.3	11 91.7	- -	- -	- -	9 75.0	2 16.7	1 8.3	7 58.3	4 33.3	1 8.3	-	17.535 [*] (^{MC} p<0.001 [*])	17.667 [*] (^{MC} p<0.001 [*])
Applying infection control measures	No. %	5 41.7	1 8.3	6 50.0	2 16.7	2 16.7	8 66.7	0 0.0	2 16.7	10 83.33	8 66.7	0 0.0	4 33.3	7 58.3	1 8.3	4 33.3	6 50.0	1 8.3	5 41.7	2.014 (^{MC} p=0.422)	4.341 (^{MC} p=0.110)	8.085 [*] (^{MC} p=0.019 [*])
Hand washing	No. %	3 25.0	3 25.0	6 50.0	3 25.0	2 16.7	7 58.3	1 8.3	2 16.7	9 75.0	11 91.7	1 8.3	0 0.0	10 83.3	1 8.3	1 8.3	10 83.3	1 8.3	1 8.3	11.511 [*] (^{FE} p=0.001 [*])	8.484 [*] (^{FE} p=0.006 [*])	14.498 [*] (^{FE} p=0.001 [*])
Use of Personal protective equipment(PEE)	No. %	12 100.0	0 0.0	0 0.0	4 33.3	2 16.7	6 50.0	1 8.3	3 25.0	8 66.7	12 100.0	0 0.0	0 0.0	11 91.7	1 8.3	0 0.0	10 83.3	1 8.3	1 8.3	-	9.662 [*] (^{MC} p=0.003 [*])	13.951 [*] (^{MC} p=0.001 [*])
Dispose of waste	No. %	0 0.0	0 0.0	12 100	0 0.0	0 0.0	12 100	0 0.0	0 0.0	12 100	0 0.0	0 0.0	12 100	0 0.0	0 0.0	12 100	0 0.0	0 0.0	12 100	-	-	-
Dealing with seizures	No. %	11 91.7	1 8.3	0 0.0	1 8.3	3 25.0	8 66.7	1 8.3	2 16.7	9 75.0	12 100	0 0.0	0 0.0	11 91.7	1 8.3	0 0.0	11 91.7	1 8.3	0 0.0	1.043 (^{FE} p=1.000)	18.202 [*] (^{MC} p<0.001 [*])	18.948 [*] (^{MC} p<0.001 [*])
Applying pain management measures	No. %	10 83.3	1 8.3	1 8.3	1 8.3	2 16.7	9 75.0	0 0.0	2 16.7	10 83.3	10 83.3	2 16.7	0 0.0	10 83.3	2 16.7	0 0.0	10 83.3	1 8.3	1 8.3	1.350 (^{MC} p=1.000)	17.535 [*] (^{MC} p<0.001 [*])	19.103 [*] (^{MC} p<0.001 [*])
Overall	No. %	8 66.7	1 8.3	3 25.0	2 16.7	2 16.7	8 66.7	1 8.3	2 16.7	9 75.0	10 83.3	1 8.3	1 8.3	9 75.0	1 8.3	2 16.7	8 66.7	2 16.7	2 16.7	1.394 (^{MC} p=0.783)	8.271 [*] (^{MC} p=0.015 [*])	9.921 [*] (^{MC} p=0.006 [*])

χ^2 : Chi square test FE: Fisher Exact Mc: Montcarlo test

p_1 : p value for comparing between the studied groups in before application of the program

p_2 : p value for comparing between the studied groups in after application of the program

*: Statistically significant at $p \leq 0.05$

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