Effectiveness of implementation of evidence-based educational intervention regarding chest tube on clinical patient's outcomes in cardiothoracic care unit

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Abstract

Background: Ineffective evacuation of the accumulated intra-thoracic air and/or fluid after cardiothoracic surgery may upsurge postoperative complications, morbidity, and mortality. So, chest drains are a prevalent intervention for patients admitted to acute respiratory or cardiothoracic care areas. **Aim:** To evaluate the effectiveness of nurses' evidence-based educational intervention regarding the chest tube on clinical patient's outcomes in intensive cardiothoracic care. **Setting:** The study was carried out at the cardio-thoracic care unit affiliated to Mansoura University Hospital. **Method:** A quasi-experimental research design was utilized to conduct this study using a pretest-posttest approach. A convenience sample of 55 nurses and 60 patients were selected to achieve the aim of the present study. **The results** revealed that there were a highly statistically significant differences regarding total mean scores of nurses' knowledge and practice pre and post implementation of evidence-based educational intervention. Also there were an improvement in total mean scores of the patients' outcomes regarding chest tube. **Conclusion:** There was a statistical significant improvement in nurses' total mean knowledge and practice scores post evidence-based educational intervention. Also, there was a statistically significant positive effect of nurses' evidence-based educational intervention regarding the chest tube on clinical patient's outcomes in intensive cardiothoracic care. **Recommendation:** The nurses should implement nursing care for patients undergoing cardiothoracic surgery based on evidence based practice. The nurses must enroll into internal and external training programs and attain and participate in conferences to renovate their knowledge and practices regarding EBP about chest tube post cardiothoracic surgery.

Keywords: Evidence-based practice, Educational intervention, Chest tube, Clinical outcomes.

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Introduction:

Cardiac surgery is one of the most common surgical interventions accounting for two million procedures performed worldwide each year **(Vervoort et al., 2020).** Patients undergo cardiothoracic surgery requiring placement of at least one chest tube following thoracic surgery. Tension pneumothorax is one of the main causes of cardiac arrest in the initial postoperative period **(Cheng et al., 2019)**. Moreover, draining the accumulation of blood and serous fluid and air is an emergent and standard procedure to avoid the accumulation of air and blood in the pleural space by chest tube placement **(Karimov et al., 2013, Allyn et al., 2020)**.

A chest drain is a tube inserted through the chest wall between the ribs into the pleural cavity. The effective drainage of air, blood or fluid from the pleural space requires an adequately positioned drain and an airtight, one-way drainage system to maintain sub atmospheric intra-pleural pressure. This allows drainage of the pleural contents and re-expansion of the lung. Chest tube management includes the actions to keep the tube functioning properly, which is the prime role of nurses while caring for patients with chest tube drainage **(Yoo et al., 2020)**.

The greatest concern after cardiothoracic surgery is given to chest tube to decline a potentially life-threatening complications such as tension pneumothorax because of air leakage or a progressive hemothorax.

Therefore, it has been a worldwide effort focused on implementing evidence based practice regarding chest tube to improve patients' outcomes such as stability in the patients' vital signs, decline pain intensity, decrease length of both hospital and CICU stay, decline complications such as cardiac complications, respiratory complications, postoperative acute kidney injury, drain complications and surgical site infection and achieve recovery **(Van Linden et al., 2019)**.

So, while caring for an adult cardiothoracic intensive care unit (CICU) patients with a chest tube drainage system, the critical care nurses (CCNs) requires problem solving skills and critical thinking ability **(Kesieme et al., 2016)**. After the chest tube has been inserted, it is the nurse's responsibility to maintain a patent and intact pleural drainage system. Moreover, inefficient nursing care of chest drains may be associated with unacceptable and sometimes life - threatening complications that can be classified as technical or infective. Therefore, it is important that CCNs must receive appropriate training in the management of chest drains and ensure that patients are cared for safely and competently and to maintained patency and proper functioning of chest tube drainage system **(Mokhtar et al., 2011)**.

Therefore, evidence-based practice (EBP) is needed for the CCNs working in the adult CICU to prevent possible complications. Providing care in an intensive care unit (ICU) is a holistic process that requires nurses to be

vigilant regarding all aspects of patients' needs; at the same time, nurses are expected to be competent experts in working with advanced technical tools **(Goode et al., 2011, Mathew, 2019)**. Therefore, the present study has been carried out in an attempt to investigate the effectiveness of CCNs' evidence based educational intervention regarding chest tube on clinical patient's outcomes in intensive cardiothoracic care.

Significance of the study:

Through clinical observation, it was found that nurses' knowledge regarding chest tube has not been totally assessed, and little is identified about the difference between critical care nurses' knowledge and effect on practices and patients' clinical outcomes. Also, lack of evidence-based practice and insufficient training has resulted in uncertainty and knowledge deficit in the main domains of chest tube intervention. There are only a few studies that have evaluated nurses' knowledge and practice regarding chest tube and effect on patients' outcomes **(Tarhan et al., 2016)**. In addition to a study conducted in Egypt by **(Bedier et al., 2016)** revealed that the importance of developing a protocol related to care of patients with chest tube and upgrading nurses' practice about caring of patients with chest tube through on evidence based educational intervention. Therefore the current study was to evaluate effectiveness of implementing evidence based educational intervention regarding chest tube on clinical patient's outcomes.

The present study aims to:

evaluate the effectiveness of implementation of evidence-based educational intervention regarding chest tube on clinical patient's outcomes in cardiothoracic care unit

Research hypothesis:

- The nurses' total knowledge and practice mean scores post-EBP educational intervention exhibit significantly higher than their pre EBP educational intervention implementation.

- The critically ill patients with chest tubes who are exposed to nurses' EBP intervention exhibit a higher level of stability in the patients' vital signs, decline pain intensity, decrease length of both hospital and CICU stay, and achieve recovery post implementing EBP educational intervention

- The critically ill patients with chest tubes who are exposed to nurses' EBP intervention exhibit decline complications such as cardiac complications,respiratory complications, postoperative acute kidney injury, drain complications and surgical site infection post implementing EBP educational intervention.

Subjects and methods:

Study Design: A quasi-experimental research design was utilized to conduct

this study using a pretest-posttest approach

Setting of the study:

The study was carried out at the cardio-thoracic care unit affiliated to Mansoura University Hospital. The CICU includes 5 beds and it is well equipped with advanced technology and manpower needed for patients' care. This unit provides postoperative care for a patient who has undergone cardiothoracic surgeries involving coronary artery bypass graft (CABG) and valvular surgeries are the most common operations performed in this unit. The nurse-patient ratio is nearly 1:1.

Sample:

A. Nurses:

A convenience sample of 55 nurses working in CICU was selected to achieve the aim of the present study.

Nurses' inclusion criteria: Aged more than 21 years of both gender with different educational levels, provide direct care for the patient with a chest tube and willing to participate in this study.

B. Patients:

Additionally, a convenience sample of 60 adults critically patient with a chest tube was selected according to the inclusion criteria:

Patients' inclusion criteria: Aged from 21 to 60 years, both gender and newly admitted CICU.

Tools for data collection:

Tools of the study: All tools were developed by the researcher after strength review of the relevant literature **(Abd El Hafez et al., 2019, Bates et al., 2020, Soge et al., 2014, Stein and Hollen, 2020)** to assess CCNs' knowledge and practice regarding the chest tube and improve patients' outcomes. Three tools were used to gather data pertinent to the study as follows:

Tool I: knowledge questionnaire sheet to assess Nurses' socio-demographic and knowledge regarding chest tube; it consisted of two parts as follows:

Part A: Nurses' socio-demographic characteristics; such as age, gender, qualification, years of experience in the CICU, frequency of providing care for a patient with a chest tube post cardiothoracic surgery, undergraduate training courses regarding chest tube and any training courses regarding chest tube.

Part B: Nurses knowledge regarding evidence-based practice regarding chest tube; It composed of 43 items; 33 items true or false and 10 items multiple-choice questions which divided into seven main knowledge domains; 9 items for nurses' knowledge about basic principles, indications, and contraindications of the chest tube, 11 items for drain and suction, 4 items manipulation for patency of the chest, 4 items chest tube

dressings, 3 items chest tube maintenance, 6 items removal of the chest tube, 6 items and infection control of chest tube.

Scoring system: Nurses' knowledge items were evaluated the correct answer was given one score and the incorrect answer was given zero score. The total scoring system of CCNs' knowledge was 43. They were calculated and classified as; 75% or more were considered a high level of knowledge, 60% to less than 75% were considered a moderate level of knowledge and less than 60% were considered a low level of knowledge.

Tool II: Nurses' observational checklist regarding chest tube

This tool was used to assess CCNs' practice in CICU during providing care for patients with the chest tube. It composed of 97 steps and divided into seven main domains; 14 steps for patient assessment, 11 steps for assessing chest tube drainage patency, 17 steps for changing chest tube drainage insertion site dressing, 15 steps for changing the chest drainage bottle if broken or filled, 5 steps for checking for repeated fluctuation in the water level in the distal end of the chest tube, 11 steps for providing health teaching, and 24 steps for applying chest tube drainage removal procedure.

Scoring system: Nurses' practice steps were rated on 3 points rating scale; 2 for each completely correct step, 1 for each partially correct step and zero for each incorrect step. The total score of practice was 97. The

higher scores indicated higher practice levels. They were categorized as: scores equal or more than 80 % were considered as satisfactory practice level and scores lower than 80 % were considered as unsatisfactory practice level.

Tool III: **Patients' demographic and clinical outcomes;** this tool was developed to evaluate the improvement of the patient's condition after implementing EBP intervention regarding the chest tube. It includes:

Part A: Patients' demographic and medical data; such as age, gender, and type of cardiothoracic surgery, patients' chest tube assessment, number of the chest tube, site of the chest tube, total drainage output per day, and duration of chest tube stay.

Part B: Patients' clinical outcomes;

Part B: Patients' vital signs such as heart rate, blood pressure, body temperature, respiratory rate, and oxygen saturation.

Part C: Visual analog scale (VAS) of pain; it was developed by **(Cline et al., 1992)** to assess the intensity of pain. VAS was consisted of a straight mark with the endpoints defining extreme limits range from 0 (no pain at all) to 10 (pain as bad as it could be). The patient is asked to spot the pain level on the line between the two endpoints. The distance between 'no pain at all' and the mark then defines the subject's pain.

Scoring system: The scores used to track pain progression for a patient described as; 1-3 scored as mild, 4-7 scored as moderate, and 8- 10 scored as severe pain.

Part D: Patients' length of stays; such as a total stay in CICU and total hospital stay.

Part E: Patients' complications; such as cardiac complications, respiratory complications, postoperative acute kidney injury, drain complications, and surgical site infection such as redness, hotness, swelling, and increased pain at the insertion site .

Content validity: All tools of this study were developed by the researchers after a strong review of the relevant literature and used to collect the data. Tool I of data collection was translated into the Arabic language because the studied nurses had different levels of education.

All tools were tested for content validity by three panels of juries' experts in the field of critical care nursing and medical-surgical nursing, and medical biostatistics and modifications were done.

Reliability of the tools: All tools of the study were tested for reliability using Cronbach alpha. It was 0.86 for tool I, 0.819 for tool II, and 0.84 for tool III which represents a highly reliable tool.

Pilot study: A pilot study was carried out before starting data collection on 10% of both studied

nurses and patients to evaluate the clarity, feasibility, and applicability of the tools as well as estimate the time needed to fillout.

Ethical Considerations:

- Official permission was obtained before conducting the current study from Mansoura University Hospital administrator.

- The study procedure was reviewed and accepted by the Ethical Committee of the Faculty of Nursing at Al Mansoura University.

- Written approval was obtained from both studied subjects after clarification the aim of the current study.

- Privacy and data confidentiality were assured to all studied subjects.

- Both the studied subjects were assured that every one had the right to withdraw from the present study at any time of the research process.

- The EBP intervention used in the current study is safe for both the studied subjects.

Data collection:

- Both studied subjects who willing to participate in this study and fulfilled the inclusion criteria have been interviewed and observed by the researchers.

- The duration of data collection was extended from the period of the beginning of May 2020 until the end of October 2020.

Field work: The current study was carried out in four phases including the assessment, planning, intervention, and evaluation phases.

1. **Assessment phase**: It was performed for all studied nurses before implementing EBP educational program using the tool I as a pretest. Also, it was done for all studied patients before nurses' intervention using tool II as a pretest.

2. **Planning phase:** During this phase, EBP educational intervention was formulated based on the assessment phase and an extensive review of the relevant literature. Goals and expected outcome criteria were being formulated based on priorities during implementing EBP educational program as the following:

- Improving nurses' total knowledge and practice mean score regarding chest tube.

- Maintaining stability of patients' vital signs, declining length of stay, and complication.

3. **Implementation phase:** During this phase, EBP educational intervention was applied to all studied nurses during sessions. These sessions were done in the educational classroom at Mansoura University Hospital. The nurses were divided into subgroups. Each subgroup ranged between 8 and 10 nurses.

Six sessions were conducted; the sessions were continued for three consecutive days for the theoretical part and three sessions were conducted for the following three consecutive days for the practical part. Every session took approximately 40- 60 minutes. The session conducting time was between morning and afternoon shift or through morning shift after giving the routine care to the critically ill patients.

- **For the theoretical part;** three sessions were included; session one definition, steps of EBP and application. Session two contained basic principles, indications, contraindications of the chest tube, and infection control regarding the chest tube. Session three consisted of complications and management of chest tube.

- **For the practical part;** three practical sessions were utilized following theoretical sessions for three consecutive days two hours for each. Session one consisted of patient assessment. Session two included assessing chest tube drainage patency, changing chest tube drainage insertion site dressing, and changing the chest drainage bottle if broken or filled. Session three covered checking for repeated fluctuation in the water level in the distal end of the chest tube, and applying chest tube drainage removal procedure, and health teaching.

The practical sessions were implemented in the CICU, demonstration and re-demonstration methods were done for each nurse. The teaching media used in this study were videos, moderate fidelity simulation, and problem-solving situations.

Demonstration and re-demonstration methods were done for each nurse. The teaching media used in the study was videos, simulation, and problem-solving situation.

4. **Evaluation phase: Concerning nurses, all studied nurses were evaluated using tool I and II. Each nurse was evaluated separately in the CICU two times.** The evaluation (posttest evaluation) was done after implementing the evidence-based educational intervention to evaluate the nurses' knowledge and practice regarding the chest tube.

Concerning patients; all patients were evaluated using tool III post-implementation of evidence-based educational intervention provided by the nurses to evaluate patients' outcomes such as stability in vital signs, decrease length of both hospital and CICU stay, achieve recovery, and decline complications related to chest tube.

Statistical design: The analysis was done using statistical software SPSS for quantitative data; mean and standard deviation were calculated. Frequency &percentages ,significance test –t-test and correlation,r test. A significance was adopted at p<0.05 for interpretation of results of tests of significance.

Results:

Table (1): illustrates the percentage distribution of studied nurses regarding personal characteristics. The current study enrolled 55 nurses. The majority of studied nurses were at the age of 20 to less than 30 years old (85.2%) and female (78.2%). Regarding years of experience, it was found that the vast majority (90.9%) of studied nurses had at least four years of nursing experience and more than three quarters (76.4%) quarters had an experience of fewer than 5 years in the intensive cardiothoracic care unit.

Figure (1): reveals the distribution of studied nurses concerning the total knowledge score pre post EBP educational intervention regarding the chest tube. It was found that the majority of studied nurses (81.80%) had low knowledge score pre EBP educational intervention. While nearly three quarters (72.70%) of studied nurses had high knowledge score post EBP educational intervention.

Table (2) reveals the mean and standard deviation of the total knowledge score among studied nurses pre post EBP educational intervention regarding the chest tube. The differences between nurses' total score of knowledge pre and post EBP educational intervention were highly statistically significant p=0.000.

Figure (2): Distribution of studied nurses according to practice level score pre post EBP educational intervention regarding the chest tube. It can be seen that the majority (85.50%) of studied nurses had an unsatisfactory total score of practice pre EBP educational intervention. While more than two thirds (70.90%) of

studied nurses had a satisfactory total score of practice post EBP educational intervention.

Table (3): shows mean and standard deviation of total practice mean score among studied nurses pre post EBP educational intervention regarding the chest tube. It was found that there were highly statistically significant differences in favor among the studied nurses concerning the total score of practice pre post EBP educational intervention regarding chest tube p=0.000.

Table (4) illustrates the correlation between nurses' total knowledge and practice mean scores pre post EBP educational intervention regarding chest tube. It was found that there were highly positive significant correlations regarding total scores of knowledge and practice which include (r=0.803, p= 0.034) and (r=0. 961, p=0.007) pre post EBP educational intervention respectively.

Table (5): shows the relationship between personal characteristics of the studied nurses and level of total practice score pre post EBP educational intervention regarding the chest tube. This finding illustrated that more than two-fifth (47.3% and 43.6%) of the studied nurses aged 20 to less than 30 years old had unsatisfactory practice mean score pre EBP educational intervention compared to satisfactory practice mean score pre EBP educational intervention respectively.

Regarding qualification and years of experience in the intensive cardiothoracic care unit, more than two thirds (65.00%) of the studied nursed joined diploma degree with 5 years of experience in the intensive cardiothoracic care unit had unsatisfactory practice mean score pre EBP educational intervention compared to 20.0% post EBP educational intervention.

Moreover, the only significant relation was observed between studied nurses practice and qualifications pre EBP educational intervention. Moreover, there were statistically significant differences among the studied nurses between total practice mean score and age, qualifications, working experiences in the intensive cardiothoracic care unit pre post EBP educational intervention p < 0.05.

Table (6): shows the percentage distribution of studied patients according to demographic characteristic. It was found that only forth of the studied patients were in the age group of 51-60 years old.

As regards the type of cardiothoracic surgery, The most common (63.3%) type of cardiothoracic surgery among the studied patients was CABG.

Table (7): reveals the percentage distribution of the patient according to chest tube assessment. It can be seen that the vast majority (91.7%) of studied patients had two chest tubes inserted at mid axillary retrosternal sites.

Concerning total drainage output per day, more than half (53.3%) of

studied patients had 100- 150 ml/ day drainage output.

Regarding the duration of chest tube stay, more than three quarters (76.7%) of the studied patients had chest tube insertion for at least 3 days. While less than a fourth (23.3%) had chest tube insertion from 4 to 6 days.

Table (8): reveals the percentage distribution of patient according to chest tube assessment clinical outcomes. It was found that nearly two thirds (60.0% and 63.3%) of the studied patient had heart rate from 60 to 80 b/m and respiratory rate from 14- 20 c/m respectively. While, more than two thirds (78.3% and 71.7%, 73.7%, 80.0%, and 75.0%) of the studied patient had systolic blood pressure 90-120 mmHg, diastolic blood pressure 50-70 mmHg, body temperature 36.3-37.0 o C, SPO2 96-100% and mild visual analog scale of pain, respectively.Regarding patients' length of stay, the majority (86.7%) of studied patients stay at least 3 days in the intensive cardiothoracic care unit.

Table (9): illustrates the percentage distribution of patient according to chest tube complications. It was noticed that surgical site complications (61.2%) were the most common complications among the studied patients. While drain complication (18%) was the least common complication.

Table (10): illustrates the correlation between patients' clinical outcomes and nurses' total knowledge and practice scores. It was found that there was a highly positive significant correlation regarding total scores of knowledge and heart rate(r=0.392, p= 0.002). Also, there were highly positive significant correlations regarding total score of practice concerning systolic and diastolic blood pressure which include (r=0.440, p= 0.000) and (r=0. 666, p=0.000) respectively. On the other hand, there was a negative significant correlation regarding total scores of knowledge and diastolic blood pressure (r=0.392, p= 0.002).

Table (1):

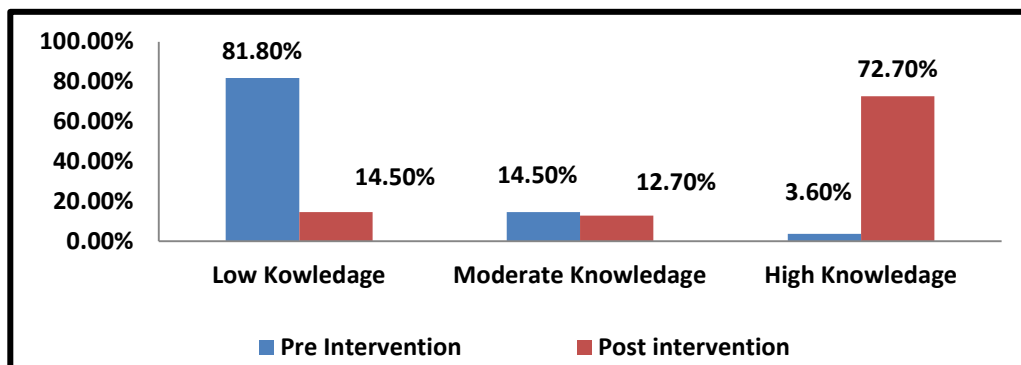| Nurses' characteristics	No. (n = 55)	%
Nurses Age:		
- 20-	32	85.2
- 30-	14	25.5
- 40-	9	16.4
Nurses gender:		
- Male	12	21.8
- Female	43	78.2
Qualification:		
- Diploma	42	76.4
- Practical	13	23.6
Years of experience in the intensive cardiothoracic care unit:		
- < 5 years	42	76.4
- 5-10 years	8	14.5
- > 10 years	5	9.1
Total years of nursing experience:		
- 1-4 years	50	90.9
- 5-10 years	5	9.1
Frequency of providing care for a patent with a chest tube post cardiothoracic surgery:		
- Every day	55	100.0
Undergraduate training courses regarding chest tube:		
- **Yes**	0	0.0
- **No**	55	100.0
Having any training regarding care of patients with chest tube:		
- **Yes**	55	100.0
- **No**	0	0.0

Figure (1): reveals the distribution of studied nurses concerning the total knowledge score pre post EBP educational intervention regarding the chest tube.

Table (2): Mean and standard deviation of the total knowledge score among studied nurses pre post EBP educational intervention regarding the chest tube

Knowledge domains	Pre EBP educational intervention Mean ± SD	Post EBP educational intervention Mean ± SD	Paired t. test	P value
• Basic principles, indications, and contraindications of chest tube	4.30±2.60	6.58 ± 1.86	4.665	0.000**
• Chest tube drainage system and suction	4.65 ± 2.07	7.00±2.27	5.399	0.000**
• Manipulation for patency of the chest tube	1.56 ± 0.91	2.41 ± 0.76	4.638	0.000**
• Chest tube dressing	2.18±1.15	3.29±1.01	4.881	0.000**
• Chest tube maintenance	1.49±1.01	2.47±0.89	5.273	0.000**
• Removal of the chest tube	2.52±1.56	4.76±1.24	8.218	0.000**
• Infection control of chest tube	4.78±0.80	5.47±0.76	4.216	0.000**
Total score of knowledge	**21.50±4.81**	**32.00±5.87**	**9.049**	**0.000**

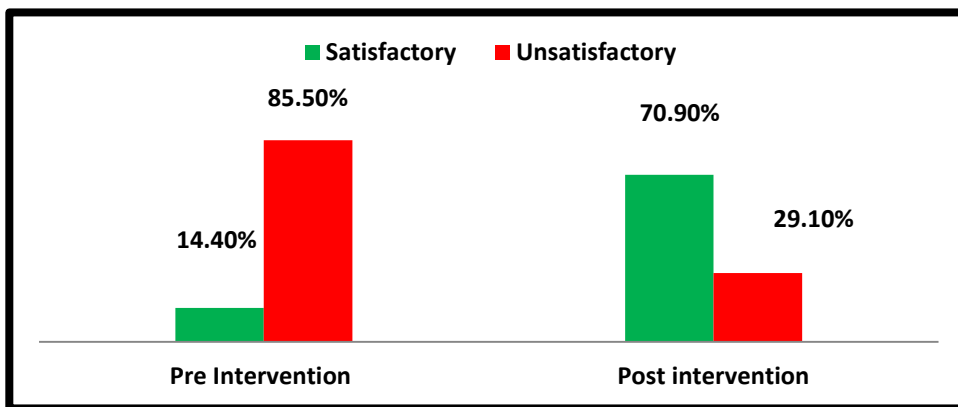**Highly statistical significant at p≤0.001

Figure (2): Distribution of studied nurses according to practice level score pre post EBP educational intervention regarding the chest tube.

Table (3):   Mean and standard deviation of the total practice mean score among studied nurses pre post EBP educational intervention regarding the chest tube

Practice domains	Pre EBP educational intervention Mean ± SD	Post EBP educational intervention Mean ± SD	Paired t. test	P value
• **Assessing the patient**	7.109±2.24	11.7 ± 1.52	**13.610**	**0.000****
• **Assessing chest tube drainage patency**	6.40 ± 1.96	9.90 ± 2.56	**5.600**	**0.000****
• **Changing chest tube drainage insertion site dressing**	9.98 ± 1.99	12.60 ± 2.35	**6.014**	**0.000****
• **Changing the chest drainage bottle if broken or filled**	12.09 ±1.69	12.81±3.44	**1.397**	**1.68**
• **Checking for repeated fluctuation in the water level in the distal end of chest tube**	3.96 ±1.20	4.54 ±1.13	**2.809**	**0.007****
• **Applying chest tube drainage removal procedure**	15.47 ±3.13	19.83 ±3.51	**6.968**	**0.000****
• **Providing health teaching**	5.32 ±2.86	9.36 ±2.37	**8.878**	**0.000****
The total score of practice	**60.34 ±9.08**	**80.03 ±6.10**	**12.490**	**0.000****

**Highly statistical significant at p≤0.001

Table (4): Correlation between nurses' total knowledge and practice mean scores pre post EBP educational intervention regarding the chest tube

Item	Total scores of knowledge			
	Pre Intervention		Post Intervention	
	r	P value	r	P value
Total scores of practice	**0.803**	**0.034***	**0.961**	**0.007****

*Correlation is significant at the 0.05 level

Table (5): Relation between personal characteristics of the studied nurses and level of total practice score pre post EBP educational intervention regarding the chest tube

Nurses' characteristics	Pre total score of practice			Post total score of practice		
	Satisfactory %	Unsatisfactory %	□2 P	Satisfactory %	Unsatisfactory %	□2 P
Age						
- 20	10.9	47.3	**0.038**	43.6	14.5	**0.327**
- 30	0.0	25.5	**0.785**	18.2	7.3	**0.015***
- < 40	3.6	12.7		9.1	7.3	
Gender						
- Male	1.8	20.0	**0.211**	16.4	5.5	**0.047**
- Female	12.7	65.5	**0.122**	54.5	23.6	**0.734**
Qualification						
- Diploma	10.9	65.5	**0.761**	56.4	20.0	**0.272**
- Practical	3.6	20.0	**0.000***	14.5	9.1	**0.045***
Years of experience in the intensive cardiothoracic care unit:						
- < 5 years	10.9	65.5	**0.066**	56.4	20.0	**0.401**
- 5-10 years	1.8	12.7	**0.631**	12.7	1.8	**0.002****
- > 10 years	1.8	1.8		1.8	7.3	

*Correlation is significant at the 0.05 level　　**Highly statistical significant at p≤0.001

Table (6): Percentage distribution of studied patients according to demographic characteristics

Patients characteristics	No. (n = 60)	%
Patient Age:		
- 31-	22	36.7
- 41-	23	38.3
- 51-60	25	25.0
Patients gender :		
- Male	32	53.3
- Female	28	46.7
Type of cardiothoracic surgery:		
- Valve surgery	22	36.7
- CABG	38	63.3

CABG: Coronary Artery Bypass Graft

Table (7): Percentage distribution of the patient according to chest tube assessment

Chest tube assessment	No. (n = 60)	%
No. of chest tube:		
- One	5	8.3
- Two	55	91.7
Site of chest tube insertion :		
- Mid axillary retrosternal	55	91.7
- Mid axillary	5	8.3
Total drainage output per day:		
- 100-150 ml	32	53.3
- 151-200 ml	19	31.7
- > 200 ml	9	15.0
Duration of chest tube stay:		
- 1-3 days	46	76.7
- 4-6 days	14	23.3

Table (8): Percentage distribution of patient according to chest tube assessment clinical outcomes

Patients' clinical outcomes	No. (n = 60)	%
a) Patient vital signs		
Heart Rate (b/m) :	36	60.0
- 60-80	17	28.3
- 81-100	7	11.7
- >100		
Respiratory rate (c/m):		
- 14-20	38	63.3
- 20-30	22	36.7
Systolic Bl. Pressure (mmHg):		
- 90-120	47	78.3
- 130-140	13	21.7
Diastolic Bl. Pressure (mmHg):		
- 50-60	43	71.7
- 70-80	17	28.3
Temperature (Cº):		
- 36.3-37.0	44	73.3
- 37.1- 37.5	16	26.7
Oxygen saturation SPO_2 (%)		
- <90	1	1.7
- 91-95	11	18.3
- 96- 100	48	80.0
Visual Analog Scale of Pain:		
- Mild (0–3)	45	75.0
- Moderate (4–7)	9	15.0
- Severe (8–10)	6	10.0
a) Patients' length of stay		
Total stay in ICU :		
- 1-3 days	52	86.7
- 4-6 days	8	13.3
Total hospital stay:		
- 6-10 days	55	91.7
- >11 days	5	8.3

Table (9): Percentage distribution of patient according to chest tube complications

Chest Tube Complications	No. (n = 60)	%
Respiratory complication (41.6%):		
- Pulmonary edema	4	6.7
- Decrease O_2 saturation	9	15.0
- Crackles	9	15.0
- Cough	3	5.0
Drain complication (18%):		
- Blockage		13.3
- Leakage at the drain site	8	5.0
	3	
Surgical site complications (61.2%):		
- Redness and hotness		30.6
- Increased pain at the insertion site	19	30.6
	19	

Cardiac and postoperative acute kidney injury complications=0

Table (10): Correlation between patients' clinical outcomes and nurses' total knowledge and practice scores

Patients' Clinical outcome	The total score of Knowledge		The total score of Practice	
	r	P value	r	P value
Heart Rate (b/m) :				
- 60-80				
- 81-100	**0.392**	**0.002****	0.052	0.641
- >100				
Respiratory rate (c/m):				
- 14-20	0.080	0.541	0.052	0.695
- 20-30				
Systolic Bl. Pressure (mmHg):				
- 90-120				
- 130-140	**0.525**	**0.000****	**0.440**	**0.000****
Diastolic Bl. Pressure (mmHg):				
- 50-60				
- 70-80	**-0.309**	**0.016***	**0.666**	**0.000****
Temperature (^{o}c):				
- 36.3-37.0		0.361	-0.139	0.291
- 37.1- 37.5	-0.120			
Oxygen saturation SPO_2 (%)				
- <90				
- 91-95	0.228	0.080	0.091	0.488
- 96- 100				
Visual Analog Scale of Pain:				
- Mild (0–3)				
- Moderate (4–7)	-0.250	0.054	-0.130	0.322
- Severe (8–10)				

**Highly statistical significant at p≤0.001

Discussion:

Regarding nurses' characteristics, the majority of studied nurses were female at the age of 20 to less than 30 years old and the vast majority of them had at least four years of nursing experience in cardiothoracic surgery. This result was contradicted with (**Almeida et al., 2018**), reported that the majority of critical care nurses were female and had more than 11 years of experience in the cardiothoracic care unit.

Regarding studied nurses' qualifications, the majority of studied nurses had a diploma degree in nursing education. It may be due to a shortage of bachelor nursing education. This finding was agreed with (**Mohammed et al., 2016**), reported that the majority of studied nurses had a diploma degree.

Concerning the total score of knowledge pre post evidence based practice educational intervention. It was found that the majority of studied nurses had low knowledge level and unsatisfactory practice score pre evidence based practice educational intervention. While nearly three quarters of studied nurses had high knowledge satisfactory practice scores post evidence based practice educational intervention. These results may be due to inadequate and lack of updating knowledge among studied nurses pre evidence based practice educational intervention. In addition to nurses' acquire competencies during evidence based practice educational intervention. This finding was supported by (**Tarhan et al., 2016**), revealed that the knowledge level of the critical care nurses for the management of patients with chest tubes was insufficient.

Concerning critical care nurses' total knowledge and practice mean scores, it was observed that there was a highly positive significant correlation between total knowledge and practice mean scores pre post evidence based practice educational intervention. It may be attributed to the majority of studied nurses in this study sample had a diploma degree and lack in university education. This finding was agreed with (**Hassanin et al., 2016**) and (**Ibrahim et al., 2014**), they found that there were statistically significant differences in the total scores of studied nurses' knowledge and practice pre-post guidelines educational program phases. On the other hand, this result was contradicted with (**Mohammed et al., 2016**), who stated that no correlation was found between both knowledge and practice levels.

Regarding the relationship between personal characteristics of the studied nurses and total score of practice pre post intervention, the only significant relation was observed between studied nurses' practice and qualifications pre evidence based practice educational intervention. Moreover, there were statistically significant differences among the studied nurses between total practice mean score and age, qualifications,

working experiences in the intensive cardiothoracic care unit post evidence based practice educational intervention. This may be related to knowledge deficits regarding chest tube assessment and management principles, busy cardiothoracic care units, inadequate staffing, limited time, inappropriate attitude or focus on other imperatives, poor communication, and lack of accountability, inadequate staff training, patients' attitude and health status among others.

This finding was in line with (**Hassanin et al., 2016**), who stated that there was a statistically significant difference between nurses' practice and degree of qualification. Conversely, (**Tarhan et al., 2016**), who discovered that there was a statistically significant difference between total knowledge level and educational background. Also, this result was contradicted with (**Ibrahim et al., 2014**), who revealed that there only significant relation was observed between studied nurses' practice and postgraduate training courses related to chest tube.

As regards patients' demographic characteristics, it was found that the need for chest tube insertion was a decline with age and more than half of the studied patients were male. From our point of view, this would be attributed to the fact that the risk of cardiovascular disease increases in males compared to females due to the presence of higher estrogen levels in women which help to protect them from cardiovascular disease. Also, The most common type of cardiothoracic

surgery among the studied patients was coronary artery bypass graft. These findings were constant with (**Baribeau et al., 2019**), who stated that more than half of the studied patients were male and undergoing coronary artery bypass graft.

Regarding the site of chest tube insertion, the most common site of chest tube insertion among studied patients was mid axillary retrosternal sites. This finding was incongruent with (**Tarhan et al., 2016**), who reported that the mediastinal cavity is the most common site of chest tube insertion for the studied patients undergoing cardiothoracic surgery.

Concerning patients' length of stay, the majority of studied patients stay at least 3 days in the intensive cardiothoracic care unit. It may be due to improvement in nurses' knowledge and practice means score post educational intervention. This result was supported by (**St-Onge et al., 2017**), who stated that studied patients had a shorter postoperative length of stay than the control group. In addition to (**Bjerregaard et al., 2014**), who stated that the median length of stay in hospital was 4 days.

In relation to postoperative complications, it was noticed that surgical site complications such as hotness, redness, and increased pain at the insertion site were the most common postoperative complications, and drain complication was the least common complication. While none of the studied patients had both cardiac

and postoperative acute kidney injury complications. It may be attributed to the release of inflammatory mediators post cardiothoracic surgery because the increase in body temperature was not high and controlled. This result was contradicted with **(Meersch et al., 2017)**, who reported that acute kidney injury was a well-recognized postoperative complication of cardiothoracic surgery. Also, **(Baribeau et al., 2019)** stated that Stroke and re-exploration most common complications, and none of both studied group had surgical site complications.

Conclusion

Based on the results of the current study, it can be concluded that:

The current study concluded that nurse' knowledge and practice concerning chest tube were highly improved significantly post implementing the evidence-based educational program. Therefore, implementing the best EBP regarding chest tube helps in improvement of patient's outcomes and declining the post cardiothoracic complications.

Recommendations

On the light of the current study findings the following recommendations are suggested: the nurses should implement nursing care for patients undergoing cardiothoracic surgery based on evidence based practice. The nurses must enroll into internal and external training programs and attain and participate in conferences to renovate their knowledge and practices regarding EBP about chest tube post cardiothoracic surgery. Also, the evidence based team in hospitals should establish a system to confirm implementing EBP regarding chest tube post cardiothoracic surgery.

Limitation of the study

The current study has some limitations. Firstly, the current study was accompanied and limited to one hospital. Secondly, there was a limited sample size. Finally, the evidence based educational interventions regarding chest tube was limited to CCNs.

Implication of this study

Feasibility and acceptability and delivery of educational intervention regarding chest tube can improve EBP among critical care nurses, thereby facilitating clinical implementation and improve patients' clinical outcomes.

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