Influence of Care Protocol on Nurses' Performance and Clinical Outcomes for Patients with Tube Thoracostomy

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Abstract:

Background: Tube thoracostomy is a life-saving implementation for patients presenting with pneumothorax, effusions and hemothorax. **Aim:** This study aimed to evaluate influence of care protocol on nurses' performance and clinical outcomes for patients with tube thoracostomy. **Design:** A quasi experimental design. **Setting:** The study was conducted at chest intensive care unit at Ain Shams University Hospitals. **Sample:** A convenient sample of all available nurses (30 nurses) from the previous mentioned settings willing to participate in the study and a purposive sample of 50 patients with tube thoracostomy divided into two groups: study & control group (25 patients in each group). **Tools of data collection: I**-Nurses' performance assessment tool (demographic characteristics of nurses, nurses' knowledge questionnaire and nurses' practice observational checklist) **II**- Clinical outcomes assessment tool. **Results:** Concerning nurses' level of performance (knowledge and practice) regarding tube thoracostomy care pre and post implementation of care protocol, there were statistically significant differences between mean scores of the pre and post-tests. Regarding clinical outcomes for patients with tube thoracostomy, there were statistically significant differences between control group and study group all over the variables of outcomes. **Conclusion:** Application of care protocol for patient with tube thoracostomy has a positive influence on nurses' performance; and consequently had a positive influence in refinement the outcomes for patients in the study group rather than the control group with a statistically significant difference. **Recommendations:** Importance of presence of care protocol related to care of patients with tube thoracostomy and further researches should be done to assess and evaluate the clinical outcomes for patients with tube thoracostomy.

Key words: Care protocol, Clinical outcomes, Nurses' performance, Tube thoracostomy.

Introduction:

Tube thoracostomy are a widespread implementation for patients admitted to acute respiratory or cardiothoracic surgery care areas. These are either inserted intra-operatively or as part of the conservative management of a respiratory illness or thoracic injury. Chest tube care is one of' the most important nursing procedures because patients who need chest tubes are usually seriously ill and require advanced nursing care. Accordingly, vigilant and expert nursing care can prevent serious complications. **(Fhlatharta & Eaton, 2020).**

Tube thoracostomy is defined as inserting a tube into the pleural or mediastinal cavity indicated to drain air, blood, fluid and pus for the following cases; spontaneous pneumothorax, tension pneumothorax (an absolute indication), presence of a significant pleural effusion,

or empyema and Post-traumatic hemothorax; in this situation a large-bore tube is to be preferred because of the likelihood of a blood clot obstructing a small catheter**.** Tube thoracostomy is generally used in the treatment of patients who have undergone heart and chest surgery or chest trauma **(Wells & Coonar, 2018).**

Complications of tube thoracostomy includes malposition; tube malposition represent a form of penetrating trauma and should be managed accordingly. Organ injury; the most common organ injury during tube thoracostomy is the lung, perforation of the heart, liver spleen, and diaphragm are also potential injuries. Infection; increased duration of indwelling chest tubes can lead to potential for infection, empyema, and problems after removal such as recurrent pneumothorax and tension pneumothorax **(Volmerig, 2017).**

Insufficient knowledge and practice of nurses may lead to unwanted complications such as increased morbidity, extension of duration of hospital stay, and even death in some cases. The insertion of tube thoracostomy in a patient using the aseptic technique is the physician's responsibility. However, as long as the tube is kept inserted, the nurses' responsibilities include monitoring the drainage bottle and suction level, recording the quantity and content of drainage, administering wound care and follow-up of pain, and providing information and support to the patient **(Kesieme, et al., 2016).**

Inappropriate management of tube thoracostomy and their drainage systems may lead to delayed or incomplete evacuation of the collected air or fluid in the pleural space, delayed reexpansion of the collapsed lung, and even development of tension pneumothorax. This is associated with significant morbidity, leading to prolonged hospitalization or even mortality. Therefore, it is important that every member in the team taking care of patients with tube thoracostomy, should have adequate understanding of the physical principles of the tube and its drainage system **(Tarhan, et al., 2016).**

While caring a patient with tube thoracostomy, the nurse requires problem solving skill and critical thinking ability. After tube thoracostomy has been inserted, it is the nurse's role to maintain a patent (clear) and intact pleural drainage system. A professional nurse engages in lifelong learning that will influence practice and ultimately impact the quality of care that a patient receives. So, it is important that nurses receive appropriate training in the management of tube thoracostomy **(Fhlatharta & Eaton, 2020).**

Significance of the study

Based on the evidence of many researches, clinical experience and observation of the nurses' performance, most of the nurses who caring for patients with tube thoracostomy had knowledge and practice deficit regarding tube thoracostomy management. So there is an urgent need for care protocol to improve nurses' performance and subsequently patient clinical outcomes. Nurses education are important and the best way to avoid complications regarding tube thoracostomy management and promoting a better quality of services for patients. So, it is essential to implement care protocol for patients regarding tube thoracostomy management that can lead to better clinical outcomes.

Aim of the study:

This study aimed to evaluate the influence of care protocol on nurses' performance and clinical outcomes for

patients with tube thoracostomy through the following:

• Assess nurses' knowledge regarding care of patients with tube thoracostomy

• Assess nurses' practice regarding care of patients with tube thoracostomy

• Assess clinical outcomes for patients with tube thoracostomy

• Implement a developed care protocol for patients with tube thoracostomy

Subject and Methods

Research Hypothesis: The current study hypothesized that:

• Application of care protocol will have positive influence on nurses' performance that consequently will affect the clinical outcomes for patients with tube thoracostomy.

Research design: To conduct this study a quasi-experimental design was utilized to assess the influence of care protocol on nurses' performance and clinical outcomes for patients with tube thoracostomy.

Setting: The study was conducted at chest intensive care unit at Ain Shams University Hospitals.

Subjects: A convenient sample of all available nurses (30) from the previous mentioned settings willing to participate in the study. A purposive sample of (50) patients adult conscious from both sex regardless their educational level newly admitted within six hours after chest trauma free from respiratory and cardiac past medical history and willing to participate in the study. The studied patients were divided into two groups: the control group (25 patients) whom received only the routine nursing care and the study group (25 patients) whom received the nursing care for tube thoracostomy post application of nurses' performance care protocol. The sample size was determined statistically by power analysis test considering Type I error with significant level $\alpha = 95\%$. & Type II error by power test $\beta = 90\%$.

Tools of Data Collection:

I- Nurses' performance assessment tools

A- Demographic characteristics of nurses caring for patient with tube thoracostomy including age, gender, level of education, marital status, training courses, and years of experience.....etc).

B- Nurses' knowledge questionnaire: It was developed by the researchers and was written in an arabic language based on the related literature **Webb, et .al, (2016) & Christopher, (2014)** to assess nurses' knowledge regarding tube thoracostomy. It was consisted of 6 parts answered by short ended questions as following: anatomy and physiology (five questions, definition (one question), indications (five questions), and contraindications (five questions), complications (six questions) and nursing care; pre procedure nursing care (five questions), during procedure nursing care (eight questions) and post procedure nursing care (10 questions).

Scoring system: The correct answer of nurses' knowledge scored by one, while the incorrect answer scored by zero. Total score was 45 degree, and it was considered that: ≥ 90 % (≥ 40.5 grades) was satisfactory while < 90% (< 40.5 grades) was unsatisfactory.

C- Nurses' practice observational checklist: It was developed by the researchers based on the related literature **White, & Eaton, (2017); Vaishali Sukhdeorao Soge et al., (2014); Mallett, et al., (2013)** to assess nurses' practice regarding tube thoracostomy management. It included 14

procedure as following: tube thoracostomy setup (eight steps), tube thoracostomy assessment (six steps), insertion site care (four steps), tube thoracostomy system and tubing care (eight steps), suction (seven steps), drain documentation (eight steps), air leak observation (two steps), oscillation observation (two steps), patient position and transport (five steps), specimen collection (8 steps), tube thoracostomy dressing (11 steps), changing the chamber (11 steps), and post tube thoracostomy removal care (seven steps).

Scoring system: If the step was done correctly, it scored one, while if the step wasn't done or done incorrectly it scored zero. The total score was 87 grades. It was considered that: ≥ 90 % (≥ 78.3 grades) was satisfactory, while < 90 % (< 78.3 grades) was unsatisfactory.

II- Clinical Outcomes assessment tool

A- Patients Medical data include patient age ,sex, present history and past history

B- Clinical outcomes for patients with tube thoracostomy and it was developed by the researcher based on **(Johnson, et al., 2000).** it included

- Respiratory status: gas exchange (mental status IER*, ease of breathing, dyspnea at rest not present, dyspnea with exertion not present, restlessness not present, cyanosis not present, somnolence not present, PaO_2 and $PaCO_2$ WNL*, arterial pH WNL*, O_2 saturation WNL*,and chest X ray finding IER*.

(*IER=in expected range, WNL=within normal limits)

- Respiratory status: ventilation (Respiratory rate and rhythm IER*, chest expansion symmetrically, vocalize adequately, accessory muscle use not present, adventitious breath sound not present, chest retraction not present, pursed lips breathing not present, orthopnea not present, shortness of breath SOB* not present, percussed sounds IER*, auscultated breath sound IER*,and pulmonary function test PFT using spirometer IER*)
- Circulatory status: (systolic blood pressure IER*, diastolic blood pressure IER* pulse pressure IER*, heart rate IER*, peripheral tissue perfusion, and extreme fatigue not present)
- Infection status (foul smelling discharge not present, purulent drainage not present, pain/tenderness at wound site not present, wound site culture free and WBCs elevation not present).
- Pain level using numerical rating pain scale with total scoring 11 points and categorized as following (0=none, 1-3=mild, 5-6=moderate, 7-10=severe).

Tube thoracostomy care protocol:

It was adapted from **Jacop, et al., (2020); Gurjar, M., (2016) & Roberts, et al., (2014)** and was translated into an arabic language by professional committee from faculty of languages and translation to be suitable for all nurses regardless to their educational level. It included two parts: **Part I**: **Theoretical part**: It was designed to cover nurses' knowledge regarding care of patient with tube thoracostomy. **Part II: Practical part:** It was concerned with nurses' practices regarding management of patient with tube thoracostomy (assistance with tube thoracostomy insertion, tube thoracostomy setup, tube thoracostomy assessment, insertion site care, tube thoracostomy system and tubing care, suction, drain documentation, air leak observation, oscillation observation, patient position and transport, specimen collection, tube thoracostomy dressing, changing the chamber, assistance with removal of tube thoracostomy and post tube thoracostomy removal care.

Operational design:

The operational design includes preparatory phase, pilot study and field work

Preparatory phase: It included reviewing of the related literature, and theoretical knowledge of various aspects of the study using books, articles, periodicals, websites and magazines to develop tools for data collection.

Content validity and reliability: Content validity were ascertained by seven experts; five from critical care nursing department faculty of Nursing Ain Shams University (three professors and two assistant professors), two chest physician at faculty of Medicine Ain Shams University (one professor and one assistant professor). Their opinion was elicited regarding the format, layout, consistency, accuracy and relevancy of the tools and modification was done. Reliability was estimated statistically for the developed tools by alpha cronbach test.

Ethical considerations:

The ethical considerations in this study included the following: The researcher clarified the objectives and the aim of the study to nurses and patients included in the study. Nurses and patients were allowed to choose to participate or not and they were informed that they have the right to withdraw from the study at any time without giving any reason.

Pilot study: A pilot study was conducted on 10% of subjects; nurses (three nurses) and patients (five patients) to test the applicability and feasibility of the study tools as well as time needed to fill these tools. Obtained results used as a guide to reconstruct the changes needed in the data collection tools and those subjects were excluded from the study sample.

Field work: The actual filed work of this study started at the beginning of September 2020 and had been completed by the end of November 2020. This period of time was divided into:

Implementation phase:

All available nurses working in chest intensive care unit were included in the study after explaining for them the purpose of the study and obtaining their oral consent before any data collection. Nurses were divided into six groups from (five nurse) in each group following the precautionary measures against COVID-19.

The researchers worked as a two group in collecting the data during the morning and afternoon shifts at two days/week. Nurses were given nurses' performance assessment tools part A & B; "Demographic Characteristics & Nurses' Knowledge questionnaire" related to tube thoracostomy that took about 20 minutes to be collected. Then, the researchers began to assess nurses' practice regarding care of patients with tube thoracostomy using nurses' performance assessment tools part C (nurses' practice observational checklist) all over the shift during their routine nursing care.

In the same time, researchers met the first 25 patients who were selected to be a control group, and began to collect clinical outcomes using (tool II) "clinical Outcomes assessment tool" during the shift while the nurses were given them the routine nursing care for tube thoracostomy.

Based on nurses' knowledge and practice level that was unsatisfactory and consequently undesirable patient's outcomes, a care protocol was given for nurses regarding caring of patients with tube thoracostomy. The care protocol included (anatomy and physiology, definition, indications, contraindications, complications and nursing

care; pre, during and post procedure nursing care. Also, it included procedures regarding assistance with tube thoracostomy insertion, tube thoracostomy setup, tube thoracostomy assessment, insertion site care, tube thoracostomy system and tubing care, suction, drain documentation, air leak observation, oscillation observation, patient position and transport, specimen collection, tube thoracostomy dressing, changing the chamber, assistance with removal of tube thoracostomy and post tube thoracostomy removal care).

The care protocol was presented in theoretical and practical sessions. The studied nurses were divided into six groups; each group included five nurses using the precautionary measures against COVID-19. Each group received three session as following: first session (theoretical session) was regarding the knowledge related to tube thoracostomy (anatomy and physiology, definition, indications, contraindications, complications and it took about 20 minutes using lectures, and group discussion and poster as a media.

While the second and third sessions (practical sessions) using demonstration, re-demonstration, through real materials and videos, each session took about 45 minutes and concerned with pre, during and post procedure nursing care; (tube thoracostomy setup, tube thoracostomy assessment, insertion site care, tube thoracostomy system and tubing care, suction, drain documentation, air leak observation, oscillation observation, patient position and transport, specimen collection, tube thoracostomy dressing, changing the chamber, assistance with removal of tube thoracostomy and post tube thoracostomy removal care).

Evaluation phase: It was emphasized on:

Evaluate the influence of tube thoracostomy care protocol on nurses' performance through the comparison between the pre and post care protocol implementation using tool (I) part B and C. Evaluate the influence of tube thoracostomy care protocol on clinical outcomes for patients with tube thoracostomy through the comparison between the control and study group pre and post care protocol implementation using tool (II).

Statistical design: Numerical data (quantitive) were presented as mean and standard deviation (X±SD). Qualitative data were presented as frequencies (n) and percentages (%). Independent-samples t-test of significance was used when comparing between two means, satisfactory levels pre and post. Chi-square test (X^2) was used for comparisons regarding qualitative data. Pearson correlation coefficient is used for quantitative variables. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics Version 20.

Results:

Regarding demographic characteristics of the studied nurses, **Table 1** showed that, mean age of the studied nurses was 29±3.4. As regards to nurse's gender, it was found that, 80.0% of them were females. In relation to their educational level, 50.0% of the studied nurses were high institute nurses. As well as, this table showed that 100.0% of them hadn't training courses regarding caring of patients with tube thoracostomy. Meanwhile, 53.3% of the studied nurses had years of experience less than 5 years.

Concerning nurses' level of knowledge regarding tube thoracostomy care pre and post implementation of care protocol, **table (2)** represents that, there were statistically significant differences between mean scores of the pre and post-tests as regard to anatomy and physiology of the respiratory system, definition, indications,

contraindications, complications and nursing care regarding chest tube.

Concerning nurses' level of practice regarding tube thoracostomy care pre and post implementation of care protocol, **table (3)** represents that, there were statistically significant differences between mean scores of the pre and post-tests as regard to tube thoracostomy setup, tube thoracostomy assessment, insertion site care, tube thoracostomy system and tubing care, suction, drain documentation, air leak observation, oscillation observation, patient position and transport, specimen collection, tube thoracostomy dressing, changing the chamber, and post tube thoracostomy removal care.

Figure (1) illustrates the difference between percentage of total satisfactory level of nurses performance regarding tube thoracostomy pre and post implementation of care protocol.

Table (4) shows, significant differences between the study and control group clinical outcomes regarding respiratory status: Gas exchange. 96% of the study group patients hadn't cyanosis and O2 saturation was 95%. Also, 92% of them didn't show dyspnea with exertion, dyspnea at rest, PaO2 and PaCO2 within normal range and arterial pH within normal range.

In **table (5) 92%** of the study group patients showed an improvement in respiratory rate and rhythm, chest expansion symmetrically, vocalize adequately, Adventitious breath sounds not present, Percussed sounds as well as Pulmonary function test (PFT) using spirometer in expected range .While **100%** of them had no chest retraction and pursed lips breathing. Also **96%** of them didn't show shortness of breath and the auscultated breath sound in expected range. Over all the respiratory status regarding ventilation outcomes showed statistically significant differences between control group and study group.

Table (6) illustrates that there were a statistically significant differences between control group and study group of patients with tube thoracostomy regarding their circulatory status clinical outcomes

Regarding the infectious status as a clinical outcomes of patients with tube thoracostomy, **table (7)** represents a statistically significant differences between control group and study group in all items of the infection status post implementation of care protocol for patient with tube thoracostomy

In this **table (8)** 60% of the study group patient reported that there were no pain after implementation of the care protocol for patient with tube thoracostomy with a statistically significant differences between control group and study group all over the variables of pain scale.

Table (9) revels statistically significant correlation between nurses knowledge and their practice regarding tube thoracostomy post care protocol implementation ($r=0.345$ at $P<0.05$).

Table 1: Distribution of the studied nurses regarding their demographic characteristics (n=30 nurses).

Demographic characteristics	N (30)	%
Age (Years)		
18< 30	17	56.7
30 <40	10	33.3
40≤60	3	10
Mean ± SD	29±3.4	
Gender		
Male	6	20
Female	24	80
Education		
Diploma nurse	10	33.3
High institute nurse	15	50
Bachelor nurse	5	16.7
Training courses		
Yes	0	0%
No	30	100%
Years of experience		
< 5	16	53.3%
≥ 5	14	46.7%

Table 2: Difference between mean scores of nurses' level of knowledge pre and post implementation of care protocol regarding tube thoracostomy (n=30 nurses)

Items of nurses' knowledge	Nurses' level of knowledge			
	Pre Mean ± SD	Post Mean ± SD	t test	P value
Anatomy and physiology	2±1.4	5	6.884	0.02
Definition	0.3±0.12	1	6.789	0.02
Indications	2.8±1.3	4.1±0.7	12.327	0.00
Contraindications	1.9±2.1	4.3±0.8	8.488	0.04
Complications	3.8±1.2	5.2±0.9	6.277	0.01
Nursing care	16.3±3.4	20.2±1.8	5.430	0.01
Total knowledge	27.1±9.52	39.8±4.2	14.65	0.000

Table 3: Difference between mean scores of nurses' level of practice pre and post implementation of care protocol regarding tube thoracostomy (n=30 nurses)

Items of nurses' practice	Nurses' level of practice			
	Pre Mean ± SD	Post Mean ± SD	t Test	P value
Tube thoracostomy setup	5.9 ±1.4	7.1 ±0.6	8.53	0.001
Tube thoracostomy assessment	3.9 ±0.9	5.4 ±0.6	10.05	0.002
Insertion site care	2.3 ±0.6	4	12.24	0.003
Tube thoracostomy system and tubing care	5.7 ±1.1	7.3 ±0.4	5.747	0.001
Suction	4.9 ±1.7	6.2 ±0.4	6.91	0.001
Drain documentation	5.3 ±1.9	8	8.51	0.002
Air leak observation	0.7 ±0.2	1.7 ±0.3	8.53	0.040
Oscillation observation	0.6 ±0.2	1.7 ±0.3	6.05	0.050
Patient position and transport	3.8 ±1.2	5	8.24	0.030
Specimen collection	5.4 ±1.1	7.2±0.8	5.747	0.04
Tube thoracostomy dressing	9.1 ±1.3	11	10.91	0.030
Changing the chamber	8.7 ±1.9	10.1±1.9	9.51	0.020
Post tube thoracostomy removal care	4.7 ±1.7	7	8.53	0.000
Total practice	61±15.2	81.7±5.3	16.54	0.000

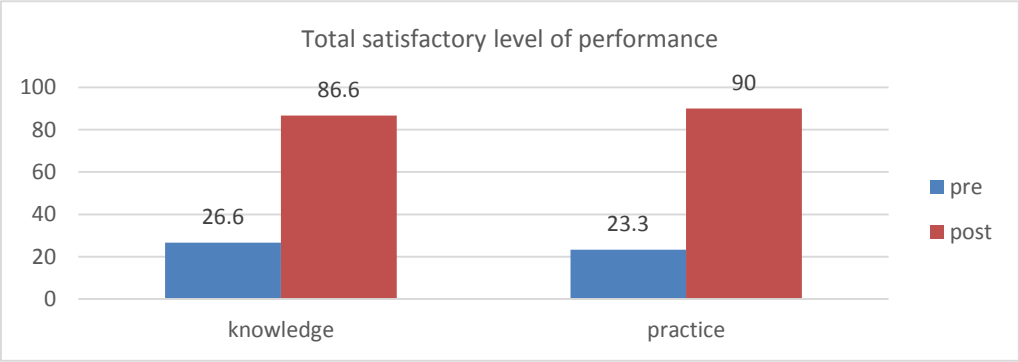

Figure 1: Difference between nurses' total satisfactory level of performance regarding tube thoracostomy pre and post care protocol implementation (n=30 nurses)

Table 4: Comparison between the control and study group regarding clinical outcomes of patients with tube thoracostomy (n= 25 patients in each group).

Clinical outcomes regarding respiratory status: Gas exchange	Clinical outcomes of patients with tube thoracostomy				X^2	P value
	Control group		Study group			
	No	%	No	%		
Mental status IER*	14	56	21	84	4.84	0.001
Ease of breathing,	13	52	22	88	4.94	0.051
Dyspnea with exertion not present	10	40	23	92	8.37	0.000
Dyspnea at rest not present	12	48	23	92	7.08	0.001
Restlessness not present	14	56	22	88	5.20	0.000
Cyanosis not present	17	68	24	96	4.92	0.033
Somnolence not present	10	40	20	80	4.37	0.000
PaO_2 and $PaCo_2$ within normal range	18	72	23	92	4.02	0.001
Arterial pH within normal range	18	72	23	92	8.27	0.031
O_2 saturation 95%	20	80	24	96	4.84	0.000
Chest X ray finding IER*	18	72	23	92	8.26	0.042

***IER: In expected range*

Table 5: Comparison between the control and study group regarding clinical outcomes of patients with tube thoracostomy (n= 25 patients in each group).

Clinical outcomes regarding respiratory status: ventilation	Clinical outcomes of patients with tube thoracostomy				X^2	P value
	Control group		Study group			
	No	%	No	%		
Respiratory rate and rhythm IER*	12	48	23	92	4.84	0.000
Chest expansion symmetrically	21	84	23	92	4.94	0.021
Vocalize adequately	16	64	23	92	8.37	0.000
Accessory muscle use not present	15	60	22	88	7.08	0.000
Adventitious breath sound not present	13	52	23	92	5.20	0.001
Chest retraction not present	20	80	25	100	5.92	0.031
Pursed lips breathing not present	16	64	25	100	5.37	0.000
Orthopnea not present	12	48	22	88	4.84	0.000
Shortness of breath not present	17	68	24	96	7.94	0.031
Percussed sounds IER*	14	56	23	92	8.37	0.020
Auscultated breath sound IER*	19	76	24	96	7.08	0.030
Pulmonary function test PFT using spirometer IER*	14	56	23	92	5.20	0.000

**IER: In expected range*

Table 6: Comparison between the control and study group regarding clinical outcomes of patients with tube thoracostomy (n= 25 patients in each group).

Clinical outcomes regarding circulatory status	Clinical outcomes of patients with tube thoracostomy				X^2	P value
	Control group		Study group			
	No	%	No	%		
Systolic blood pressure IER*	22	88	25	100	8.884	0.031
Diastolic blood pressure IER*	22	88	25	100	6.789	0.000
Pulse pressure IER*	22	88	25	100	8.327	0.000
Heart rate IER*	18	72	24	96	5.489	0.043
Peripheral tissue perfusion,	14	56	23	92	6.277	0.000
Extreme fatigue not present	18	72	24	96	5.430	0.000

**IER: In expected range*

Table 7: Comparison between the control and study group regarding clinical outcomes of patients with tube thoracostomy (n= 25 patients in each group).

Clinical outcomes regarding infection status	Clinical outcomes of patients with tube thoracostomy				X^2	P value
	Control group		Study group			
	No	%	No	%		
Foul smelling discharge not present	17	68	25	100	8.544	0.031
Purulent drainage not present	19	76	25	100	8.679	0.000
Pain/tenderness at wound site not present	19	76	24	96	6.316	0.000
Wound site culture free	19	76	24	96	65.415	0.043
WBCs elevation not present	19	76	24	96	6.233	0.000

Table 8: Comparison between the control and study group regarding clinical outcomes for patient with tube thoracostomy (n= 25 patients in each group).

Clinical outcomes regarding pain level	Clinical outcomes of patients with tube thoracostomy				X^2	P value
	Control group		Study group			
	No	%	No	%		
Absence of pain	7	28	15	60	6.554	0.031
Mild pain	12	48	8	32	7.558	0.000
Moderate pain	5	20	2	8	3.327	0.030
Severe pain	1	4	0	0	2.414	0.043

Table 9: Correlations between total satisfactory level of knowledge and total satisfactory level of practice post care protocol implementation regarding tube thoracostomy

Total satisfactory level of Practice	Total satisfactory level of Knowledge			
	Pre		post	
	r test	P value	r test	P value
Pre	0.129	0.251	-0.152	0.177
Post	-0.019	0.861	0.345	0.002**

Discussion

Lifelong learning is essential for the nurse to maintain and increase competence in nursing practice. There are many different means to meet continuing professional development needs. Formal means include continuing education, staff development, academic education and research activities. The purpose here is to help the nurses to maintain and improve their competencies as required for the delivery of quality care to the consumer. Implementations based on educational program, specifically designed nursing protocols, perceive gaps in their knowledge and would welcome the opportunity to be updated regularly.

The discussion of this study finding will prove our research hypothesis assumed that Application of care protocol will have positive influence on nurses' performance that consequently will affect the clinical outcomes for patients with tube thoracostomy.

The present study revealed that, the mean age of the studied nurses was 29±3.4, this result is in an agreement with **Ibrahim, (2016)** in his study entitled "impact of educational program on knowledge and practice of nurses about caring of patient with chest tube" who found that more than half of nurses 52.5% less than 30 years old. Regarding to gender, the current study found that, most of the studied nurses were females, these results were in the same line with **Tarhan et al., (2016)** on their research study titled "Nurses' Knowledge Levels of chest drain Management: A Descriptive Study" whom stated that most of the studied sample were females.

In relation to the educational level, the current study showed that, half of the studied nurses were High institute nurses. This result was not similar to **Ibrahim, (2016)** who found that more than half of the studied subject were technical education. Concerning training courses, none of the studied nurses had training course regarding tube thoracostomy care. This result is similar to the result of **Ibrahim, (2016)** who found that majority of studied nurses 95% had no past training in caring of chest tube. In relation to years of experience, more than half of the studied nurses had experience less than 5 years, from the researchers 'opinion this result may be due to that more than half of studied nurses' aged between 18-30 years old. This result in accordance with **Tarhan et al., (2016)** who found that less than two third 65% of the studied nurses had experience less than 5 years in caring of chest tube.

Concerning nurses' knowledge regarding tube thoracostomy care pre and post implementation of care protocol, the current study showed that, there were statistically significant differences between mean scores of the pre and post-tests as regard to anatomy and physiology of the respiratory system, definition, indications, contraindications, complications and nursing care regarding tube thoracostomy. The improvement due to the present care protocol using information, adequate sessions and practical content of the care protocol which was given to the studied nurses with the continuous explanations, reinforcement and feedback. From the researchers point of view comprehensive educational session regarding tube thoracostomy care should beheld regularly. An appropriate evidenced-base clinical guidelines and protocols should be developed for safe clinical practices and reducing unnecessary complications. This research emphasized that utilization of research validated knowledge in clinical setting should be focused by the nurses to improve their clinical practice.

This goes with **Hamel & Ahmed, (2020)** in their study titled "Effectiveness of an Educational Program on Nurses' Knowledge and Practices Regarding Nursing Implementations of Chest Tube Drainage System in Ibn Alnafees Teaching Hospital" whom found highly significant difference between pre & post-test in the study group. Also, this results in accordance with **Ibrahim, (2016)** who found that the mean post-test knowledge scores of studied nurses regarding chest tube had significantly higher than their mean pretest knowledge scores as test P< 0.05 level of significance. **Mazloum et al., (2018)** reported that a comprehensive educational session relating to chest tube management should be held regularly. An appropriate evidenced-base clinical guidelines and protocols are needed to develop for safe clinical practices.

The researchers explication for nurses unsatisfactory level of knowledge pre care protocol implementation that the years of experience of more than half of studied nurses were less than 5 years, and the nurses didn't attend any in-service training program related to tube thoracostomy. Also more than one third of the studied nurses were diploma graduates, and their knowledge was obtained during school study years and it might be forgotten. In addition from our observation during nurses practice, the supervision and evaluation system for them were inadequate. Therefore, lack of continuing education programs, in-service training and proper supervision, contribute to the problem.

As regard to nurses' practice regarding tube thoracostomy care pre and post implementation of care protocol, the current study represented that, there were statistically significant differences between mean scores of the pre and post-tests as regard to tube thoracostomy setup, tube thoracostomy assessment, insertion site care, tube thoracostomy system and tubing care, suction, drain documentation, air leak observation, oscillation observation, patient position and transport, specimen collection, tube thoracostomy dressing, changing the chamber, and post tube thoracostomy removal care. Significant improvement post program implementation might be due to the effect of the in-service training program which did not only stress the acquisition of knowledge of tube thoracostomy but also stressed on practical training to gain information and change work practice using adequate sessions, different teaching strategies as discussion, lecture, demonstration and re-demonstration, using media as handout including pictures and knowledge as well as availability of sufficient materials and supplies needed for achievement of the work, this motivated the studied nurses to achieve the desired objectives through rewarding and acknowledgement of positive attitude and discouragement of negative attitudes. All nurses participated in the program had received a handout of the program content. Also, recurrent reinforcement for both knowledge and practice was done in each session.

This result go in line with **Bedier & Ibrahim, (2016)** in their study entitled **"**Impact of an Educational Program on Nurses, Practice Related to Care of Patients with Chest Tube" which revealed that there was a highly statistically significant improvement in the studied nurses' practice about patient assessment, chest drain assessment, continuing care, changing the drainage system , chest tube dressing, care after thoracotomy, documentation, removal of chest tube and total practice score post program implementation.

Regarding clinical outcomes of patients with tube thoracostomy, the current study revealed that, there was statistically significant difference between patients in the study and control groups.

The researchers attributed this improvement in the outcome of study group to the care protocol provided to nurses caring for them using simple and attractive media, simulation techniques, continuous demonstration and re-demonstration that affect positively on their knowledge and subsequent their practice. Improving nurses' practice regarding caring for patients with tube thoracostomy will improve patient's respiratory status, vital signs, comfort level and prevent complication associated with poor knowledge and practice. Management of tube thoracostomy must be based on careful practice to ensure good prognosis and desirable patients outcomes. **Lit, et al., (2010)** emphasized in their thesis entitled "The need for nurses to have an in-service education of chest drain management" the importance of improving nurses' knowledge and practice to ensure optimum clinical outcomes of patients with chest drain.

Also, the results of the present study revealed that, there were positive significant correlations between nurses' knowledge and practice post care protocol implementation regarding caring of patients with tube thoracostomy. The knowledge is necessary for nurses to improve their practice. This is based on the recognition that nursing knowledge production must also be viewed in conjunction with practice as practice invades not only the use of knowledge but also gaining of knowledge. Nursing competencies depend largely on intuitive knowledge and skills. Therefore, the reasons for nurses, improper performance are usually the lack of nurses' knowledge and skills. The study result was contradicted with the findings of the research study done by **AbdelAziz, et al., (2016) in their study "**Assessment the Nurses Performance in Providing Care to Patients Undergoing Chest Tube in Suez Canal University Hospital" whom stated that there was no statistically significant relationship between nurses' knowledge and practice.

Conclusion

In view of the findings, the researches hypothesis has been proved as the application of care protocol for patient with tube thoracostomy has a positive effect on nurses' performance; as it improved their knowledge and practical level regarding care of patient with tube thoracostomy and consequently has a positive effect in refinement the outcomes for patients in the study group rather than the control group with a statistically significant difference.

Recommendations:

- Importance of presence of protocol related to care of patients with tube thoracostomy.
- Developing a system of periodical evaluation for nurses to determine strategies of upgrading their knowledge and enhancing their practice regarding tube thoracostomy.
- Tube thoracostomy training program should be mandatory for newly employed nurses.
- Nurses involved in patient care should have a valid tube thoracostomy care certification and renew it regularly at least every three year.
- Further researches should be done to assess and evaluate the clinical outcomes for patients with tube thoracostomy.

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Conflict of interest

The authors declare no conflict of interest or otherwise.

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