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The Effect of Nursing Intervention on the Reduction of Pulmonary Complications after Thoracotomy

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Abstract

Postoperative pulmonary complications are a common occurrence after major cardiac and thoracic surgeries because the effect of surgical procedures, anesthesia, and pain can impede chest wall movement and lung expansion. ***Aim:*** The aim of the present study was to determine the effect of nursing intervention on the reduction of pulmonary complications after thoracotomy. ***Design:*** A quasi-experimental research design was utilized in the study. **Subject:** A purposive sample of 70 adult patients from both genders required for thoracotomy was involved in this study and divided randomly into two equal groups (35 patients in each group). ***Setting:*** This study was carried out at Surgical Intensive Care Units at National Heart Institute. **Tools:** Two tools were used for data collection ***(I)*** A structured interview assessment questionnaire, ***(II)*** Postoperative pulmonary complications assessment questionnaire. ***The results:*** This study revealed that, there was a statistically significant difference in the occurrence of postoperative pulmonary complications between the control and study group, in which the study group showed lower occurrence of postoperative pulmonary complications in comparison to the control group. ***Conclusion:*** Applying the nursing intervention by the researcher, which involves monitoring of hemodynamic and respiratory status, care of the chest tube, physiotherapy and deep breathing exercises, using incentive spirometer, early mobilization, sterile wound dressing, and control of pain help in reducing postoperative pulmonary complications as well as decrease the patient's length of stay in the hospital. ***Recommendations:*** This study recommended that; the designated nursing intervention should be carried out as a routine nursing care for the patients after thoracotomy.

Keywords: Nursing Intervention, Pulmonary Complications, Thoracotomy.

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Introduction:

A thoracotomy is a surgical procedure in which a cut is made between the ribs to see and reach the lungs or other organs in the chest or thorax. Typically, a thoracotomy is performed on the right or left side of the chest. An incision on the front of the chest through the breast bone can also be used, but is rare. A thoracotomy

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is performed for diagnosis or treatment of a disease and allows doctors to visualize, biopsy or remove tissue as needed. An approximate six-inch incision is made below the tip of the shoulder blade, typically between the fifth and sixth ribs. During the surgery, the doctors will insert a chest tube on the side of the thoracotomy, which drains excess fluid or air leaking into the chest and helps your lungs to re-inflate. This tube remains in place for a few days **(Urden, Stacy, and Lough, 2020).**

Risk factors for PPCs development are numerous, and clinicians should be aware of non-modifiable and modifiable factors in order to recognize those at risk and optimize their care. Risk reduction strategies include preoperative strategies such as smoking cessation, optimization of underlying chronic lung disease and patient education. Intraoperative strategies such as choice of type of anesthesia and neuromuscular blockade, and lung protective ventilation. Postoperative strategies such as lung expansion maneuvers, and pain control **(Nagelhout and Elisha, 2018).**

Postoperative pulmonary complications (PPCs) are a major cause of morbidity after thoracotomy, resulting in patient discomfort, prolonged length of hospital stay, and increased health care costs. Thoracotomy can also lead to long-term restriction of shoulder function and range of motion, reduced muscle strength, chronic pain, and reduced health-related quality of life, so that postoperative nursing care is playing an important role to reduce these complications **(Urden, Stacy, and Lough, 2020).**

Postoperative pulmonary complications are common, costly, and increase patient mortality. Changes to the respiratory system occur immediately on induction of general anesthesia; respiratory drive and muscle function are altered, lung volumes reduced, and atelectasis develops in>75% of patients receiving a neuromuscular blocking drug. The respiratory system may take 6 weeks to return to its preoperative state after general anaesthesia for major surgery **(Park et al., 2020).**

Another complication that is frequently met after cardiac and thoracic surgeries is pulmonary infection, which not only affects the lung as an organ, but contributes to the surgery outcome and patient survival. Postoperative pulmonary infection has different degrees of severity ranging from mild cough to respiratory failure necessitating invasive ventilation. Diaphragmatic dysfunction is not a serious complication except in patients with underlying pulmonary problem; it may pass smoothly or may affect the patient leading to frequent pulmonary infections or even respiratory failure **(Mali and Haghaninejad, 2019).**

Postoperative interventions that are definitely beneficial for high risk patients include deep breathing exercises or incentive spirometer and use of epidural analgesia, where appropriate in place of parenteral opioids. Continuous positive airway pressure (CPAP), intercostal nerve blocks, and early mobilization are probably beneficial postoperative interventions **(Mohamed, 2017).**

Physiotherapy treatment post-thoracotomy usually focus on prevention of pulmonary complications during the acute recovery phase and improvement of thoracic and shoulder mobility by range of motion exercise (ROM)**.** Physiotherapy treatment modalities include airway clearance techniques such as deep breathing exercises (DBE), using incentive spirometer (IS), active cycle of breathing technique

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(ACBT), manual chest clearance techniques e.g. percussions and body positioning **(Ahmad, 2018).**

Significance of the study:

Pulmonary complications are a major cause of morbidity and mortality during the postoperative period after thoracic surgery. The incidence of post-operative pulmonary complications has been reported to vary between 5% and 80%. The incidence varies between hospitals. Lower rates of complications have been reported in hospitals with a high volume of patients. Higher rates have been reported in hospitals with a lower volume **(Miskovic and Lumb, 2017).**

In Egypt, there was a study conducted in the cardiothoracic department with collaboration of chest department in Tanta University hospitals through a period of 14 months duration; the results revealed that, pulmonary complications more common after cardiothorathic surgery and incidence of it was as the following; Atelectasis (70.51%), pleural effusion (47.44%), pneumonia (34.62%), and sternal wound infection (12.82%), acute respiratory distress syndrome (2.56%), pneumothorax (1.28%) **(Elkolaly et al., 2018).**

It has been estimated that worldwide >230 million major operations occur annually. The incidence of PPCs in major surgery ranges from <1 to 23%. Several studies have shown that pulmonary complications are more common than cardiac complications and postoperative respiratory failure is the most common PPCs. Mortality is increased in both the short and long term in patients who develop a PPCs. Length of hospital stay (LOS) has been shown to be prolonged by 13–17 days. Developing a PPCs also increases healthcare costs, primarily as a result of increased LOS **(Miskovic and Lumb, 2017).**

Aim of the study:

The aim of the present study was to determine the effect of nursing intervention on the reduction of pulmonary complications after thoracotomy.

Research Hypothesis

At the end of the study, patients who will receive the nursing intervention will have significant reduction of pulmonary complications after thoracotomy than patients who will not receive the nursing intervention.

Sample and Methods:

Design:

A Quasi-experimental research design was utilized in this study.

Participants:

A purposive sample of 70 adult patients from both genders required for thoracotomy was involved in this study at surgical intensive care units at National Heart Institute, then divided randomly into two equal groups (35 patients in each group).

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Research tools:

Tool I: Structured Interview Assessment Questionnaire.

Which adapted from **Ahmed, Soliman, and Mohamed, (2017)** with a minor modification done by the researcher and consist of two parts.

I.1 - The first part concerned with the patient's socio-demographic data.

It composed of (5) ended questions included the following; age, gender, marital status, educational level, and occupation.

I.2 - The second part concerned with the patient's medical data.

It composed of (7) ended questions included the following; type of surgery, duration of hospital stay, duration of mechanical ventilation, history of comorbidities disease, previous hospitalization, previous surgery, and history of smoking.

Tool II: Postoperative Pulmonary Complications Assessment Questionnaire.

Which adapted from **Ahmed, Soliman, and Mohamed, (2017)** with a minor modification done by the researcher after reviewing the most recent and relevant literatures and consist of seven parts.

II.1- The first part concerned with assessment of hemodynamic state.

It used to assess vital signs of the patients immediately after the operation, which includes temperature, pulse, blood pressure, respiration rate, and oxygen saturation.

II.2- The second part concerned with assessment of the chest tube.

It used to assess site of insertion, size and number of the tubes, patency of the tubes, drainage fluctuation in the tubes, and duration of chest tubes stay.

II.3- The third part concerned with assessment of the drainage.

It used to assess the characteristics of the drainage including; type, color, and amount of the drainage, and air bubbling.

II.4- The fourth part concerned with wound assessment.

It used to assess the characteristics of the wound as clean, dry, inflamed, swelled, or exudates fluid or pus.

II.5- The fifth part concerned with assessment of pain.

It used to assess the degree of pain by using visual analog scale as the following; No pain=0, Mild pain=2, Moderate pain=4, Sever pain=6, Very sever pain=8, and Worst pain=10.

II.6- The sixth part concerned with assessment of respiratory system.

It used to assess the respiratory system immediately after the operation for respiration depth, lung sound, and presence of pulmonary complications.

II.7- The seventh part concerned with assessment of the laboratory finding.

Which included hemoglobin, leukocytes, sodium, potassium, and blood gases.

Content validity and reliability:

Content validity was conducted to determine whether or not the instrument measures what it is designed to measure. The tools were revised by a jury of 5 experts as the following; 2 lecturers of medical, surgical nursing from faculty of nursing, Helwan University, 2 assistant professors of medical surgical nursing from faculty of nursing, Helwan University, and professor of medical, surgical nursing

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from faculty of nursing, Zagazig University, who reviewed the content of the tools for comprehensiveness, accuracy, clarity, relevance, and applicability. Minor modifications were done. Reliability of the tools of the present study was (cronbach's alpha (0.811), acceptable).

Pilot study:

A Pilot study was carried out with 10% of the sample under study to test the applicability, clarity, and efficiency of the tools, then the tools modified according to the results of the pilot study. Patients whom shared in pilot study not included in the sample and replaced by other patients.

Field work:

After obtaining the official permissions, the researcher started to recruit the sample of patients. The purpose of the study was explained simply to the patients or to their families who agree to participate in the study prior to any data collection. Sampling was started and completed within twelve months. Data collection was done by the researcher in the morning and afternoon shifts before and after thoracotomy. Tool (I): Structured Interview Assessment Questionnaire was filled for the study and control group by the researcher before and after thoracotomy. Tool (II): Postoperative Pulmonary Complications Assessment Questionnaire was filled by the researcher every other day as in 1^{st} , 3^{rd}, and 5^{th} day following thoracotomy.

Ethical considerations:

An approval was obtained from a scientific research ethics committee of the faculty of nursing at Helwan University and a consent was obtained from the study subjects individually before starting the study. The aim and objectives of the study was clarified to the patients included in the study by the researcher. Participants were assured that anonymity and confidentiality would guarantee. Patients were informed that they are allowed to choose to participate or withdraw from the study at any time. Ethics, culture, values were respected.

Statistical analysis:

Qualitative data were presented as frequencies (n) and percentages (%). Chi-square test (or Fissure's Exact test when applicable) were used for comparisons between the two groups. McNemar's test was used to study the change at the end of treatment for binary variables. Friedman's test and Wilcoxon signed-rank test was used to study the change at the end of treatment for other qualitative variables. Numerical data were presented as mean, median, standard deviation (SD) and range values. Student's t-test was used to compare between mean age values in the two groups. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with "IBM-SPSS" Statistics Version 20 for Windows.

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Results:

Table (1): Descriptive statistics for both control and study group regarding socio-demographic data.

Items	Control (n = 35)	Study (n = 35)	Test statistic	*P*-value
Age /years				
Mean ± SD	39.6±10.59	41.4±10.56	t = 0.475	0.493
Median	37.00	42.00		
Range	24-60	22-61		
Age category [n (%)]				
20 – 35 y	15 (42.9%)	10 (28.6%)	x^2 = 1.63	0.443
36 – 50 y	12 (34.3%)	16 (45.7%)		
51 – 65 y	8 (22.9)	9 (25.7%)		
Gender [n (%)]				
Male	3 (8.6%)	4 (11.4%)	x^2= 0.159	0.690
Female	32(91.4%)	31 (88.6%)		
Social status [n (%)]				
Single	6 (17.1)	8 (22.9%)		
Married	23 (65.7%)	21 (60%)	x^2= 0.377	0.945
Divorced	4 (11.4%)	4 (11.4%)		
Widowed	2 (5.7%)	2 (5.7%)		
Education [n (%)]				
Illiterate	6 (17.1%)	7 (20.0%)		
Basic education	5 (14.3%)	10 (28.6%)	x^2 =3.625	0.305
Secondary education	17 (48.6)	10 (28.6%)		
Higher education	7 (20.0%)	8 (22.9%)		
Occupation [n (%)]				
Not work	21 (60.0%)	23 (65.7%)	x^2 =0.245	0.805
Work	14 (40.0%)	12 (34.3%)		

**: Significant at P ≤ 0.05*

Table (1) showed that, there was no statistically significant difference between socio-demographic characteristics of the two groups regarding mean age (P-value = 0.493), age categories (P-value = 0.443), social status (P-value = 0.945), education (P-value = 0.305) as well as occupation (P-value = 0.805).

Table (2): Descriptive statistics for both control and study group regarding medical data.

Items	Control (n = 35)		Study (n = 35)		Test statistic	*P*-value
	N	%	N	%		
Type of surgery						
Mitral valve replacement	27	77.1	25	71.4	x^2 = 0.311	0.856
Coronary artery bypass graft	3	8.6	4	11.4		
Atrial septal defect	5	14.3	6	17.1		

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Duration of hospital stay						
4-5 Days	7	20	14	40	x^2= 6.858	0.032*
6-7 Days	21	60	20	57.1		
More than 7 Days	7	20	1	2.9		
Duration of mechanical ventilation						
4-6 hours	12	34.3	16	45.7	x^2 = 4.316	0.229
7-9 hours	9	25.7	12	34.3		
10-12 hours	12	34.3	7	20		
More than 12 hours	2	5.7	0	0		
Comorbidities disease						
Diabetes mellitus	5	14.3	6	17.1	x^2 =3.158	0.676
Heart disease	4	11.4	4	11.4		
Hypertension	4	11.4	2	5.7		
Liver disease	1	2.9	0	0		
Neurological disease	3	8.6	1	2.9		
Previous hospitalization	4	11.4	8	22.9	*Fisher's Exact test =1.609*	0.342
Previous surgery						
Heart surgery	2	5.7	2	5.7	*Fisher's Exact test = 0.000*	1.000
Lung surgery	0	0	0	0		
History of smoking	4	11.4	2	5.7	*Fisher's Exact test = 0.729*	0.673

*: *Significant at P ≤ 0.05*

Table (2) showed that, there was a statistically significant difference between the two groups regarding the duration of hospital stay (*P*-value = 0.032*).

Table (3): Descriptive statistics for both control and study group regarding hemodynamic state

Items	First Day				Third Day				Fifth Day				ANOVA F (p)
	Control (n = 35)		tudy (= 35)		Control (n = 35)		Study (n = 35)		Control (n = 35)		Study (n = 35)		
	N	%	N	%	N	%	N	%	N	%	N	%	
Temperature													
Normal	33	94.3	34	97.1	28	80	31	88.6	33	94.3	35	100	1.962 (0.166)
Hyperthermia	2	5.7	1	2.9	7	20	4	11.4	2	5.7	0	0	
Test & (P-Value)	*Fisher's Exact test* =0.348 1.000				*Fisher's Exact test = 0.971* 0.513				*Fisher's Exact test = 2.059* 0.493				
Pulse													
Normal	24	68.6	25	71.4	24	68.6	31	88.6	31	88.6	34	97.1	2.293 (0.135)
Tachycardia	11	31.4	10	28.6	11	31.4	4	11.4	4	11.4	1	2.9	
Test & (P-Value)	*Fisher's Exact test =* 0.068 1.000				*Fisher's Exact test =* 4.158 0.078				*Fisher's Exact test =* 1.938 0.356				

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Blood Pressure													
Hypotension Normal Hypertension	10 20 5	28.6 57.1 14.3	10 21 4	28.6 60 11.4	4 29 2	11.4 82.9 5.7	0 33 2	0 94.3 5.7	2 31 2	5.7 88.6 5.7	0 35 0	0 100 0	0.138 (0.711)
Test & (P-Value)	*x2* = 0.136 0.934				*x2* =4.258 0.119				*x2* =4.242 0.120				
Respiration													
Normal Tachypnea	26 9	74.3 25.7	28 7	80 20	20 15	57.1 42.9	29 6	82.9 17.1	26 9	74.3 25.7	34 1	97.1 2.9	5.630 (0.020*)
Test &(P-Value)	*x2* =0.324 *0.569*				*x2* =*5.510* *0.019**				*Fisher's Exact test* = 7.467 *.0013**				
Oxygen saturation													
(91-100) (70-90)	35 0	100 0	35 0	100 0	34 1	97.1 2.9	35 0	100 0	35 0	100 0	35 0	100 0	1.000 (0.321)
Test & (P-Value)	*Not Computed*				*Fisher's Exact test* = 1.014 1.000				*Not Computed*				

**: Significant at P ≤ 0.05*

Table (3) showed that, there was a statistically significant difference between the two groups regarding respiration in the third day (P-value = 0.019*), and in the fifth day (P-value = 0.013*) as well as there was a statistically significant difference between the three measures of respiration during the study period (P-value = 0.020*)

Table (4): Descriptive statistics for both control and study group regarding wound and pain assessment.

Items	First Day				Third Day				Fifth Day				ANOVA F (p)
	Control (n = 35)		Study (n = 35)		Control (n = 35)		Study (n = 35)		Control (n = 35)		Study (n = 35)		
	N	%	N	%	N	%	N	%	N	%	N	%	
Wound Assessment													
Dry clean Inflammed&swelled Fluid, or pus drainage	35 0 0	100 0 0	35 0 0	100 0 0	31 4 0	88.6 11.4 0	34 1 0	97.1 2.9 0	31 3 1	88.6 8.6 2.9	35 0 0	100 0 0	3.163 (0.080)
Test & (P-Value)	*Not Computed*				*Fisher's Exact test* = 1.938 0.356				x^2=4.242 0.120				
Pain Assessment													
No pain Mild pain Moderate pain Sever pain	0 12 18 5	0 34.3 51.4 14.3	0 25 8 2	0 71.4 22.9 5.7	0 12 22 1	0 34.3 62.9 2.9	0 27 8 0	0 77.1 22.9 0	9 20 5 1	25.7 57.1 14.3 2.9	26 8 1 0	74.3 22.9 2.9 0	18.044 (0.000*)
Test & (P-Value)	x^2=9.699 0.008*				x^2=13.303 0.001*				x^2=17.067 0.001*				

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: Significant at P ≤ 0.05

Table (4) showed that, there was a statistically significant difference between the two groups regarding pain assessment in the first, third, and fifth day (P-value=0.008*, 0.001*, and 0.001* respectively); as well as, there was a highly statistically significant difference between the three measures during the study period (P-value= 0.00**).

Table (5): Descriptive statistics for both control and study group regarding presence of pulmonary complications in the fifth day.

Item	Group				Test Statistic	*P*-value
	Control (n = 35)		Study (n = 35)			
	N	%	N	%		
Presence of pulmonary complications						
Yes	16	45.7	3	8.6	*Fisher's Exact test* = 12.208	0.001*
No	19	54.3	32	91.4		

: Significant at P ≤ 0.05

Table (5) showed that, there was a statistically significant difference (P-value= 0.001*) between the two groups at the fifth day regarding presence of pulmonary complications in which about half of the control group (45.7%) developed PPCs, while (8.6%) of the study group developed PPCs.

Table (6): Descriptive statistics and results of the association between Socio-demographic data and prevalence of postoperative pulmonary complications.

Items	Prevalence of PPCs				Test statistic	*P*- value
	No PPCs (n=51)		PPCs (n=19)			
	N	%	N	%		
Age:						
20 – 35 y	21	41.2	4	21.1	x^2=3.292	0.193
36 – 50 y	20	39.2	8	42.1		
51 – 65 y	10	19.6	7	36.8		
Gender:						
Male	4	7.8	3	15.8	*Fisher's Exact test* =0.971	0.379
Female	47	92.2	16	84.2		
Education:						
Illiterate	10	19.6	3	15.8	x^2=0.871	0.832
Basic education	10	19.6	5	26.		
Secondary education	19	37.3	8	42.1		
Higher education	12	23.5	3	15.8		

**: Significant at P ≤ 0.05*

Table (6) showed that, there was no statistically significant association between age, gender, &education and the prevalence of PPCs (*P*-value=0.193, 0.379, and 0.832, respectively).

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Table (7): Descriptive statistics and results of the association between medical data and prevalence of postoperative pulmonary complications.

Items	Prevalence of PPCs				Test Statistic	*P*- value
	No PPCs (n=51)		PPCs (n=19)			
	No	%	No	%		
Duration of hospital stay						
4-5 Days	21	41.2	0	0	x^2=29.299	0.000*
6-7 Days	30	58.8	11	57.9		
More than 7 Days	0	0	8	42.1		
Duration of mechanical ventilation						
4-6 hr	26	51	2	10.5	x^2= 20.814	0.000*
7-9 hr	17	33.3	4	21.1		
10-12 hr	8	15.7	11	57.9		
More than 12 hr	0	0	2	10.5		
Comorbidities disease						
DM	7	13.7	4	21.1	x^2= 6.434	0.266
Heart disease	4	7.8	4	21.1		
Hypertension	3	5.9	3	15.8		
Liver disease	1	2	0	0		
Neurological disease	3	5.9	1	5.3		
History of smoking						
Smoker	2	3.9	4	21.1	*Fisher's Exact test* = 5.184	0.042*
Non Smoker	49	96.1	15	78.9		

*: *Significant at P ≤ 0.05*

Table (7) showed that, there was a statistically significant association between duration of hospital stay, duration of mechanical ventilation, & history of smoking and the prevalence of postoperative pulmonary complications (P-value 0.000**, 0.000**, and 0.042* respectively).

Table (8): Descriptive statistics and results of the association between respiration depth&Lung sound and prevalence of postoperative pulmonary complications.

Items	Prevalence of PPCs				Test Statistic	*P*- value
	No PPCs (n=51)		PPCs (n=19)			
	No	%	No	%		
Respiration Depth						
Normal	51	100	9	47.4	x^2= 31.316	0.000**
Shallow	0	0	10	52.6		
Lung Sound						
Normal	50	98	12	63.2	x^2=16.850	0.000**
Wheezing	1	2	5	26.3		
Crackles	0	0	2	10.5		

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*: *Significant at P ≤ 0.05*

Table (8) showed that, there was a statistically significant association between respiration depth&lung sound and prevalence of PPCs (P-value 0.000**, and 0.000* respectively).

Discussion:

The study aimed to determine the effect of nursing intervention on the reduction of pulmonary complications after thoracotomy. The results of the present study revealed that, the studied patients from the study and control group were homogenous related to their socio-demographic characteristics and medical data. This could be related to, the selection of the patients based on inclusion and exclusion criteria, then divided randomly into two groups. This finding is similar to **El far et al., (2018)** entitled "Effect of Protocol of Care on Clinical Outcomes of Patients with Chest Tube Post Cardiothoracic Surgery", and it is also similar to **Hariedy et al., (2011)**, which about "The Impact of Implementing of Standardized Nursing Care toward Patient with a Chest Tube to Reduce Pulmonary Complications after Thoracotomy", revealed that, the two groups were similar to each other in socio-demographic characteristics and medical data.

In the present study, the finding regarding the patient's characteristics revealed that, more than three quarters of the total studied patients were in the age group 20-35 and 36-50, while less than one quarter were in the age group 51-60. This finding is supported by **Ávila and Fenili, (2017)** entitled "Incidence and risk factors for postoperative pulmonary complications in patients undergoing thoracic and abdominal surgeries", who reported that, more than two thirds of the studied patients were aged from 35-50 years old.

Concerning the gender of the studied patients, it was found that, the majority of the total studied patients were female. This could be related to thoracotomy operation more done for young female patients to maintain chest appearance and avoid presence of any scars in the sternum. This finding is supported by **Ávila and Fenili, (2017)** entitled "Incidence and risk factors for postoperative pulmonary complications in patients undergoing thoracic and abdominal surgeries", who reported that, about two thirds of the studied patients were female, while this finding disagrees with **El far et al., (2018)**, which about "Effect of Protocol of Care on Clinical Outcomes of Patients with Chest Tube Post Cardiothoracic Surgery", who reported that, more than half of the studied patients were male.

Concerning the duration of hospital stay, this study showed that, there was a statistically significant difference between the study and control group regarding length of hospital stay in which patients in the study group had a less length of hospital stay than the patients in the control group. This finding illustrates the importance of the nursing intervention that done by the researcher for the study group. This finding is supported by **El far et al., (2018)** entitled "Effect of Protocol of Care on Clinical Outcomes of Patients with Chest Tube Post Cardiothoracic Surgery", who reported that, the patients in the study group had a less length of ICU stay (Mean±SD 4.97±1.27) than the patients in the control group (Mean±SD 6.77±2.39), while This finding disagrees with **Awad et al., (2018)**, which about "Effect of Therapeutic Exercises Program on Patients' Outcomes Undergoing Open Heart Surgeries" who reported that, about four-fifths of the studied patients stay less than 5 days after

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surgery. Also, this finding disagrees with **Cui et al., (2020)** entitled "Precision implementation of early ambulation in elderly patients undergoing off-pump coronary artery bypass graft surgery", who revealed that, there was no statistically significant difference between the study and control group regarding length of hospital stay.

Concerning the history of comorbidities disease, this study showed that, more than half of the studied patients from both study and control group had no history of comorbidities disease. This could be related to a lot of the studied patients from both study and control group were young age. This finding is in line with **Elkolaly et al., (2018)**, which about "Pulmonary affection after cardiac surgery", who reported that, about only one quarter of the studied patients had a history comorbidities disease. But this finding disagrees with **Olafiranye et al., (2011)**, which about "Management of Hypertension among Patients with Coronary Heart Disease", who reported that, the majority of the studied patients had hypertension and heart disease.

As regards hemodynamic state (vital signs); this study showed no statistically significant difference regarding temperature, pulse, blood pressure, and oxygen saturation in which the majority of the studied patients from both study and control group were having a normal measurements, while there was a statistically significant difference regarding respiration in which tachypnea more observed in the patients in the control group. It could be related to close monitoring and controlling of temperature, pulse, blood pressure as well as supplementation of oxygen, while tachypnea may be occurring due to the painful sensation with deep breathing and lack of using spirometer & physiotherapy. This result is supported by **Chandler et al., (2020)** entitled "Perioperative strategies for the reduction of postoperative pulmonary complications", who revealed that, the majority of the studied patients were having a normal measurement of the vital signs. But this result is against **Hany, (2019)** in a master thesis in critical care and emergency nursing entitled "effect of deep breathing technique on severity of pain among postoperative coronary artery bypass graft patients", who mentioned that, there was a statistically significant difference between the study and control group regarding temperature, pulse, respiration, and blood pressure.

In relation to wound assessment; the majority of the total studied patients had a dry clean wound, while signs and symptoms of wound infection present in a fewer number of patients. This is could be related to the smaller thoracotomy incision as well as a lateral incision of the chest is more suitable for healing and reduction of incision site infection. This finding is supported by **Qin et al., (2021)**, which about "Perioperative breathing training to prevent postoperative pulmonary complications in patients undergoing laparoscopic colorectal surgery", who mentioned that, there was no statistically significant difference between the study and control group regarding criteria of the wound.

Regarding pain assessment; this study showed a statistically significant difference in pain level between study and control group in which study group had a lower level of pain than the control group, which may be explained as implementing of deep breathing exercise, relaxation technique, and using spirometer is very useful in the reduction of pain sensation. This finding agrees with **Hany, (2019)** in a master thesis in critical care and emergency nursing entitled "effect of deep breathing technique on severity of pain among postoperative coronary artery bypass graft patients", who mentioned that, there was a statistically significant difference between

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the study and control group regarding degree of pain in which the control group was suffering from high degree of pain than the study group.

Regarding pulmonary complications; this study showed a statistically significant difference in the occurrence of pulmonary complications in the fifth day between the study and control group in which pulmonary complications occurred in about half of patients in the control group, while the majority of the patients in the study group were free from pulmonary complications. This finding illustrates the efficacy of nursing interventions which implemented by the researcher for the study group. This finding is supported by **Qin et al., (2021)**, which about "Perioperative breathing training to prevent postoperative pulmonary complications in patients undergoing laparoscopic colorectal surgery:" who reported that, the incidence of postoperative pulmonary complications in the breathing training group was lower than that in the control group.

There was no statistically significant among the studied patients regarding the association between socio-demographic data as age, gender&education, and prevalence of PPCs. This finding contraindicated with **Fernandes et al., (2019)** entitled "Root causes and outcomes of postoperative pulmonary complications after abdominal surgery: a retrospective observational cohort study", who reported that, postoperative pulmonary complications more occurred in old age male patients, as well as this finding disagrees with **Garutti et al., (2020)**, which about "Spontaneous recovery of neuromuscular blockade is an independent risk factor for postoperative pulmonary complications after abdominal surgery" reported that, patients who developed postoperative pulmonary complications were older with a higher body mass index (BMI).

There was a statistically significant among the studied patients regarding the association between duration of hospital stay and the prevalence of PPCs, in which presence of PPCs increases a patient's hospital length of stay. This finding is in line with **Qin et al., (2021)**, which about "Perioperative breathing training to prevent postoperative pulmonary complications in patients undergoing laparoscopic colorectal surgery:" who revealed that, patient with PPCs had a longer length of hospital stay, and lower patient satisfaction than those without.

There was a statistically significant among the studied patients regarding the association between duration of mechanical ventilation and the prevalence of PPCs, in which PPCS more occurred in patients whose spends more time on mechanical ventilation. This result is constant with **Mathis et al., (2019)**, which about "Intraoperative mechanical ventilation and postoperative pulmonary complications after cardiac surgery" who revealed that, there was a statistically significant among the studied patients regarding the association between duration of mechanical ventilation and the prevalence of PPCs, in which patients with PPCs were connected with mechanical ventilator for long period than patients without PPCs, also he reported that, early weaning from mechanical ventilation provide pulmonary function and reduce incidence of postoperative pulmonary complications.

There was a statistically significant among the studied patients regarding the association between respiration depth & lung sound and the prevalence of PPCs, in which occurrence of PPCs is associated with tachypnea and shallow respiration as well as abnormal lung sounds more present. This result is supported by **Chandler et al., (2020)** entitled "Perioperative strategies for the reduction of postoperative

pulmonary complications", who revealed that, rapid shallow respiration more observed in patients with PPCs.

Conclusion:

Based on the results of the present study, this study concluded that, Applying the nursing intervention by the researcher, which involves monitoring of hemodynamic and respiratory status, sterile wound dressing, care of the chest tube, physiotherapy and deep breathing exercises, using incentive spirometer, early mobilization, and control of pain help in reducing postoperative pulmonary complications as well as decrease the patient's length of stay in the hospital.

Recommendations:

Based upon the results of the current study, the following recommendations are suggested; The designated nursing intervention, which involves monitoring of hemodynamic and respiratory status, care of the chest tube, physiotherapy and deep breathing exercises, using incentive spirometer, early mobilization, sterile wound dressing, and control of pain should be carried out as a routine nursing care for patients after thoracotomy. The patients undergoing thoracotomy should be educated about non pharmacological pain management, chest tube care, deep breathing and coughing exercises, and effective training for using spirometer to enhance lung expansion.

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