

# Assessment of Pulmonary Complications after Thoracotomy

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**Abstract:** 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. **Aim:** The aim of the present study was to assess pulmonary complications after thoracotomy. **Design:** A descriptive research design was utilized in the study. **Subject:** A purposive sample of 35 adult patients of both genders required for thoracotomy was involved in this study. **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, which included (a) Patient's socio demographic data, (b) Patient's medical data, (II) Postoperative pulmonary complications assessment sheet for thoracotomy patients, which included (a) Assessment of hemodynamic state, (b) Assessment of chest tube, (c) Assessment of the drainage, (d) Wound assessment, (e) Pain assessment, (f) Assessment of the respiratory system, (g) Assessment of laboratory finding. **Results:** The majority of the studied patients 91.4% were females, while 8.6% were males with mean and standard deviation values of age  $39.6 \pm 10.59$  years old. More than three quarters of the studied patients 77.1% admitted to ICU post mitral valve replacement, while 8.6% admitted post coronary artery bypass graft. About four fifths of the studied patients suffered from pulmonary complications in the third day following thoracotomy, in which cough and dyspnea are the most occurred complications. **Conclusion:** Pulmonary complications are common occurred after thoracotomy in the third day following thoracotomy, in which cough and dyspnea are the most occurred complications. **Recommendations:** Conducting future studies that should focus on determining the incidence of postoperative pulmonary complications after cardiac and thoracic surgery as well as illustrate the major risk factors for the presence of this complication. Further research studies are needed to develop a nursing intervention protocol for the patients indicated for thoracotomy.

**Keywords:** Postoperative pulmonary complications, Thoracotomy.

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## 1. INTRODUCTION

Postoperative pulmonary complications are reported in the range of 2–39%, and include atelectasis, pneumonia, and respiratory failure. Post-operative pulmonary complications are a major concern after thoracotomy and thoracic surgery. The coexisting medical diseases that the patient has a poor baseline pulmonary function that exists for which the surgery is needed, the invasiveness of the surgical procedure and the anesthetic technique may contribute to the type and severity of the post-operative pulmonary problems. A bad post-operative outcome can result from damage to anatomical structures. Most of the common morbidities and mortality arise due to respiratory failure. Anticipation and recognition of the problems can prevent major complications (Jing et al., (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**).

Thoracotomy patients are at risk for developing post-operative pulmonary complications due to a number of factors. Preoperative factors include age over 65 years, female gender, recent smoking, chronic obstructive pulmonary disease (COPD), congestive heart failure, diabetes, and use of vasoactive drug support. Intra-operative risk factors include phrenic nerve injury, aortic cross-clamping, use of intra-aortic balloon pump (IABP), and duration of cardiopulmonary bypass time. Post-operative risk factors include the presence of bacteremia, endocarditis, gastrointestinal hemorrhage, acute kidney injury, wound infection, stroke, new onset atrial fibrillation, anemia, and reoperation of post-operative for post-operative bleeding (**Dabbagh, Esmailian, and Aranki, 2018**).

Preoperative identification of patients with pulmonary risk factors should facilitate the provision of proper pre-operative intervention. Early identification and intervention to maximize lung function prior to surgery can prevent the incidence of most postoperative pulmonary dysfunction. Understanding of the post-operative changes in pulmonary function, routine pulmonary management, and contributory factors of pulmonary dysfunction allow for the early identification and management of such problems (**Ahmed, Soliman, and Mohamed, 2017**).

Many mechanisms explain the effects of these surgeries on other organs than the heart, including lung and pleura. The pathogenesis of these complications are not fully understood, but many surgery-related factors contribute to these complications, such as general anesthesia, median sternotomy, cardiopulmonary bypass (CPB), the injurious effect of mechanical ventilation, systemic inflammatory mediators release, and capillary wall injury (**Mali and Haghaninejad, 2019**).

#### **Significance of the study**

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**).

Patients undergoing thoracic surgery are usually high-risk patients. They are most often elderly, have concurrent medical comorbidities and have poor physical status either due to the malignancy, malnutrition and the pre-existing primary disease. Most of these patients are smokers, have occupational exposure and are therefore at even greater risk of developing pulmonary complications. Part of their problem is due to their poor baseline pulmonary function. Pulmonary complications may manifest in the operating room itself or in the post-anaesthesia care unit (PACU), intensive care unit (ICU), and also in the surgical ward (**Hardin and Kaplow, 2020**).

#### **Aim of the study:**

The aim of the present study was to assess pulmonary complications after thoracotomy.

#### **Research Question**

What is the incidence of pulmonary complications after thoracotomy?

## **2. SAMPLE AND METHODS**

#### **Design:**

A descriptive research design was utilized in this study.

#### **Participants:**

A purposive sample of 35 adult patients from both genders required for thoracotomy was involved in this study from the above mentioned setting according to inclusion and exclusion criteria and accept to participate in the study.

### **Research tools:**

#### **Tool I: Structured Interview Assessment Questionnaire (Appendix I).**

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 Sheet for Thoracotomy Patients (Appendix II).**

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 & 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.

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

It used to assess the degree of pain by using visual analog scale.

##### **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 from faculty of nursing, Zagazig University, who reviewed the content of the tools for comprehensiveness, accuracy, clarity, relevance, and applicability. Minor modifications were done.

### **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 from June (2020) until the end of May (2021). 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 Sheet for Thoracotomy Patients was filled by the researcher in the first, third, and fifth 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 (%). Numerical data were presented as mean, median, standard deviation (SD) and range values. The General linear model used to compare repeated measures. The significance level was set at  $P \leq 0.05$ . Statistical analysis was performed with "IBM-SPSS" Statistics Version 20 for Windows.

### 3. RESULTS

**Table (1): Descriptive statistics for the studied patients regarding socio- demographic data.**

Items	The Studied Patients (n=35)	
	N	%
<b>Age category [n (%)]</b>		
20–35 y	15	42.9
36–50 y	12	34.3
51–65 y	8	22.9
Mean ± SD	39.6±10.59	
<b>Gender [n (%)]</b>		
Male	3	8.6
Female	32	91.4
<b>Social status [n (%)]</b>		
Single	6	17.1
Married	23	65.7
Divorced	4	11.4
Widowed	2	5.7
<b>Education [n (%)]</b>		
Illiterate	6	17.1
Basic education	5	14.3
Secondary education	17	48.6
Higher education	7	20
<b>Occupation [n (%)]</b>		
Not work	21	60
Work	14	40

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This table showed that, the majority of the studied patients 91.4% were females, while 8.6% were males with mean and standard deviation values of age  $39.6 \pm 10.59$  years old. 65.7% of the patients were married, while 5.7% were widowed. About half of the patients 48.6% had secondary education, while 14.3% had basic education. As regards occupation; 40% were worker, while 60% were not working.

**Table (2): Descriptive statistics for the studied patients regarding medical data.**

Items	The Studied Patients (n=35)	
	N	%
<b>Type of surgery</b>		
Mitral valve replacement	27	77.1
Coronary artery bypass graft	3	8.6
Atrial septal defect	5	14.3
<b>Duration of hospital stay</b>		
4-5 Days	7	20
6-7 Days	21	60
More than 7 Days	7	20
<b>Duration of mechanical ventilation</b>		
4-6 hours	12	34.3
7-9 hours	9	25.7
10-12 hours	12	34.3
More than 12 hours	2	5.7
<b>Comorbidities disease</b>		
Diabetes mellitus	5	14.3
Heart disease	4	11.4
Hypertension	4	11.4
Liver disease	1	2.9
Neurological disease	3	8.6
<b>Previous hospitalization</b>		
Yes	4	11.4
No	31	88.6
<b>Previous surgery</b>		
Heart surgery	2	5.7
Lung surgery	0	0
<b>History of smoking</b>		
Smoker	4	11.4
Non smoker	31	88.6

This table shows that, more than three quarters of the patients 77.1% admitted to ICU post MVR, while 8.6% admitted post CABG. Regarding to duration of hospital stay, more than half of the patients 60% were discharged in sixth & seventh day, while 20% stay in hospital more than a week. Only 5.7% of the patients had previous surgery, and 11.4% had a history of smoking.

**Table (3): Descriptive statistics for the studied patients regarding wound and pain assessment.**

Items	The Studied Patients (n=35)						ANOVA F (p)
	1 <sup>st</sup> day		3 <sup>rd</sup> day		5 <sup>th</sup> day		
	N	%	N	%	N	%	
<b>Wound assessment</b>							
- Dry clean wound	35	100	31	88.6	31	88.6	3.778 (0.053)
- Inflamed&swelled wound	0	0	4	11.4	3	8.6	
- Fluid, or pus drainage	0	0	0	0	1	2.9	
<b>Pain Assessment</b>							
- No pain	0	0	0	0	9	25.7	54.236 (0.000**)
- Mild pain	12	34.3	12	34.3	20	57.1	
- Moderate pain	18	51.4	22	62.9	5	14.3	
- Sever pain	5	14.3	1	2.9	1	2.9	

\*: Significant at  $P \leq 0.05$

This table showed that, there was a high statistically significant difference between the three measures during the study period regarding pain assessment ( $P$ -value=0.000\*\*), which high level of pain more noted in the first and third day than in the fifth day following thoracotomy, while there was no statistically significant difference between the three measures during the study period regarding wound assessment ( $P$ -value=0.053), but infected wound more observed in the third & fifth day.

**Table (4): Descriptive statistics for the studied patients regarding assessment of the respiratory system.**

Items	The Studied Patients (n=35)						ANOVA F (p)
	1 <sup>st</sup> day		3 <sup>rd</sup> day		5 <sup>th</sup> day		
	N	%	N	%	N	%	
<b>Respiration depth</b>							
- Normal	21	60	22	62.9	26	74.3	1.085 (0.320)
- Deep	0	0	1	2.9	0	0	
- Shallow	14	40	12	34.3	9	25.7	
<b>Lung Sound</b>							
- Normal	24	68.6	20	57.1	28	80	3.864 (0.026*)
- Wheezing	8	22.9	11	31.4	5	14.3	
- Crackles	3	8.6	4	11.4	2	5.7	
<b>Pulmonary complications</b>							
- No	19	54.3	6	17.1	19	54.3	2.097 (0.141)
- Yes	16	45.7	29	82.9	16	45.7	
Pneumonia	0	0	4	11.4	2	5.7	
Cough	5	14.3	8	22.9	5	14.3	
Dyspnea	6	17.15	10	28.6	3	8.6	
Orthopnea	2	.7	3	8.6	3	8.6	
Atelectasis	1	2.9	2	5.7	1	2.9	
Emphysema	1	2.9	1	2.9	0	0	
Hypoxemia	1	2.9	1	2.9	2	5.7	

\*: Significant at  $P \leq 0.05$

This table showed that, about four fifths of the studied patients suffered from pulmonary complications in the third day following thoracotomy, in which cough and dyspnea are the most occurred complications. There was a statistically significant difference between the three measures during the study period regarding lung sound ( $P$ -value=0.026\*), which abnormal lung sound more noted in the third day following thoracotomy, while there was no statistically significant difference between the three measures during the study period regarding respiration depth and pulmonary complications ( $P$ -value=0.320 and 0.141, respectively).

#### 4. DISCUSSION

The study aimed to assess the pulmonary complications after thoracotomy. The results of the present study revealed that, the finding regarding the patient's characteristics revealed that, more than three quarters of the 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. Also this finding disagrees 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, the majority of the studied patients were a male.

Concerning type of surgery, this study showed that, mitral valve replacement was done for more than three quarters of the studied patients, while coronary artery bypass graft and atrial septal defect was done for about only one quarter of the studied patients. This finding is 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", who reported that, mitral valve replacement was done for more than half of the studied patients.

Regarding the duration of hospital stay, three fifths of the studied patients stays in hospital for 6-7 days after surgery, while only one fifth of the studied patients stays 4-5 days and the another fifth of the studied patients stays for more than 7 days after surgery. 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 surgery.

Concerning the history of comorbidities disease, this study showed that, more than half of the studied patients had no history of comorbidities disease. This could be related to a lot of the studied patients 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 of 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.

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, wound infection noted in the minority of the studied patients.

Regarding pain assessment; this study showed that, the studied patients suffered from higher levels of pain in the first and third day than in the fifth day following thoracotomy. 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, the majority of the studied patients were suffered from high degree of pain after coronary artery bypass graft.

Regarding pulmonary complications; this study showed that, about four fifths of the studied patients suffered from pulmonary complications in the third day following thoracotomy, in which cough and dyspnea are the most occurred complications. This finding disagrees with by **Qin et al., (2021)**, which about “Perioperative breathing training to prevent postoperative pulmonary complications in patients undergoing laparoscopic colorectal surgery:” who reported that, only (12%) of the patients in the control group were suffering from postoperative pulmonary complications.

## 5. CONCLUSION

**Based on the results of the present study, this study concluded that:**

Pulmonary complications are common occurred after thoracotomy in the third day following thoracotomy, in which cough and dyspnea are the most occurred complications.

## 6. RECOMMENDATIONS

**Based on the current study findings, the following recommendation can be suggested:**

Conducting future studies that should focus on determining the incidence of postoperative pulmonary complications after cardiac and thoracic surgery as well as illustrate the major risk factors for the presence of this complication.

Further research studies are needed to develop a nursing intervention protocol for the patients indicated for thoracotomy.

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