Effect of Implementing Standardized Nursing Measures on Prevention of Pulmonary Atelectasis among Patients Undergoing Open Heart Surgeries

Nour Ramadan Ibrahim Ahmad [1,2], Gehan A. Younis [3], Elatafy El metwaly Elatafy [4], Nadia Mostafa Eleter [5]

[1]Master student of Critical Care and Emergency Nursing, Faculty of Nursing, Tanta University, Egypt
[2] Nursing specialist at Kafer Elsheik University Hospital
[3]Professor of Critical Care and Emergency Nursing Department, Faculty of Nursing, Tanta University, Egypt
[4]Professor of Cardiothoracic Surgeries, Faculty of Medicine, Tanta University, Egypt
[5]Lecturer of Critical Care and Emergency Nursing Department, Faculty of Nursing, Tanta University, Egypt

Corresponding author: Yahiaabdelrahman41@gmail.com

Abstract

Background: Standardized nursing measures are series of nursing interventions and practices that help in decreasing pulmonary atelectasis after open heart surgeries. **Aim**: the current study aimed to evaluate the effect of implementing standardized nursing measures on prevention of pulmonary atelectasis among patients undergoing open heart surgeries. **Subjects and Method: Design**: Quasi-experimental study design. **Setting**: this study was performed at Surgical Intensive Care Unit at Tanta International Teaching Hospital affiliated to Ministry of High Education and Scientific Research. **Subjects**: A purposive sample of 80 adult conscious patients admitted to the previously mentioned setting and was selected and divided to two equal groups 40 patients in each. **Tools: Tool I**: Open Heart Surgery Patients' Assessment Tool, **tool II**: Pulmonary Atelectasis Assessment Tool. **Results**: In relation to signs of atelectasis, it was observed that most of the study sample (75%) and less than half (40%) of the control group didn't have cough during the first and the fifth postoperative day, respectively. Regarding to sings of dyspnea it was observed that 5% of patients and more than half 52.5% of the control group had mild dyspnea during the fifth post-operative day. **Conclusion:** It can be concluded that implementation of standardized nursing measures techniques decreased signs of postoperative pulmonary atelectasis. **Recommendations**: It can be recommended that standardized nursing measures should be implemented for patients post heart surgeries to prevent pulmonary atelectasis.

Keywords*:* Open heart surgeries, Postoperative pulmonary atelectasis, standardized nursing measures.

Introduction

Open heart surgeries are surgeries on the heart and great vessels performed by cardiac surgeons **(Senst & Diaz, 2022).** It is often used to treat complications of ischemic heart diseases such as, coronary artery bypass grafting, correct congenital heart diseases, or treat valvular heart diseases from various causes, including endocarditis, rheumatic heart disease, and atherosclerosis. It also includes heart transplantation **(Bianco et al., 2020).**

Coronary artery bypass graft (CABAG) surgery is among the most common operations performed in the U.S.A with more than 500,000 surgeries performed each year. In Surgical Intensive Care Unit at Tanta International Teaching Hospital which is affiliated to Tanta University Hospital (2022), about 100 patients underwent open heart surgeries **(Ye, 2020; Li, Bardhan, & Ring, 2023).**

Atelectasis is one of the primary mechanisms associated with acute lung injury, reduced lung compliance, a major cause of postoperative hypoxemia, a predisposition to infection, leading to longer stay in the intensive care unit (ICU) and increased length of stay (LOS) in the hospital **(Tanner & Colvin, 2020).**

Postoperative period is a critical period for open heart surgical patients **(Kubitz et al., 2020).** So, inappropriate nursing and medical care in this period can lead dangerous complications. Careful assessment of the patient's respiratory status is required throughout the hospitalization. Particular attention should be given to lung sounds for diminishment and /or crackles. Complaints of dyspnea should be reported. The presence of cough should be further assessed for sputum production **(McGinigle et al., 2022).**

Risk factors of atelectasis include; preoperative, intraoperative and postoperative risk factors. Preoperative risk factors include age, gender, body mass index, smoking, having diabetes, heart failure, hypertension, previous myocardial infarction, angina, previous cardiac surgeries and history of lung diseases. Intraoperative risk factors include total operative time, site of surgery, time of surgery e.g., urgency or planned surgery, type of surgical procedure, blood transfusion, total vessels bypassed and the name and number of valve repair or replacement **(Sharma, 2023).**

Postoperative risk factors include delayed mobilization, inadequate pain control, shallow rapid breathing and inadequate coughing. Postoperative care of a heart surgery patient is difficult because changes can happen quickly. In postoperative treatment, the patient's preoperative status as well as intraoperative events should be considered. It is vital for the nurse to foresee future problems in order to administer appropriate treatments in a timely manner and guarantee that the patient has a positive outcome **(Lagier et al., 2022).**

Postoperative care is the management of a patient after surgery. This includes the care given during the immediate postoperative period, both in the operating room and post anesthesia care unit (PACU), as well as days following the surgery. This aims to prevent complications such as infection, promote healing of the surgical incision, and to return the patient to a state of health, and decreasing length of hospitalization, and thus prevent nosocomial infection (**Smith et al., 2020).**Standardized nursing measures improves ventilation-perfusion mismatching,increasepulmonarycomplianc

e, helps reinflate collapsed alveoli, improve oxygenation, decreases work of breathing; prevent atelectasis, pneumonia and decrease length of hospital stay after cardiac surgery. As a member of the medical team, critical care nurses should perform standardized nursing measures immediately in postoperative period **(Stark & Finlay, 2020).**

Aim of the study

Evaluate effect of implementing standardized nursing measures on prevention of pulmonary atelectasis among patients undergoing open heart surgeries

Research hypothesis:

Pulmonary atelectasis among patients undergoing open heart surgeries is expected to be decreased after implementing standardized nursing measures.

Subjects and Method

Design:

A quasi-experimental research design was utilized to conduct this study.

Setting:

The study was conducted at Surgical Intensive Care Unit at Tanta International Teaching University Hospital affiliated to Ministry of Higher Education and Scientific Research. This unit contained 9 beds.

Subjects:

A purposive sample of 80 adult patients who fulfilled the inclusion criteria was selected from the previously mentioned setting. The sample was estimated using Epi Info 7 Statistical Program and the total patients admitted per year according to review of Tanta University Hospital statistical health record in 2022 were 100 patients and the sample size calculated as the following:

- Total patients are 100 per year
- Confidence level=99.9%
- Expected frequency=50%
- Accepted error=5%
- Confidence coefficient=95%

The sample was divided into two equal groups, 40 patients in each as follows:

Control group: Consisted of 40 adult patients who received routine ICU care after open heart surgery such as early mobilization for patients.

Study group: Consisted of 40 adult patients who received standardized nursing measures that were implemented by the researcher in addition to the routine hospital care.

Inclusion criteria include:

- Adult patients aged from 21 years and above, of both sex.
- Hemodynamically stable patients.
- Patients extubated from mechanical ventilation.
- Conscious patients who are able to communicate
- Oxygen saturation more than 94%.

Tools of Data Collection:

Two tools were used for data collection as the following:

Tool I: Open Heart Surgery Patients' Assessment Tool.

This tool was developed by the researcher after reviewing the relevant literature, to gather baseline data. It included two parts as the following:

Part (a): Patients' Sociodemographic Data:

It included age, sex, education, occupation and marital status.

Part (b): Patients' clinical Data:

This part was included the following items: current diagnosis, past medical history, past surgical history, current medications, weight, height, body Mass Index (BMI), smoking history.

Tool II: Pulmonary Atelectasis Assessment Tool

This tool was used to assess the occurrence of pulmonary atelectasis. It included four parts as the following;

Part (a): Clinical Signs of Pulmonary Atelectasis:

This part was developed by the researcher after extensive review of the related literature (Ullmann et al., 2020; Tanner et al., 2020). It involved: assessment of physiological parameters such as temperature, respiratory rate, heart rate, mean arterial blood pressure (MAP) and oxygen saturation (SPO2).Also, assessment of respiratory signs of pulmonary atelectasis which included cough, cyanosis, use of accessory muscles for breathing, abnormal chest sound, respiratory rhythm, respiratory depth and symmetry of chest expansion.

-Numerical data was presented as mean and stander deviation. While, descriptive data was presented as score (1) if the item is present and score (0) if the item is absent.

Part (b): Numerical pain Rating Scale; This part was developed by **Borg1 et al., 1981.** and adopted by Gorrall et al., 2016 and it was used by the researcher to measure severity of pain which felt ranged across a continuum from none to an extreme amount of pain. This scale was usually a horizontal line, 10 cm in length, the patient marked on the line. The point that represented the severity of pain they experienced.

Scoring system:

- Score (0) Indicated no pain
- Score from (1-3) Indicated mild pain
- Score from (4-6) Indicated moderate pain
- Score from (7-10) Indicated severe pain

Part (c): Numerical Rating Scale for Dyspnea Assessment:

This scale was developed by (Farncombe et al., 1997) and adopted by (Guirimand et al., 2015) and used by the researcher to measure severity of dyspnea. It was a categorical scale with a score from 0 to 10, where (0) corresponded to the sensation of normal breathing (absence of dyspnea) and 10 corresponded to the patients' maximum possible sensation of dyspnea.

Scoring system:

- Score (0) indicated no dyspnea
- Score from (1- 4) indicated mild dyspnea
- Score from (5- 6) indicated moderate dyspnea
- Score from (7- 10) indicated sever dyspnea

Part (d) Laboratory Investigations and diagnostic studies.

1) Arterial blood gases (ABG) test: This includes PaO_2, $PaCO_2$, Hco_3, Sao_2 and PH. The mean scores of theses parameters will be assessed.

2) Pulmonary Function Studies: it includes tidal volume and minute ventilation. The results of this test will be score as mean score.

Method

1. An official permission to carry out the study was obtained from the responsible authorities at Faculty of Nursing, Tanta University to the director of International Teaching Hospital affiliated to Tanta University Hospital.

2. Ethical and legal considerations:

-Scientific research ethical committee approval of the Faculty of Nursing and Faculty of Medicine at Tanta University approval was obtained and the number was (2023/203).

- Nature of the study was not causing any harm or pain to the entire subjects.

-Confidentiality of data and privacy of the patients were taken into consideration regarding data collection.

-Patients' written informed consent to participate in this study was obtained after explaining the aim of the study. All participants were informed about the purpose of the study and the right to withdraw from the study at any time if desired.

3. Tool development: tool I and tool II part (a) and (d) were developed by the researcher based on reviewing the relevant literature. Numerical pain rating scale was developed by Gorrall et al., (2016) and numerical dyspnea rating scale was developed by Guirim et al., (2015).

4. Tool validity:

-The content validity of the developed tools was tested for clarity and applicability by nine experts in the field of critical care and emergency nursing, open surgeons and biostatistics to ensure their validity and needed modifications were done.

5. Reliability of the tools:

-The reliability was done on the developed tools (tool I and tool II part (a) and (d)) by crombach alpha test and the result was 0.950.

- Reliability of Numerical Rating Scale for assessing incisional pain was 0.71.

- Reliability of numerical rating scale for dyspnea was 0.94.

6. Pilot study:

- A pilot study was carried out on 10% (8) patients in order to assess the feasibility and applicability of the tools and the needed modifications were done. A pilot study patients were excluded from the study.

7. Patients who fulfilled the inclusion criteria immediately after extubation from the ventilator were assessed and were divided into two equal groups, 40 patients in each group. The researcher started by control group first to prevent data contamination.

8. Duration of data collection: Data was collected through the period of 6 months started from May 2023 to the end of December 2023.

- The present study was conducted through four phases: Assessment, planning, implementation and evaluation.

Phase (1): Assessment phase:

Immediately up on admission, initial assessment was carried out by the researcher for all study subjects in both control and study groups using tool I to assess the patients who met the inclusion of the study and to collect baseline data.

Phase (2): Planning phase:

- This phase was formulated based on data from the assessment phase, literature review, Goals and expected outcome criteria were taken into considerations when planning patient's care.

-During this phase, nursing interventions were formulated based on the expected outcome.

Expected outcome:

-Maintain normal physiological parameters.

-Maintain optimal level of oxygen saturation.

- Decreased severity of chest pain

- Decreased severity of dyspnea.

- Maintain optimal level of arterial blood gases.

- Decrease occurrence of atelectasis.

Phase (3): Implementation phase:

Control group:

Consisted of 40 adult patients who received routine ICU care after open heart surgeries which included early ambulation and pharmacological treatment of

pulmonary atelectasis only when it occurred.

Study group:

- Consisted of 40 adult patients who received standardized nursing measures with routine ICU care.
- The researcher educated all patients in the preoperative phase the techniques of coughing and breathing exercises
- The researcher implemented these interventions for the study group immediately after extubation and continued for five consecutive days.

Standardized nursing measures included the following techniques:

1- Semi-fowler position

1. Assess hemodynamic parameters
   Put the patient in semi -Fowler position.

2-Early mobilization

It started from the first postoperative day and immediately after extubation. Early mobilization was performed gradually included activities such as

a) Sitting upright
b) Transferring from bed to chair
c) Rising from a chair.
d) Be sure that hemodynamic parameters are stable. Measure heart rate, O2 saturation and blood pressure.

3-Postural drainage

a) Auscultate the lungs to determine which lung segments needed postural drainage.
b) Put the patient in the appropriate postural drainage position.
c) Maintain integrity and connections of invasive lines such as chest tube, arterial line, central venous catheter and urinary catheter.
d) Maintain the patient in the appropriate postural drainage position for 3-5 minutes.
e) Maintain comfort of the patient.

4. Percussion.

a. The purpose of percussion is to intermittently apply kinetic energy to the chest wall and lung.

b.This is accomplished by rhythmically striking the thorax with cupped hand or mechanical device directly over the lung segment(s) being drained.

c. rhythmically clapping on the chest wall over the area being drained to force secretions into larger airways for expectoration.

5-Vibration.

- Vibration involves the application of a fine tremorous action (manually performed by pressing in the direction that the ribs and soft tissue of the chest move during expiration) over the draining area.
- The nurse uses rhythmic contractions and relaxations of arm and shoulder muscles over the patient's chest.

6-Diaphragmatic breathing exercises.

- Place the hand on the patient's abdomen.
- Instruct the patient to inhale through his nose taking slow and deep breath.
- As the exercise progresses, slight pressure can be applied to the abdomen during inspiration.

7.Coughing Exercise.

-Coughing Exercises were taught to the patient in the preoperative period.

- Coughing exercises were performed four sessions per day each session consisted of 20-30 minutes.

-During this session the patient was encouraged to practice breathing and coughing exercises.

- Coughing exercises include; Low flow (huff) coughing.

8. Chest pain control.

- Support the wound by using small pillow during deep breathing and coughing exercises.

-Encourage the patient to perform breathing and coughing exercises within 20-30 minutes from taking the analgesics.

Phase (4): -Evaluation phase:

Evaluation was done for patients of both study and control groups three times during: 1st, 3rd and 5th postoperative day, using tool II part a to assess clinical signs of pulmonary atelectasis, tool II-part b to assess severity of pain, tool II-part c to assess severity of dyspnea and tool II-part d to assess arterial blood gases and pulmonary function studies.

Limitations of the study.

-Incisional pain which limit the ability of the patient to implement deep breathing and coughing exercises.

Statistical analysis:

The collected data were organized, tabulated and statistically analyzed using SPSS software statistical computer package version 26.

Results

Table (1): Distribution of the studied patients undergoing open heart surgeries regarding their socio-demographic characteristics.

It was observed that the mean age of the control group was 39.08±10.32, while it was 42.75±11.56 in the study group. Regarding patients' gender, about two thirds (65.00%) of the control group compared to 62.5% of the study group were males. In relation to marital status, more than half (57.5%) of the control group were married compare to (65.00%) of the study group.

With regard educational level, it was observed that (22.5%) of the control group compared to fifth of the study group (20%) was read and write about half (47.5%) and more than third (37.5%) of the control group and study group had university and post studied education, respectively. Regarding occupation, more than half of the control group (55%) and the study group (52.5%) were manual workers. No statistical significant differences were found between the two groups regarding age, gender, marital status, level of education and occupation where p> 0.05 for each.

Table (2): Distribution of the studied patients undergoing open heart surgeries regarding their clinical data.

Regarding current diagnosis, this table presented that nearly one third (32.5%) of the control group compared to one fourth (25.00%) of the study group had mitral valve replacement (MVR) . While, (30.00%) and (32.5%) of the control and the study group had coronary artery bypass graft surgery. Also, this table revealed that (60.00%) of the control group and (90.00%) of the study group had diabetes mellitus and hypertension, respectively. In relation to past surgical history, it was noticed that 32.5% of the control group compared to half (50.00%) of the study group had previous abdominal surgeries. No statistical significant differences were found between the control and the study group regarding current diagnosis, past medical and past surgical history where p> 0.05.

Table (3): Mean scores of physiological parameters of the studied patients undergoing open heart surgeries throughout periods of intervention

It was observed that mean± SD of pulse at the end of first postoperative day was 90.63±12.04 and 82.63±9.12 during the fifth postoperative day for the control group compared to 86.35±9.71 of the first postoperative day and 78.73±9.20 during the fifth postoperative day for the study group. Additionally, this table revealed that mean± SD of mean arterial pressure (MAP) during the first postoperative day as 86.25±10.22 and during fifth postoperative day it was 84.90±6.95 for

the control group. While it was 83.88±8.93 and 86.68±5.71 for the study group, respectively.

Table (4): Distribution of the studied patients undergoing open heart surgeries regarding their signs of atelectasis throughout periods of intervention.

In relation to signs of atelectasis, it was observed that most of the sample (75%) and less than half (40%) of the control group didn't have cough during the first and the fifth postoperative day, respectively, compared to less than half (45%) and majority (92.5%) of the study group, respectively. While about one quarter (10%) and 42.5% of the control group had dry cough during the first and the fifth postoperative day, respectively, compared to less than half (47.5%) and (7.5%) of the study group, respectively.

Table (5): Distribution of the studied patients undergoing open heart surgeries regarding their dyspnea level throughout periods of intervention.

In this table about 5% of patients and more than half 52.5% of the control group had mild dyspnea during the first and the fifth postoperative day, respectively. while it was about (17.5) and the (12.5%) of the study group, respectively.

Also, this table presented that (57.5%) and (62.5%) of the control and study group had severe dyspnea during the first postoperative day, respectively. While neither the control nor the study group had severe dyspnea during the fifth postoperative day. Statistical significant differences were found between the control and the study group regarding level of dyspnea during first, third and fifth postoperative day where p=0.000, 0.010 and 0.000, respectively.

Table (1): Distribution of the studied patients undergoing open heart surgeries regarding their socio-demographic characteristics

Characteristics	The studied patients (n=80)				χ^2 P
	Control group (n=40)		Study group (n=40)		
Age (in years)					
- (20-<30)	8	20.0	8	20.0	
- (30-<40)	15	37.5	10	25.0	3.85
- (40-<50)	11	27.5	9	22.5	0.28
- (50-60)	6	15.0	13	32.5	
Range	**(24-59)**		**(24-68)**		t=2.25
Mean ± SD	**39.08±10.32**		**42.75±11.56**		P=0.14
Gender					
- Male	26	65.0	25	62.5	FE
- Female	14	35.0	15	37.5	1.00
Marital status					
- Single	9	22.5	6	15.0	1.08
- Married	23	57.5	26	65.0	0.78
- Divorced	5	12.5	6	15.0	
- Widowed	3	7.5	2	5.0	
Level of education					
- Illiterate	8	20.0	13	32.5	1.72
- Read and write	9	22.5	8	20.0	0.63
- Secondary education	4	10.0	4	10.0	
- University /Post studies	19	47.5	15	37.5	
Occupation					
- Not work	2	5.0	4	10.0	
- Manual work	21	52.5	22	55.0	
- Employee	17	42.5	14	35.0	2.64
					0.76

FE: Fisher' Exact test * Statistically significant at level P<0.05.

Table (2): Distribution of the studied patients undergoing open heart surgeries regarding their clinical data among the studied groups

Clinical data	The studied patients (n=80)				χ^2 P
	Control group (n=40)		Study group (n=40)		
	No	%	No	%	
Diagnosis					
- MVR	13	32.5	10	25.0	
- AVR	7	17.5	10	25.0	1.027
- Coronary artery bypass surgery	12	30.0	13	32.5	0.79
- Repair of congenital heart diseases	8	20.0	7	17.5	
# Past medical history					
- None	9	22.5	8	20.0	
- Diabetes and hypertension.	24	60	36	90	
- Endocrine and renal disease.	8	20	5	12.5	0.54
- Respiratory disorders and cardiovascular diseases.	16	40	23	57.5	0.82
# Past surgical history					
- None	16	40.0	8	20.0	
- Abdominal surgery	13	32.5	20	50.0	
- Orthopedic surgery	0	0.0	1	2.5	
- Neurosurgical operation	3	7.5	4	10.0	1.08
- Obstetric surgery	10	25.0	9	22.5	0.78
length of ICU Stay (in days)					
Range	(1-6)		(1-5)		**9.59**
Mean ± SD	2.50±1.36		1.68±1.00		**0.000***
length of hospital stay (in days)					
Range	(3-13)		(3-7)		**26.30**
Mean ± SD	6.55±2.65		4.30±0.82		**0.000***
Total length of stay (in days)					
Range	(5-17)		(5-10)		**23.57**
Mean ± SD	8.98±3.59		6.03±1.37		**0.000***

More than one answer was chosen FE: Fisher' Exact test

* Statistically significant at level P<0.05

Table (3): Mean scores of physiological parameters of the studied patients undergoing open heart surgeries among the studied groups throughout periods of intervention

Physiological Parameters	The studied patients (n=80) Range / Mean ± SD							
	Control group (n=40)			F / P	Study group (n=40)			F / P
	On 1st day	At 3rd day	At 5th day		On 1st day	At 3rd day	At 5th day	
Temperature (c°)	(36.4-39.0) 37.74±0.59	(36.4-39.0) 37.51±0.51	(36.5-39.6) 37.39±0.58	**4.04** **0.02***	(36.4-38.5) 37.43±0.60	(36.4-38.5) 37.26±0.51	(18.0-38.0) 36.60±3.03	2.34 0.10
Respiratory rate (16 -20 c/min)	(16-30) 20.70±3.31	(14-28) 19.55±3.49	(14-24) 18.03±3.13	**6.56** **0.000***	(14-24) 17.98±2.51	(12-22) 15.83±2.00	(12-22) 15.20±1.91	**18.26** **0.000***
Heart rate (60-100 b/min)	(66-130) 90.63±12.04	(60-110) 85.93±11.80	(66-98) 82.63±9.12	**5.28** **0.01***	(60-100) 86.35±9.71	(64-98) 82.93±9.68	(60-96) 78.73±9.20	**6.42** **0.000***
Blood pressure								
Systolic	(90-140) 116.63±10.15	(90-130) 112.50±7.85	(90-130) 112.50±7.93	2.99 0.05	(100-130) 111.88±7.22	(100-130) 113.13±7.40	(90-130) 109.38±8.56	2.43 0.09
Diastolic	(60-90) 71.38±7.68	(60-90) 70.00±8.99	(50-90) 71.00±11.22	0.23 0.80	(60-90) 73.88±6.84	(60-80) 72.13±6.78	(60-95) 71.38±10.38	0.99 0.38
Mean arterial pressure (MAP) (70-100 mmHg)	(63-106) 86.25±10.22	(70-103) 83.88±7.52	(70-100) 84.90±6.95	0.81 0.45	(70-100) 83.88±8.93	(75-96) 85.43±5.72	(73-100) 86.68±5.71	1.63 0.20
O_2 saturation (%)	(90-96) 94.60±1.50	(90-97) 95.25±1.37	(94-99) 95.88±1.27	**8.51** **0.000***	(90-98) 96.00±1.65	(90-99) 96.95±1.66	(94-99) 97.73±1.01	**13.76** **0.000***

* Statistically significant at level P<0.05

Table (4): Distribution of the studied patients undergoing open heart surgeries regarding their signs of atelectasis among the studied groups throughout periods of intervention

Respiratory parameters / signs	The studied patients (n=80)													
	Control group (n=40)						χ^2 P	Study group (n=40)						χ^2 P
	On 1st day		At 3rd day		At 5th day			On 1st day		At 3rd day		At 5th day		
	No	%	No	%	No	%		No	%	No	%	No	%	
Cough														
- None	30	75.0	10	25.0	16	40.0	**18.04**	18	45.0	28	70.0	37	92.5	**36.71**
- Dry	4	10.0	20	50.0	17	42.5	**0.000***	19	47.5	10	25.0	3	7.5	**0.000***
- Productive	6	15.0	10	25.0	7	17.5		3	7.5	2	5.0	0	0.0	
Cyanosis														
- Absent	32	80.0	39	97.5	39	97.5	**10.69**	36	90.0	38	95.0	39	97.5	2.12
- Present	8	20.0	1	2.5	1	2.5	**0.01***	4	10.0	2	5.0	1	2.5	0.346
Breathing with accessory muscles														
- Absent	1	2.5	10	25.0	19	47.5	**21.60**	8	20.0	31	77.5	35	87.5	**44.91**
- Present	39	97.5	30	75.0	21	52.5	**0.000***	32	80.0	9	22.5	5	12.5	**0.000***
Chest sound														
- Normal														
- Crackles	12	30.0	7	17.5	15	37.5	13.29	10	25.0	26	65.0	36	90.0	**46.05**
- Ronchi	9	22.5	12	30.0	8	20.0		11	27.5	3	7.5	1	2.5	
- Wheezing	6	15.0	10	25.0	6	15.0	0.10	12	30.0	6	15.0	2	5.0	**0.000***
- Diminished chest expansion	5	12.5	8	20.0	8	20.0		5	12.5	4	10.0	1	2.5	
	8	20.0	3	7.5	3	7.5		2	5.0	1	2.5	0	0.0	

* Statistically significant at level P<0.05

Table (5): Distribution of the studied patients undergoing open heart surgeries regarding their dyspnea level among the studied groups throughout periods of intervention.

Dyspnea level	The studied patients (n=80)												
	Control group (n=40)						χ^2 P	Study group (n=40)						χ^2 P
	On 1st day		At 3rd day		At 5th day			On 1st day		At 3rd day		At 5th day		
	No	%	No	%	No	%		No	%	No	%	No	%	
▪ None	0	0.0	2	5.0	13	32.5		0	0.0	15	37.5	34	85.0	
▪ Mild	2	5.0	14	35.0	21	52.5	**45.54**	7	17.5	21	52.5	5	12.5	**68.42**
▪ Moderate	15	37.5	15	37.5	6	15.0	**0.000***	8	20.0	4	10.0	1	2.5	**0.000***
▪ Severe	23	57.5	9	22.5	0	0.0		25	62.5	0	0.0	0	0.0	
Range	**(2-9)**		**(0-7)**		**(0-5)**		**25.97**	**(1-9)**		**(0-6)**		**(0-5)**		**50.58**
Mean ± SD	**5.28±1.97**		**3.75±1.72**		**2.28±1.88**		**0.000***	**4.08±2.11**		**1.65±1.81**		**0.33±0.94**		**0.000***
Gp1 VS Gp2 t	**5.86**		**2.63**		**5.32**									
P	**0.000***		**0.010***		**0.000***									

* Statistically significant at level P<0.05

Discussion

The aim of the current study is to evaluate the effect of implementing standardized nursing measures on prevention of pulmonary atelectasis among patients undergoing open heart surgeries. One of the greatest challenges for critical care nurses is caring for patient undergoing open heart surgeries. Because those patients require complex assessment, high intensive therapies and care. Critical care nurses provide immediate, ongoing assessment, prophylactic therapeutic interventions, early recognition and management of postoperative complications **(Gaudino et al,. 2020).**

Regarding age, the current study revealed that the mean age of the control and study group were 39.08 years and 42.75, respectively. This could be explained by lifestyle changes, such as changes in eating habits, consuming fast food or food with high fat and cholesterol. Also, family history of heart diseases, hyperlipidemia and hypercholesterolemia, diabetes mellitus, diagnosis of hypertension are the main risk factors for ischemic heart disease and mitral valve disease.

This is result is supported by the findings reported by **Mohamed et al., (2019)** who reported in the study of "Effect of nursing exercise protocol on hemodynamics and functional capacity among patients after cardiac surgery" that the most common age of the studied group approximately was (50 < 60) years old. Also **Awaludin et al., (2021)** reported that the most common mean age of the studied group was (50 < 60) years old.

As regard to patients' gender, the current study showed that more than half of both groups were males. This could be explained by males are likely to develop coronary artery diseases twice than females because males spent more of the time out of the home and unhealthy lifestyles such as smoking, alcohol consumption, and unhealthy diet and genetic factors that proposed that estrogen hormone protect women from cardiac diseases. Furthermore, male individuals are at risk of open-heart surgery due to the nature of the work difficulties of their daily living.

Regarding occupation, the findings of the current study revealed that more than half of the studied sample were manual workers. This result is explained by the finding that less than of the studied samples were secondary educated which affect at the attitude and health of the patients that need more effort, less keeping fit, less time of rest , smoking habits and maintain healthy life and make them high risk of cardiac diseases. This finding was supported by **Hany et al., (2019)** in the study of "Effect of deep breathing technique on severity of pain among postoperative coronary artery bypass graft patients" that supposed that approximately more than half of the sample were manual workers.

Regarding current diagnosis, thisfindings of the current study concluded that about one third of both groups had coronary artery bypass graft. This could be explained that the most sample were males and secondary educated patients who didn't keep on their health, manual work which effect on lifestyle, unhealthy diet, smoking, stress which all of that are predisposing factors of ischemic heart diseases and mitral valve diseases.

This finding is in line with **Elgaza et al., (2020)** who found that approximately one

third of the patients had coronary artery bypass graft surgery in the study of "Effect of immediate pain management on oxygenation level among early extubation patients post heart surgery. Also, **Vaewthong et al., (2020)** found that one third of the patients had coronary artery bypass graft surgery.

On the other hand, this finding is disagreed with **Haji-Jafari et al., (2023)** who found that in the study of "The effect of rewarming on hemodynamic parameters and arterial blood gases of patients after open-heart surgery" that approximately one third-of the sample had mitral valve replacement. Also **Alaparthi et al., (2021)** who approved that in the study of "Contrasting effects of three breathing techniques on pulmonary function, functional capacity and daily life functional tasks in patients following valve replacement surgery" the about one third of the study sample had mitral valve replacement.

Regarding SpO_2 , the current result revealed that highly statical significant difference was found within the study group regarding SpO_2 during the period of intervention. As a result of standardized nursing measures that implemented in the patient early in the postoperative period as early immobilization and breathing exercises which maintain lung function and prevent pulmonary atelectasis that affect in lung function, airway clearance, progress of pathogens which cause infection that affect the body temperature.

This result is supported with the findings supported by **Fouad, et al., (2020)** who found that mean Spo_2 was significantly improved in the in the study group patients throughout days of the follow. Also**, Elhaddad et al., (2022)** Found that (SpO_2) improved during days of intervention.

Also **Javed et al., (2023)** supposed that that mean± SD of SpO_2 highly improved in the study group than in the control group in the result of Effects of Physical Therapy in Preventing Complications of Postoperative Coronary Artery Bypass. Also **khosravi et al., (2023)** reported that the mean of SpO_2 was improved in the study of The Effect of Breathing Exercises on Respiratory Condition After Coronary Artery Bypass Surgery. Also **Hashim et al., (2021)** supposed that the mean of SpO_2 was highly improved in the study of Structured Deep Breathing Exercises Education in Patient with Coronary Artery Bypass Graft.

On the other hand this result is disagreed with **Eid et al., (2022)** in the study of "Evidence Based Exercise and Early Mobilization Effectiveness on Post Cardiac Surgeries Physiological and Psychological Outcomes" who found that the mean± SD of SpO_2 was the same in the studied sample.

Regarding respiratory parameters, this finding presented that regular respiration during the fifth postoperative day was significantly higher in the study group than in the control group. Standerdised nursing measures and chest exercises consider an aspect of bronchial hygiene that aims at moving bronchial secretions to the central airways via gravity, external manipulation of the chest and eliminate secretions by cough, early mobilization, percussion, vibration and breathing exercises which affect and promote respiratory parameters and maintain regular respiration **(Toussaint et al., 2021).**

This finding was agreed by **Fjerbaek et al., (2020)** who reported that the majority of the sample had regular respiration in the study of "Change of position from a supine

to a sitting position increases pulmonary function early after cardiac surgery".

In relation to signs of atelectasis, it was observed that nearly half of the control group compared to majority of the study group had no cough during the fifth postoperative day, dry cough was significantly higher in the control group than in the study group. This finding could be explained by breathing exercises and coughing exercises are essential parts and plays an important role in clearing the airway and decrease the occurrence of atelectasis and decrease cough. This result is consisted with **Fjerbaek et al., (2020)** who found that none cough was significantly higher in the control group.

In relation to dyspnea, this finding revealed that about one third (32.5%) of the control group compared to majority (85.0%) of the study group had no dyspnea during fifth postoperative day. While, nearly half (52.5%) of the control group compared to 12.5% of the study group had mild dyspnea during the fifth postoperative day. Highly statical significant difference were found between the two studied groups regarding dyspnea level throughout first, third and fifth postoperative day where p=0.0.

The finding of the current study is in similar with **Allam et al., (2023)** in the study of the "Effect of Active Cycle Breathing Technique on Airway Clearance among Patients Underwent Cardiac Surgery" who reported that majority of the sample were smokers. Also, **Oshvandi et al., (2020)** in the study of the "Effect of respiratory exercises on the prevalence of atelectasis in patients undergoing coronary artery bypass surgery"

Conclusion

It can be concluded that:

-Implementation of the standerdized nursing measures for patients undergoing open heart surgeries is an effective nursing strategy in prevention of pulmonary atelectasis.

-Standerdized nursing measures implemented to prevent pulmonary atelectasis are cost effective nursing strategies which helped in decreasing duration of ICU stay and reducing total period of hospitalisation.

-Implementation of standardized nursing measures reduced severity of dyspnea and incisional pain.

-Implementation of standardized nursing measures reduced signs of atelectasis such as coughing, cyanosis, use of accessory muscles and abnormal breathing sounds.

Recommendations

For administration:

- An established guideline outlining the usual implementation of standerdised nursing measures on prevention of pulmonary atelectasis for patients undergoing open heart surgeries.
- In-service training programs should be conduct periodically and regularly for the nurses in the intensive care units to improve and update their knowledge and practices about open heart surgeries.

References

Amin, R., Alaparthi, G. K., Samuel, S. R., Bairapareddy, K. C., Raghavan, H., & Vaishali, K. (2021). Effects of three pulmonary ventilation regimes in patients undergoing coronary artery bypass graft surgery: A randomized clinical trial. *Scientific Reports*, *11*(1), 6730. https://nature.com/articles/s41598-021-86281-4

Awaludin, A. M., Larasati, H. T., & Kim, H. (2021). High-speed and unified ECC processor for generic

Weierstrass curves over GF (p) on FPGA. *Sensors*, *21*(4), 1451. https://link.springer.com/article/10.1186/s12864-021-08139-3

Bianco,V., Kilic, A., Gleason, T., Aranda-Michel, E., Habertheuer, A., Wang, Y., & Sultan, I. (2020). Reoperative cardiac surgery is a risk factor for long-term mortality. *The Annals of thoracic surgery*, 110(4), 1235-1242. https://www.sciencedirect.com/science/article/pii/S0003497520303994

Borg1, G., Lindblad, I., & Holmgren, A. (1981). Quantitative evaluation of chest pain. Acta Medica Scandinavica, 209(S644), 43-45. https://onlinelibrary.wiley.com/doi/abs/10.1111/j.09546820.1981.tb03117.x

Celler, A., Farncombe, T., Harrop, R., & Lyster, D. (1997). Dynamic heart-in-thorax phantom for functional SPECT. *IEEE Transactions on Nuclear Science*, *44*(4), 1600-1605. https://ieeexplore.ieee.org/abstract/document/632739

Creber, R., Dimagli, A., Spadaccio, C., Myers, A., Moscarelli, M., Demetres, M., & Gaudino, M. (2022). Effect of coronary artery bypass grafting on quality of life: A meta-analysis of randomized trials. *European Heart Journal-Quality of Care and Clinical Outcomes*, *8*(3),259-268. https://academic.oup.com/ehjqcco/article-abstract/8/3/259/6395312

Eid S, H., Hassan A, M., Elsayed B, E., & El-Said H, A. (2022). Evidence based exercise and early mobilization effectiveness on post cardiac surgeries physiological and psychological outcomes. *Egyptian Journal of Health Care*, *13*(1), 311-322. https://journals.ekb.eg/article_216643_666cd39e302fff9ee8c775912a760d05.pdf

Elbeheiry, N., Amer, A., Elgazar, S., Shukri, S., Metry, M., & Balog, R. S. (2020, November). Techno-Economic Evaluation of Residential PV Systems in Oil/Gas-Rich Economies: A Case Study of Qatar & Texas. *2nd International Conference on Photovoltaic Science and Technologies (PVCon)* (pp. 1-6). IEEE. https://ieeexplore.ieee.org/abstract/document/9757759

Elsaed, M., Mohamed, H., & Ebrahim, N. (2020). Factors affecting post open-heart surgery outcomes for hospitalized patients. *Egyptian Journal of Health Care*, *11*(1), 41-58. https://journals.ekb.eg/article_72593_2ef5cd46a2a469c1e9ad9d554d86f5f1.pdf

Eslam, M., Newsome, P. N., Sarin, S. K., Anstee, Q. M., Targher, G.,Romero-Gomez, M., ... & George, J.(2020). A new definition for metabolic dysfunction-associated fatty liver disease:An international expert consensus statement. *Journal ofHepatology*, *73*(1), 202-209. https://www.sciencedirect.com/science/article/abs/pii/S0168827820302014

Fjerbæk, A., Søndergaard, L., Andreasen, J., & Glavind, K.(2020). Treatment of urinary incontinence in overweight women by a multidisciplinary lifestyle intervention. *Archives of Gynecology and Obstetrics*, *301*, 525-532. https://link.springer.com/article/10.1007/s00404-019-05371-x

Gorrall, B. K., Curtis, J. D., Little, T.

D., & Panko, P. (2016). Innovations in measurement: Visual analog scales and retrospective pretest self-report designs. *Actualidades en Psicología*, *30*(120), 2-7. https://www.scielo.sa.cr/scielo.php?pid=S2215-35352016000100002&script=sci_arttext&tlng=en

Guirimand, F., Sahut d'izarn, M., Laporte, L., Francillard, M., Richard, J. F., & Aegerter, P. (2015). Sequential occurrence of dyspnea at the end of life in palliative care, according to the underlying cancer. *Cancer Medicine*, *4*(4), 532-539. https://onlinelibrary.wiley.com/doi/full/10.1002/cam4.419

Haji-Jafari, S., Rezaei, M., Azizi-Fini, I., Tafti, S. A., & Atoof, F. (2023). The effect of rewarming on hemodynamic parameters and arterial blood gases of patients after open-heart surgery: A randomized controlled trial. *Journal of Vascular Nursing*, *41*(1), 29-35. https://www.sciencedirect.com/science/article/abs/pii/S1062030323000031

Hamid, M., Akhtar, M., & Ahmed, S. (2020). Immediate changes in hemodynamics and gas exchange after initiation of noninvasive ventilation in cardiac surgical patients. *Annals of Cardiac Anaesthesia*, *23*(1), 59-64.https://journals.lww.com/aoca/fulltext/2020/23010/immediate_changes_in_hemodynamics_and_gas_exchange.11.aspx

Hashim, F. A., Hussain, K., Houssein, E. H., Mabrouk, M. S., & Al-Atabany,W. (2021). Archimedes optimization algorithm: A new metaheuristic algorithm for solvingoptimization problems. *Applied intelligence*, *51*, 1531-1551. https://link.springer.com/article/10.1007/s10489-020-01893-z

Jafari, H., Bagheri-Nesami, M., Khosravi, S., Habibi, M., & Tohamtan, R. (2023). The effect of breathing exercises on respiratory condition after coronary artery bypass surgery. *Journal of Nursing and Midwifery Sciences*, *10*(3). https://brieflands.com/articles/jnms-139183

Javed, M. S., Najam, T., Hussain, I., Idrees, M., Ahmad, A., Imran, M., ... & Han, W. (2023). Fundamentals and scientific challenges in structural design of cathode materials for zinc-ion hybrid supercapacitors. *Advanced Energy Materials, 13*(3), 2202303. https://onlinelibrary.wiley.com/doi/abs/10.1002/aenm.202202303

Kubitz, J., Schulte-Uentrop, L., Zoellner, C., Lemke, M., Messner-Schmitt, A., Kalbacher, D., & Girdauskas, E. (2020). Establishment of an enhanced recovery after surgery protocol in minimally invasive heart valve surgery. *PLoS One,* 15(4), 231-378. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0231378

Lagier, D., Zeng, C., Fernandez-Bustamante, A., & Vidal Melo, M. F. (2022). Perioperative pulmonary atelectasis: Part II. Clinical implications. *Anesthesiology*, *136*(1), 206-236. https://pubs.asahq.org/anesthesiology/article/136/1/206/117846/Perioperative-Pulmonary-Atelectasis-Part-II

Li, J., Bardhan, I., Sethi, S., & Ring, W. (2023). *20*(1),50-64.

https://onlinelibrary.wiley.com/doi/abs/10.1002/joom.1247

Mathis, N., Allam, A., Kissling, L., Marquart, K. F., Schmidheini, L., Solari, C., ... & Schwank, G. (2023). Predicting prime editing efficiency and product purity by deep learning. *Nature Biotechnology*, *41*(8),1151-1159. https://www.nature.com/articles/s41587-022-01613-7

McGinigle, K., Spangler, E., Pichel, A., Ayyash, K., Arya, S., Settembrini, A., & de Boer, H. (2022). Perioperative care in open aortic vascular surgery: A consensus statement by the Enhanced Recovery After Surgery (ERAS) Society and Society for Vascular Surgery. *Journal of vascular surgery, 75*(6), 1796-1820.https://www.sciencedirect.com/science/article/pii/S074152142200249X

Mohammadi, F., Farjam, M., Gholampour, Y., Tehranineshat, B., Oshvandi, K., & Bijani, M. (2020). Health professionals' perception of psychological safety in patients with coronavirus (COVID-19). *Risk Management and Healthcare Policy*, 785-794. https://www.tandfonline.com/doi/full/10.2147/RMHP.S261410

Niederwieser, D., Baldomero, H., Bazuaye, N., Bupp, C., Chaudhri, N., Corbacioglu, S., ... & Saber, W. (2022). One and a half million hematopoietic stem cell transplants: continuous and differential improvement in worldwide access with the use of non-identical family donors. *Haematologica*, *107*(5), 1045. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9052915/

Senst, B., Kumar, A., & Diaz, R. (2022). https://www.ncbi.nlm.nih.gov/books/NBK532935/

Sharma, G. (2023). *16*(1), 52-65. Atelectasis.https://publications.aap.org/aapbooks/editedvolume/751/chapter/13392061/Atelectasis

Smith, T., Wang, X., Singer, M., Godellas, C., & Vaince, F. (2020). Enhanced recovery after surgery: a clinical review of implementation across multiple surgical subspecialties. *The American Journal of Surgery*, *219*(3), 530-534. https://www.sciencedirect.com/science/article/pii/S000296101931027X

Stark, P., Muller, N., & Finlay, G. (2020). Atelectasis: Types and pathogenesis in adults. *U*: *Up To Date, Muller NL ed. Up to Date [Internet]. Waltham, MA 13*(1), 51-74. *UpToDat*http://publishingimages.s3.amazonaws.com/eZineImages/PracticePerfect/715/Atelectasis-Types-and-pathogenesis-in-adults-UpToDate.pdf

Tanner, T., & Colvin, M. (2020). *21*(1), 79-94. https://link.springer.com/article/10.1007/s00408-020-00405-7

Toussaint, L., Nguyen, Q., Roettger, C., Dixon, K., Offenbächer, M., Kohls, N., & Sirois, F. (2021). Effectiveness of progressive muscle relaxation, deep breathing, and guided imagery in promoting psychologial and physiological states of relaxation. *Evidence-Based Complementary and Alternative Medicine, 18*(2),69-84 https://www.hindawi.com/journals/ecam/2021/5924040/

Ullman, T. D., & Tenenbaum, J. B. (2020). Bayesian models of conceptual development: Learning as

building models of the world. *Annual Review of Developmental Psychology*, *2*, 533-558. https://www.annualreviews.org/content/journals/10.1146/annurev-devpsych-121318-084833

Vaewthong, N., & Kritsnakriengkrai, S. (2020). Effect of combined chest mobilization with physical therapy treatment on chest expansion and pain in patients undergoing lobectomy: randomized controlled trial (Doctoral dissertation, Srinakharinwirot University).*19*(1),77-90. https://www.monaldiarchives.org/index.php/macd/article/view/1499.

Zhang, Z., Yang, G., Zhou, C., Chung, C. C., & Hany, I. (2019). Optical and electrical properties of all-inorganic Cs 2 AgBiBr 6 double perovskite single crystals. *RSC Advances*, 9(41), 23459-23464. https://pubs.rsc.org/en/content/articlehtml/2019/ra/c9ra04045e