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Faculty of Graduate Studies

The Effect of Different Levels of Positive End-Expiratory Pressure on the Occurrence of lung Atelectasis after Coronary Artery Bypass Grafting in West Bank: A Retrospective Study

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Thesis Approval

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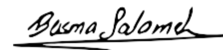
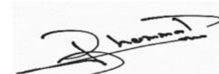
1.Dr. Basma Salameh. Supervisor	
2.Mr. Bahaa Hammad. Internal Examiner	
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Declaration

I certify that this thesis submitted for the master's degree in nursing critical care is the result of my own research except where otherwise acknowledge and that this study has not been submitted for a higher degree to any other university or institution.

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Abstract

Background: Respiratory complication is one of the most common post CABG, this study focused on the effect of PEEP on lung atelectasis post CABG

Objectives: The primary objectives were to assess the association between PEEP levels and post-CABG atelectasis, to investigate demographic risk factors for atelectasis, and to determine the timing pattern of atelectasis development.

Method: Data from 268 CABG patients were analyzed retrospectively, taking into account three different levels of PEEP, 5 cm H2O, 8 cm H2O and 10 cm H2O, demographics and postoperative outcomes through a self-developed data collection tool, it was done in a tertiary care hospital in Nablus - Westbank. Statistical analysis and appropriate statistical measures were used to address the research questions.

Results: Higher PEEP levels, especially at 10 cm H2O were associated with decreased pulmonary atelectasis. Smoking emerged as an important factor influencing atelectasis, Interventions such as spirometry and early thoracic drainage showed positive effects in reducing the occurrence of atelectasis. Furthermore, higher PEEP levels were associated with shorter hospital stay after CABG.

Conclusion: The study has highlighted the potential benefit of optimizing PEEP levels to prevent atelectasis after CABG and the benefit of using a PEEP of 10 cmH2O in post CABG patient without history of respiratory complications, which contributes to decreasing LOS.

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List of Abbreviations

Abbreviation	Meaning
ANOVA	Analysis of Variance
AVR	Aortic Valve Replacement
BiPAP	Bi-level Positive Airway Pressure
CABG	Coronary Artery Bypass Graft
CBC	Complete Blood Count
cmH_2O	Centimeters of Water
COPD	Chronic Obstructive Pulmonary Disease
CPAP	Continuous Positive Airway Pressure
EF	Ejection Fraction
ETT	Endotracheal Tube
ICU	Intensive Care Unit
IPPB	Intermittent Positive Pressure Breathing
IRB	Institutional Review Board
IV	Intravenous
Kg	Kilogram
LIMA	Left Internal Mammary Artery
LOS	Length of Stay
MOH	Ministry of Health
MV	Mechanical Ventilation
NIV	Non-Invasive Ventilation
NPO	Nil Per Os (nothing by mouth)
O_2	Oxygen
OR	Operating Room
p	p-value
PCI	Percutaneous Coronary Intervention
PEEP	Positive End-Expiratory Pressure
PhD	Doctor of Philosophy
PMH	Past Medical History
RCT	Randomized Controlled Trial
RIMA	Right Internal Mammary Artery
SAH	Specialized Arab Hospital
SIMV	Synchronized Intermittent Mandatory Ventilation
SPSS	Statistical Package for the Social Sciences

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Chapter one: Introduction

1.1 Introduction

Coronary artery bypass graft (CABG) was officially first done in 1967 (Rocha E.2017), it's a surgical procedure done for reperfusion of diseased coronaries when stenting with coronary catheterization is risky or comes with unwanted complications, the conflict between cardiac catheterization and surgical open heart is still not conclusive, since the first CABG many changes was made in the surgical techniques with all it effects and complications was known and had enough time to study all the complication to avoid it when possible, but respiratory complications still one of the stubborn challenges according to the anesthesiologist , one of the main challenges was sedation and mechanical ventilation which is directly related to post-operative respiratory complication, lung atelectasis was one of main respiratory complication which affect the alveolar wall causing it to collapse and impairing the gas exchange process (Rocha E, 2017).

While the circulation in the alveolar vessels in unaffected ventilation in the alveoli is impossible, Atelectasis develops in the dependent sections of the lungs of the majority of anesthetized patients. It is related with reduced lung compliance, impaired oxygen delivery, increased pulmonary vascular resistance, and the development of lung damage. The negative consequences of atelectasis extend into the postoperative phase and can have an influence on patient recovery (Duggan, M et al., 2005).

The detection of lung atelectasis is usually suspected when there is an alteration in the lung mechanics which come as a symptoms on the patients such as tachypnea, decrease in

O2 (Oxygen) saturation and labored breathing, it can be detected in the conventional chest radiography and shows as opacification of the lobe or lobar segment, another easy and assessable detection tool is lung ultrasound imaging which shows atelectasis as a as consolidated parenchyma with a reduced lung volume (Mojoli, F et al.,2019).

When a patient underwent a CABG, the procedure usually take from 3 to 6 hours according to the grafts needed, the complexity of the procedure, and the use of heart-lung machine pump (Naughton et al., 2003).

During that time, the patient is fully sedated and ventilated by the anesthesia machine. After finishing the procedure, the patient is transferred to post-surgical care unit while still being intubated and kept on a mechanical ventilator. Extubation achieved once the patients meet the following criteria, which vary from each individual: achieving consciousness, obeying commands, no surgical bleeding, minimal inotropes support, acceptable blood gases on minimal MV (Mechanical Ventilator) settings, and acceptable chest x-ray. Within the first several hours, some patients might achieve these requirements, while others might take longer (Montrief, Koyfman, & Long, 2018).

Many studies now focusing on early extubation (within six hours post-operative) and its effect. For example, a study conducted by Brovman et al. (2021) focused on early extubation in post CABG & AVR (Aortic Valve Replacement) patient and the risk of reintubation, and concluded that the risk of reintubation was not increased with early extubation (Goeddel, Hollander, & Evans, 2018).

Many studies were implemented regarding the use of spirometer practice pre-op and post-op in minimizing respiratory complication including lung atelectasis (Itomskyi, Al-Hawamde, Vitomska, Lazarieva, & Haidai, 2020), and the result of one of these studies was confirming on the benefits of using spirometer in preventing respiratory complication, one of the latest studies regarding the use of incentive spirometry was done in Palestine by Sweity, et al. (2021).

In this research we focused mainly on coronary artery bypass graft and the associated respiratory complications, lung atelectasis in specific.

1.2 Background

The use of MV is unavoidable during and after CABG, patients being fully sedated and intubated during the whole procedure until being fully conscious and able to maintain an open airway, there are many studies regarding the use of mechanical ventilator modes and MV time post-operative, all focused on knowing the most appropriate measurements in minimizing the complications of MV use (Rocha E, 2017).

After the completion of CABG and the chest is closed, patients continue to be sedated and the use of MV is a must. This period differs according to patient status and being able to achieve extubation criteria, which includes fully conscious with good power, no neurological impairment, and acceptable chest radiography and blood gases (Dimeling, Bakaeen, Khatri, & Bakaeen, 2021).

Additionally, the patient should be hemodynamically stable without any signs of bleeding and minimally dependent on MV. Fulfilling all these requirements guarantees that

the patient can be extubated safely and with the least number of problems, as the literature suggests However some complications can still happen which may sometimes cause a reintubation related to respiratory failure caused by lung atelectasis (Montrief, T., Koyfman, A., & Long, B. 2018).

The process of knowing if a patient is in need to CABG initiates after the patient underwent a cardiac catheterization. If the interventional cardiologist finds it to be unable to place a stent in the coronary or if stenting comes with major risks a surgeon opinion is then needed. If both agreed that the patient needs a CABG, the patient is informed with risks and benefits in addition to any other possible treatment. After patients' approval, all blood work up is done including CBC (Complete Blood Count), blood group, serum electrolytes, coagulation profile, liver function tests, kidney function tests, blood gases and thyroid tests. Radiography assessments were performed including chest x-ray, bilateral carotid Doppler ultra sound to check for carotid stenosis to avoid brain hypo-perfusion and cardiac echo to check for EF (Ejection Fraction) and any valvular disorders.

After checking of all what previously mentioned the patient were ready for operation, on the operation day after checking with all pre op requirement from anesthesia evaluation to being NPO (Nil Per Os), the patient enters the operation room, sedated with propofol, fentanyl, midazolam and cisatracurium. The patient then intubated, and all IV (Intra Venous) access is placed, Foley catheter is placed and an invasive arterial line usually radial, then a sternotomy is done. If a heart lung machine is needed, cannulation is done, then taking the possible replaced coronary with one of the following: LIMA (Left Internal

Mammary Artery), RIMA (Right Internal Mammary Artery), radial artery, or saphenous veins (Rocha E, 2017).

The history of CABG surgery in Palestine started in the late nineties, as the development of advanced cardiac surgery techniques and infrastructure in the region took time. However, with advancements in medical technology and the establishment of specialized cardiac centers, CABG surgery has become a vital component of cardiac care in Palestine, In the early stages, cardiac surgeries, including CABG, were not widely performed in Palestine. Patients in need of such procedures often traveled abroad, primarily to neighboring countries or further afield, to receive treatment, Development of Cardiac Centers: Over time, Palestinian hospitals recognized the increasing need for cardiac care, and specialized cardiac centers were established. These centers aimed to provide comprehensive cardiovascular services, including CABG surgery.

Palestinian cardiac surgeons and medical professionals sought collaboration with international medical institutions and organizations to gain expertise and training in advanced cardiac surgery techniques. Collaborations with medical centers in neighboring countries, Europe, and North America facilitated the exchange of knowledge and skills. With the establishment of specialized cardiac centers and the training of local cardiac surgeons, CABG surgery was introduced in Palestine. Initially, a limited number of procedures were performed, but as experience and expertise grew, the availability of CABG surgery expanded. As medical technology advanced globally, Palestinian cardiac centers gradually acquired state-of-the-art equipment and facilities necessary for performing CABG surgery.

This included the use of sophisticated imaging techniques, robotic-assisted surgery, and minimally invasive approaches, allowing for safer and more precise procedures. As the Palestinian medical community gained experience and expertise in CABG surgery, there was a focus on building local capacity. Palestinian cardiac surgeons started to perform more CABG surgeries independently, reducing the need for patients to travel abroad for treatment. Increasing accessibility to CABG surgery became a priority, ensuring that patients from various regions in Palestine could receive timely and quality cardiac care. This involved expanding the availability of cardiac centers and improving the referral system to ensure that patients in need were identified and directed to the appropriate facilities (Abuejheisheh. 2021).

In Palestine the first CABG was done in Jerusalem at Al Makassed Charity Hospital in the late nineteens according to the Palestinian ministry of health (MOH), then many other hospital followed in the West bank and Gaza, all hospitals in Palestine are following the previous preparations and techniques, regarding the post operation care, patient are transferred into a special surgical ward directly after closure of sternotomy and placing the chest drains, at this moment sedation still effective, during the first hour patient are closely checked for hemodynamics, surgical bleeding, and any other related signs (Dimeling, Bakaeen, Khatri, & Bakaeen, 2021).

Regarding MV, all patients come out of operation rooms fully sedated and intubated with an ETT (Endo-Tracheal Tube), then connected to a MV on a specific mode usually SIMV (Synchronized Intermittent Mandatory Ventilation) with an appropriate measurements, at the post-op ward no additional sedation is being given unless is needed to

procedure or if the patient wake up confused, using of MV continues until achieving extubation criteria, the time until achieving this varies between patients, then patient is extubated and kept on nebulizer mask with O_2 , then regular blood work and radiography imaging is done to assess the respiratory function (Brovman et al., 2022).

One of the most serious respiratory consequences following CABG is lung atelectasis., with a relatively high incidence among these patients, it can lead to a serious life-threatening situation, if not it can increase the patient's length of stay, treatment cost and decrease the patient comfort and quality of care delivered (Martinez & Cruz, 2008).

1.3 Problem statement

It was noted that some post-CABG patients without a history of lung disease, experience lung atelectasis after being taken off mechanical ventilation. These people frequently have longer hospital stays and higher medical costs. Remarkably, some patients do not develop lung atelectasis, including those who have a history of lung disease. When atelectasis occurs, patients typically require a prolonged course of therapy that may include NIV (Non-Invasive Ventilation) or other therapeutic measures. Notably, all patients receive the same regimens and methods of treatment intended to avoid lung atelectasis, including incentive spirometer, early mobilization, and chest physiotherapy.

PEEP (Positive End-Expiratory Pressure) is a widely used mechanical ventilation technique to prevent alveolar collapse and may contribute to this issue. In a study, Setak-Berenjestanaki et al, (2017) claimed that a substantial variation in the incidence of lung atelectasis was discovered in post-CABG patients using two different PEEP levels.

Therefore, additional research is needed to identify the optimal PEEP level to reduce atelectasis risk in this patient population.

The primary objective is to determine the optimal PEEP level for reducing the occurrence of lung atelectasis, while secondary objectives include assessing the length of hospital stay and the need for respiratory support, with the aim of improving patient outcomes and decreasing healthcare costs.

1.4 Significance of the study

The significance of this research lies in its potential to improve patient outcomes by reducing the occurrence of lung atelectasis, which is a common post-operative complication. This improvement could lead to a shorter hospital stay and less suffering for patients. Additionally, the intervention required to achieve this improvement is simple and cost-effective, which could have a positive impact on the institution by reducing the cost of care. By decreasing the total number of days patients spend in admission, hospitals could potentially treat more patients and better manage their capacity rates.

1.5 Research objective

The primary aim is to improve patient outcome and wellbeing after CABG by avoiding the development of lung atelectasis, in addition to finding any association between varying levels of PEEP and the occurrence of atelectasis in patients who had undergone coronary artery bypass grafting but had no history of lung illness.

This can be achieved by comparing the outcomes of previous patients who received different PEEP levels. The objective of the study is to establish clear guidelines for the

optimal PEEP level to reduce the risk of developing lung atelectasis in this patient population, which can potentially lead to better clinical outcomes and shorter hospital stays

1.6 Research questions

Main question: How does different levels of PEEP affect the development of lung atelectasis in post CABG patient?

The sub questions:

1- Does a PEEP of 10 H2O most beneficial in decreasing the probability of developing lung atelectasis in post CABG patient?

2- Does a higher PEEP result in shorter length of stay in post CABG patients?

3- Does the post-operative MV time affect the probability of developing lung atelectasis?

4- Does the use of cardiopulmonary pump increase the probability of developing lung atelectasis?

5- Does demographic data affect the occurrence of lung atelectasis at same PEEP level?

1.7 Research variables

The dependent variables were length of stay, did the patients developed atelectasis or not, and PEEP levels.The independent variables include the following: demographics, time on MV, PEEP, smoking, BMI (Body Mass Index), High-risk operation, PMH (Past Medical History), number of grafts, Pre-operative EF, heart pump used, Blood units given in OR

(Operation Room), Vasopressors use, MV settings and modes, Blood labs, Operative time, Estimated blood loss, Graft type, Chest drains, spirometer use, pus wound discharge, weaning off supplement, Length of stay and Average O2 sat.

Chapter Two: Literature review

2.1 Introduction

During the search in many data bases including pub-med, google scholar, and many others search words include, CABG, MV, PEEP, lung atelectasis, respiratory complications, to provide the needed literature of this research.

2.2 previous research studies of CABG

Globally, cardiovascular illnesses are the largest cause of mortality, with coronary artery disease being the most frequent. Coronary Artery Bypass Grafting (CABG) has become the most prevalent procedure in the world as the number of patients undergoes a significant increase, despite the improving in catheterization stenting techniques and trying to avoid CABG due to risky complications but, some cases may be advised by the doctors to do CABG which is mainly depending on the risks and benefits (Rocha E, 2017).

According to recent research, percutaneous coronary intervention (PCI) is not necessarily the optimum treatment for coronary artery disease, since the risk of restenosis occurs in around 30% of non-coated stents and 10% of coated coronary stents, with multiple occlusions or lesions in the coronary the need of multiple stents increases the risk of in-stent stenosis or the occurrence of restenosis (Bakhai, et al., 2005).

One of the most typical complications of CABG is respiratory disorders. As a result, weaning these patients off of mechanical ventilator and extubation is critical. The mechanical ventilation is also linked to several post-operative complications. As the time

on mechanical ventilator rises, so do the number of complications, the length of hospital stay, and the expense of treatment. Because of many variables influencing the post-operative period, the goal of this research is to determine the predictors of extubation duration in CABG patients and the ideal time for extubation postoperatively to in order to minimize lung complications (Martínez & Cruz, 2008).

The decision when going with a CABG or stenting is made depending on individual clinical status of the patient and other risk factor considering the mortality and morbidity of each procedure, a pooled analysis study made in 2018 which involved 11 randomized studies with a total of 11,518 patients who were randomly allocated to PCI (n=5753) or CABG (n=5765) by cardiac teams. Over the course of 3.8 years, 976 patients died. After PCI, all-cause mortality was 11.2%, but after CABG, it was 9.2% (Head et al.,2018).

All-cause mortality over 5 years varied significantly between interventions in patients with multivessel disease (11.5% after PCI vs. 8.9% after CABG), including diabetic patients (15.5% vs 10.0%), without significant difference in patient with diabetes 8.7% vs 8.0% (Head et al.,2018).

Coronary artery bypass graft was officially first done in 1967 (Rocha E. 2017), since that time many changes was done in the surgical techniques which all it effects and complications was known and had enough time to study all the complication to avoid it when possible, but according to the anesthesiologist one of the main challenges was sedation and mechanical ventilation which is directly related to post-operative respiratory complication.

Lung atelectasis:

Lung atelectasis was one of main respiratory complication which affect the alveolar wall causing it to collapse and impairing the gas exchange process, while the circulation in the alveolar vessels in unaffected ventilation in the alveoli is impossible, Atelectasis develops in the dependent sections of the lungs of the majority of anesthetized patients. It is related with reduced lung compliance, impaired oxygenation, increased pulmonary vascular resistance, and the development of lung damage. The negative consequences of atelectasis extend into the postoperative phase and can have an influence on patient recovery (Duggan, M et al., 2005).

With incidence rates of more than 30%, lung atelectasis is considered a very common and undesirable complication due to the further needed interventions and its effect on the patient (Niyayeh Saffari et al., 2015).

The detection of lung atelectasis is usually suspected when there is an alteration in the lung mechanics which come as a symptoms on the patients such as tachypnea, decrease in O2 saturation and labored breathing, it can be detected in the conventional chest radiography and shows as opacification of the lobe or lobar segment, another easy and assessable detection tool is lung ultrasound imaging which shows atelectasis as a as consolidated parenchyma with a reduced lung volume (Mojoli, F et al.,2019).

When a patient underwent a CABG, it usually take from 3 to 6 hours according to the grafts its needed, the complexity of the procedure and the use of heart-lung machine (pump) (Naughton, C et al., 2003), during that time the patient is fully sedated and

ventilated by the anesthesia machine, then after finishing the procedure the patient is sent to post-surgical care unit while still being intubated and keep on a mechanical ventilator until achieving the extubation criteria which vary from each individual but must achieve all of the following: consciousness, obeying commands, no surgical bleeding, minimal inotropes support, acceptable blood gases on minimal MV settings and acceptable chest x-ray, some patient may be able to achieve these in the first hours, while others may took more time to achieve the extubation criteria (Montrief et al., 2018).

Mechanical ventilation time

Many studies focusing on early extubation (within 6 hours post-operative) and its effect for example a study conducted by Brovman, E. Y et al.,2021 focused on early extubation in post CABG & AVR patient and the risk of reintubation and concluded that the risk of reintubation was not increased with early extubation.

Siddiqui et al. (2018) stated in a retrospective, observational study focused on early extubation after CABG and lung complication that needed re-intubation, the result showed that Reintubation following a cardiac surgery is an uncommon occurrence, with old age being the most affected group, the study showed that early extubation does not enhance the risk or minimize the lung related complications (Siddiqui et al., 2018).

Another systematic review study focused on the use of incentive spirometry and educating patients in preventing atelectasis or pneumonia and the use of non-invasive ventilation, this review was based on four studies with a total of 443 patients. There was no significant difference in minimizing atelectasis or pneumonia between incentive spirometry

and positive pressure breathing techniques such as Continuous Positive Airway Pressure (CPAP), Bi-level Positive Airway Pressure (BiPAP) and Intermittent Positive Pressure Breathing (IPPB) or educating patients pre-operative between incentive spirometry and positive pressure breathing techniques (CPAP, BiPAP, and IPPB). When compared to positive pressure breathing, patients using incentive spirometry showed lower pulmonary function and arterial oxygenation (CPAP, BiPAP, IPPB) (Freitas et al., 2012).

Prospective randomized comparison study was done in 2002, included two groups of post CABG patient, extubation was done in the first group as soon as possible while in the second group extubation was done after minimum of 3 hours postoperative, both groups of patients were only extubated after meeting specified extubation criteria. Patients were excluded from the research if they did not achieve the extubation requirements within the time restriction specified (90 minutes in group I and 6 hours in group II). The statistical data were comparable among groups. In groups I and II, the mean time to extubation was 45.7 plus or minus 27.6 minutes and 201.4 plus or minus 21 minutes, respectively. After failing to meet the extubation requirement within the time restriction, . There was a significant loss in pulmonary function in the two groups, although there were no changes after 24 or 72 hours. after surgery There were no differences between the groups in blood gases, atelectasis scores, or pulmonary complications (Fernández-Mondéjar et al., 2002).

According to the findings, prolonging mechanical ventilation following CABG surgery had little effect on pulmonary function. If normal extubation conditions are met, patients can be extubated safely after major heart surgery within 1 hour. This reduces the risk of subsequent pulmonary derangement (Trouillet et al., 2009).

Positive end-expiratory pressure effect:

A clinical trial was done in 2017, including 90 patients underwent coronary artery bypass surgery. The trial aimed to the incidence rate of lung atelectasis and hemodynamic status, For 4 hours, the intervention group individuals had PEEP = 10 cmH2O while the control group patients had PEEP = 5 cm / H(2)o. A chest radiograph was taken six hours after extubation and five days following surgery to confirm the diagnosis of atelectasis, They concluded that using PEEP=10 cm/H2O after Coronary Artery Bypass Surgery may lower the occurrence rate of atelectasis following the surgery, and taking into account that applying two levels of positive end-expiratory pressure with 5 and 10 cm of water has no influence on the hemodynamic status of patients (Pouria, A, et al.,2017).

In 2018, a trial was conducted based on a study completed in 2015 at the Fatemeh Zahra Hospital in the Mazandaran Heart Center to compare the impact of different levels of PEEP on patients receiving mechanical ventilation (MV) after CABG surgery and their probability of developing lung complications such as atelectasis. 180 post-CABG patients were divided into three equal groups and given either 8 cm water or 10 cm water PEEP for 4 hours and 30 minutes following being admitted to the ICU, followed by 5 cm H2O PEEP till extubation. On the third day following operation and two hours after extubation, the rate of atelectasis was measured. When compared to the control and PEEP 8 groups, the use of 10 cm H2O PEEP reduced the incidence of atelectasis, the duration of intubation in the the intensive care unit, and the length of stay in the ICU and hospital. The distinctions among the three groups were statistically significant. This technique is recommended for use in

postoperative management of patients, as this level of PEEP is useful (Setak-Berenjestanaki, M et al., 2018).

The knowledge gap in the literature linked with this research is the lack of information and guidelines on the ideal PEEP level to prevent lung atelectasis in post-CABG patients without a history of the condition in Palestine and the Arab countries. There is only a few similar studies available, and there is no clear consensus on the appropriate PEEP level for this patient population in the ICU.

Therefore, the study aims to fill this gap and provide valuable information to improve patient outcomes and reduce healthcare costs.

Chapter Three: Methodology

3.1 Introduction

In order to answer our research question, we need to choose an appropriate research design that contribute to the following process of data collection and analysis, to check if what we claimed is right or wrong, the following parts clarifies the design that was used and all other methodology related questions.

3.2 Study design

A quantitative methodology was used in this research, retrospective design was used

3.3 Study site and setting

The study was conducted at a tertiary care hospital in northern west bank called specialized Arab Hospital (SAH), it was chosen due to the high load of CABG procedure done each year, the SAH is located in the city of Nablus, according to the Palestinian ministry of health in 2020 the SAH was the most hospital that did CABG that year, since 2019 the SAH had a fully computerized health information system (HIS) containing all the information related to their case and the treatment or any procedure that was made in full details with the name and note of each health care provider contacted with him.

3.4 Study population

The population were all post CABG patient in West bank.

3.5 Sample and sampling

A sample was taken from a tertiary care hospital in northern West bank, which included data from the last two years data base in SAH.

Convenience sampling was used, including the period from the beginning of Jan 2021 until the end of DEC 2022.

3.6 Inclusion criteria

All post CABG patient via sternotomy aged from 30-80 years old, weighing from 60-120kg, extubated within the first 6 hours post-op, with no previous respiratory complications, with no post-operative complications including massive bleeding or re-opening, total operative time of less than 6 hours, and using or not using the heart-lung pump during operation.

3.7 Exclusion criteria

Excluded patients include any patient with a history of lung disease asthma ,COPD , etc., ,any patient weighing more than 120Kg because there would be a big change in the needed MV setting to ensure the safety of this patient so we can't use the same MV settings in overweight patients, any patient had a peak air way pressure of more than 30 cmH_2O, patient of other types of cardiac surgeries were excluded, more than 2 units blood transfusion post-operative, top urgent cases or post cardiac arrest.

Moreover, any patient develops any other unspecified complication were excluded.

3.8 Sample size

The sample include all operation from the period from the beginning of Jan 2021 until the end of DEC 2022 were done by the same surgeon, and achieving the pre-determined inclusion criteria

3.9 Study instrument

The data collection tool was self-developed by the researcher and the supervisor of this research with a PhD in critical care, it was viewed by a cardiac surgeon and an anesthesiologist, and all their comments were taken in consider and adjusted accordingly.

The data collection tool had 4 section includes various patient and operative details, demographics, preoperative data, intraoperative data and postoperative data,

Demographics

The demographics section includes information on the patient's age, gender (male/female), residential area (city/village/camp), and smoking status (yes/no).

Preoperative Data

The preoperative data section collects details such as the patient's body mass index (BMI), presence of high-risk operation (yes/no), and pre-existing medical conditions including diabetes mellitus (DM), hypertension (HTN), ischemic heart disease (IHD), and others. Additionally, it records the pre-operative ejection fraction (EF%) and the specific type of operation (x1, x2, x3, x4, x5).

Intraoperative Data

The intraoperative data section documents details such as the operating surgeon (1/other), use of a heart pump (yes/no), blood units given in the operating room (1, 2, 3, 4, 5+), mechanical ventilation settings (SIMV, TV, PEEP, PS, RR, Fio2, PIP), and operative time in minutes. It also includes the estimated blood loss in milliliters, the type of graft used (total arterial/total venous/mixed), and management of chest drains (peri, left.p, right.p, M/S).

Postoperative Data

The postoperative data section captures information on the need for high-dose vasopressors in the first day (yes/no), blood gases before extubation (acceptable/abnormal), extubation time in minutes, and the removal day of chest drains (2nd day, 3rd day, 4th day+). It records the total chest drain discharge in milliliters, first chest x-ray after extubation results (acceptable/lung atelectasis/other abnormal results), chest x-ray results on the 1st, 3rd, and 5th days post-operation, and presence of pus wound discharge (yes/no). Furthermore, it tracks the day of weaning off supplemental oxygen (3rd day, 4th day, +5th day), length of stay from operation day, and average oxygen saturation levels for day zero, 1st day, 2nd day, 3rd day, and 5th day.

3.10 Validity and reliability

Internal Validity, methodology, and data collection methods used in the study accurately measure the effect of various PEEP levels on atelectasis during CABG. Any potential sources of bias or confounding factors were carefully controlled to establish a causal

relationship. External Validity, the findings of this study can be generalized to the broader population of coronary artery bypass grafting patients. Considerations should be given to the representativeness of the sample and the relevance of the PEEP levels studied.

3.11 Ethical considerations

Ethical approval was obtained from Arab American University, Institutional Review Board (IRB) and registered under the number 2023/A/163/N, and permission for conducting the study in private hospitals was taken from their administrative department, all data were confidential and only for the use of research purposes, no names of any patient was mentioned or used, no patient's information were used in any context than this research, all data were kept confidential.

The data were gathered from a health information system used by the hospital, this system had all the patient data during hospitalization from admission to discharge, also including intraoperative data of the procedure.

After gaining access to the history of patient's files and searched all patients underwent CABG of the mentioned period, then the inclusion and exclusion criteria were applied o get the required sample.

3.12 Analysis plan

A software program was used in analyzing the data, SPSS v27, different tests were used to test the significance changes in each independent variables on the dependent variable, including measures of central tendency and inferential statistics, testing hypothesis via T test, ANOVA and Chi square test was used in the analysis of the gathered data, the

occurrence of lung atelectasis can be calculated from the percentage of patients who developed lung atelectasis in each group of PEEP levels, ANOVA test was also employed in testing the significance between the groups of different level measurements and other variables.

Chapter Four: Results

4.1 introduction

The total number of CABG procedures for patients between the mentioned periods was 314 patients in total, after applying the previously mentioned inclusion and exclusion criteria a total of 268 patients CABG procedures were done and included in this study analysis, the data were collected using the stated tool, the analysis plan focused on answering the research questions. Data were tested for normality with kolomongrogh normality test, and it were normally distributed, parametric analysis was used.

4.2 Demographic data and statistical analysis

As table 1 shows, the majority of the sample were on PEEP 8 (64.6%), and 26.1% on PEEP 5 and 9.3% were on PEEP 10, the occurrence rates of lung atelectasis for patients post CABG on PEEP 5 was 45%, while the occurrence rate of lung atelectasis for patients post CABG on PEEP 8 was 27.2%, and the incidence rate of lung atelectasis for patients post CABG on PEEP 10 was only 12%. Figure 1.

Table 1

PEEP distribution and lung atelectasis.

		Developed Lung Atelectasis?			
		Yes		No	
		Count	%	Count	%
postive end-expiratory pressure	PEEP 5	32	45.7%	38	54.3%
	PEEP 8	47	27.2%	126	72.8%
	PEEP 10	3	12.0%	22	88.0%

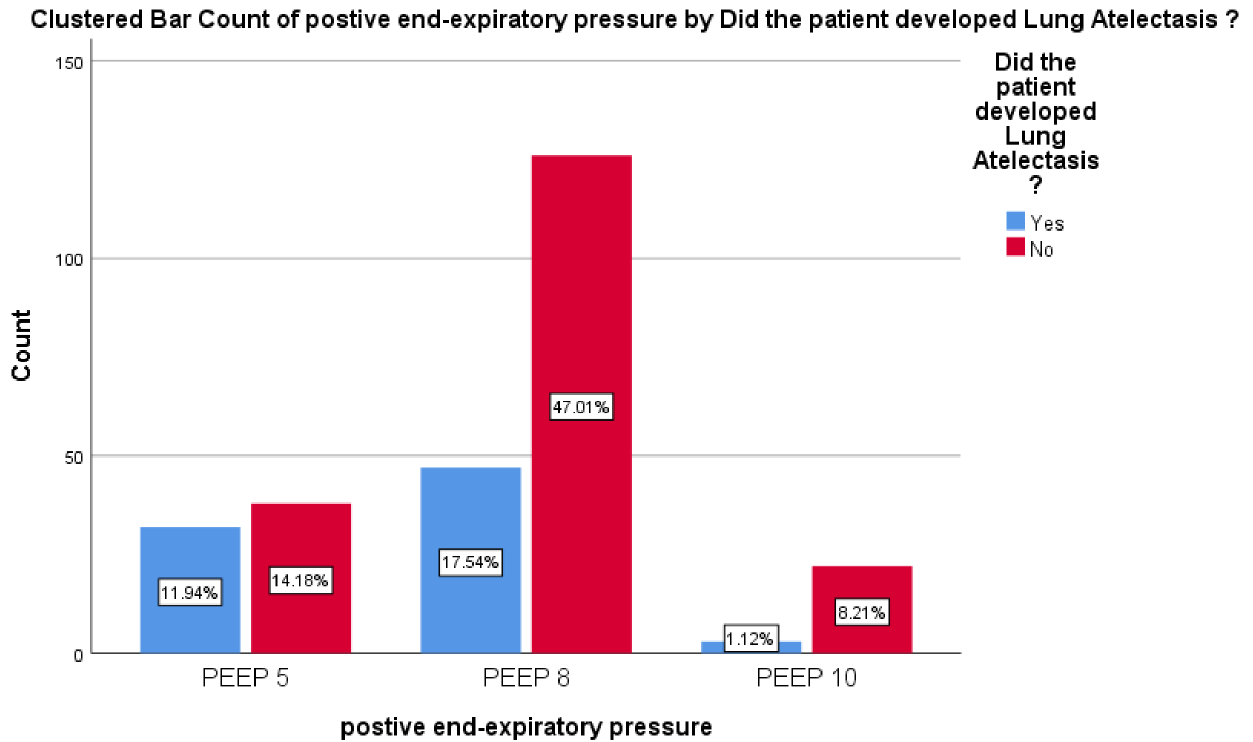

Figure 1

PEEP with lung atelectasis.

Table 2 below shows the demographic data of the taken sample and PEEP levels with significance level using Chi square test, generally males were the majority of the sample with females representing 18% of the taken sample, 71.6% of the sample were smokers, 38.8% were living in cities, 32.1% living in villages while 29.1% of the sample were living in a refugee camp, 11.9% of the total operations were signed as a high risk procedure, 86.2% of the patients had a past medical history of diabetes mellitus, hypertension or ischemic heart disease, the majority of the sample had underwent a 3 grafts procedure 60.8%, the heart-lung machine was used in 45.9% of the total procedures. Smokers with higher PEEP levels had significantly higher occurrence of developing lung atelectasis post CABG as clearly showed in figure 2.

Table 2

Demographics with PEEP levels and sig (Chi square test).

		PEEP 5		PEEP 8		PEEP 10		P
Gender	Male	63	(24%)	140	(52%)	16	(6%)	0.087
	Female	7	(3%)	33	(12%)	9	(3%)	
Smoker?	No	19	(7%)	46	(17%)	11	(4%)	0.015
	Yes	51	(19%)	127	(47%)	14	(5%)	
Residential area	City	28	(10%)	66	(25%)	10	(4%)	0.878
	Village	23	(9%)	56	(21%)	7	(3%)	
	Camp	19	(7%)	51	(19%)	8	(3%)	
Is it a High risk operation	No	65	(24%)	155	(58%)	16	(6%)	0.466
	Yes	5	(2%)	18	(7%)	9	(3%)	
Past medical history	DM / HTN / IHD	47	(18%)	159	(59%)	25	(9%)	0.795
	Free PMH	23	(9%)	14	(5%)	0	(0%)	
Number of Grafts	x1	17	(6%)	24	(9%)	0	(0%)	0.840
	x2	5	(2%)	16	(6%)	2	(1%)	
	x3	41	(15%)	104	(39%)	18	(7%)	
	x4	7	(3%)	22	(8%)	5	(2%)	
	x5	0	(0%)	7	(3%)	0	(0%)	
on Pump ?	No	41	(15%)	95	(35%)	9	(3%)	0.867
	Yes	29	(11%)	78	(29%)	16	(6%)	

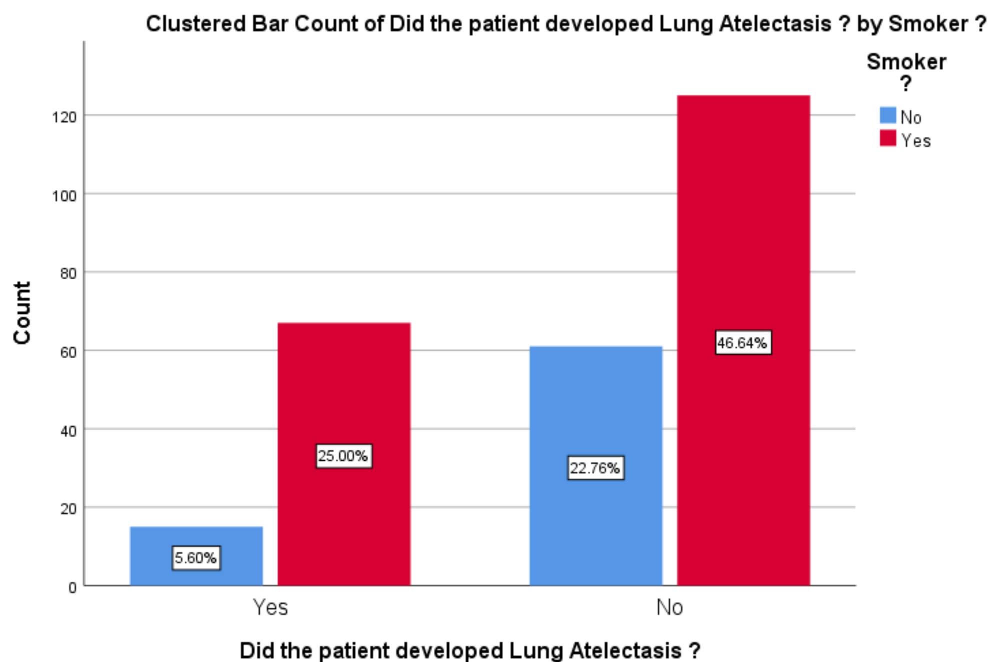

Figure 2

Smoking with lung atelectasis.

As table 3 shows, 35.8% of smoker patients on PEEP 5 developed lung atelectasis, 61.2% of smokers on PEEP 8 developed lung atelectasis, only 3% of smokers on PEEP 10 developed lung atelectasis, while 21.6% of smokers on PEEP 5 didn't develop lung atelectasis, 68.8% of smokers on PEEP 8 didn't develop lung atelectasis, and 9.6% of smoker patients on PEEP 10 didn't develop lung atelectasis.

Table 3,

Smokers with lung atelectasis and PEEP levels

		Developed Lung Atelectasis?											
		Yes						No					
		PEEP 5		PEEP 8		PEEP 10		PEEP 5		PEEP 8		PEEP 10	
		N	N%	N	N%	N	N%	N	N%	N	N%	N	N%
Smoker?	No	8	53.3%	6	40.0%	1	6.7%	11	18.0%	40	65.6%	10	16.4%
	Yes	24	35.8%	41	61.2%	2	3.0%	27	21.6%	86	68.8%	12	9.6%

Table 4 also shows that, 52.7% of patient who developed lung atelectasis on PEEP 8 was on the 1st post op day, 41.8% with PEEP 5 also developed lung atelectasis on the 1st post op day, only 5.5% of patients who had lung atelectasis was on the 1st post op day, while 69.2% of the patient who developed lung atelectasis on PEEP 8, was on the 2nd post op day, 30.8% of patients who developed lung atelectasis was on the 2nd post op day and none of the patients on PEEP 10 developed lung atelectasis on the 2nd post op day.

Table 4

When lung atelectasis happened with PEEP.

		Developed lung atelectasis					
		PEEP 5		PEEP 8		PEEP 10	
		Count	%	Count	%	Count	%
If yes when ?	1st day	23	41.8%	29	52.7%	3	5.5%
	2nd day	8	30.8%	18	69.2%	0	0.0%

As table 5 shows below, 63.1% of the patients took less than 2 units of blood during operation, 36.2% of the patients took 1-2 units of blood post operation, 17.2% of the patients needed more than 15mcg/m vasopressor in the first post-operative day, 47% of the patients had a mixed grafts type (venous and arterial) ,78% of the patients had 3 chest tubes (mediastinal, left plural and right plural), 36.8% of the patient's chest tubes were removed on the 2nd post op day, 17.5% of the patients had wound discharge of any type, 30% of the patients had developed lung atelectasis, 67.9% of them developed lung atelectasis on the 1st post op day.

Patients on high doses norepinephrine of 15mcg/m or higher with lower PEEP levels had a significant higher occurrence of developing lung atelectasis, using spirometer had a significant effect in decreasing the occurrence of lung atelectasis in all PEEP levels (figure 3), removing chest drains (besides the number of drains) on the 2nd post op day had a significant effect in decreasing the occurrence of lung atelectasis in all PEEP levels, patients who had any kind of wound discharge had a higher occurrence of developing lung atelectasis for patients on PEEP 5 and 8.

Table 5

Operation characteristics with PEEP levels. (NOR : Norepinephrine)

		PEEP 5		PEEP 8		PEEP 10		P
Blood units given in OR	less than 2 units	47	(18%)	110	(41%)	12	(4%)	0.937
	More than 3 units	23	(9%)	63	(24%)	13	(5%)	
Blood units given post op	yes, 1-2 units	25	(9%)	62	(23%)	10	(4%)	0.143
	No	45	(17%)	111	(41%)	15	(6%)	
High dose NOR on 1st day	No	59	(22%)	146	(54%)	17	(6%)	0.037
	Yes	11	(4%)	27	(10%)	8	(3%)	
Type of Grafts	Mixed	29	(11%)	84	(31%)	14	(5%)	0.201
	Total Arterial	20	(7%)	41	(15%)	1	(0%)	
	Total Venous	21	(8%)	48	(18%)	10	(4%)	
Chest Drains	M/S,Left.P and Right.P	50	(19%)	136	(51%)	23	(9%)	0.763
	M/S + left or right plural	20	(7%)	37	(14%)	2	(1%)	
Patients using spirometer	Active	37	(14%)	102	(38%)	14	(5%)	0.001
	Lazy or Refused	33	(12%)	71	(26%)	11	(4%)	

Chest drains removed on?	2nd op day	36	(13%)	114	(43%)	21	(8%)	0.001
	3rd + op day	34	(13%)	59	(22%)	4	(1%)	
Wound discharge?	No	61	(23%)	145	(54%)	15	(6%)	0.001
	Yes	9	(3%)	28	(10%)	10	(4%)	
When atelectasis developed?	1st day	23	(9%)	29	(11%)	3	(1%)	
	2nd day	8	(3%)	18	(7%)	0	(0%)	

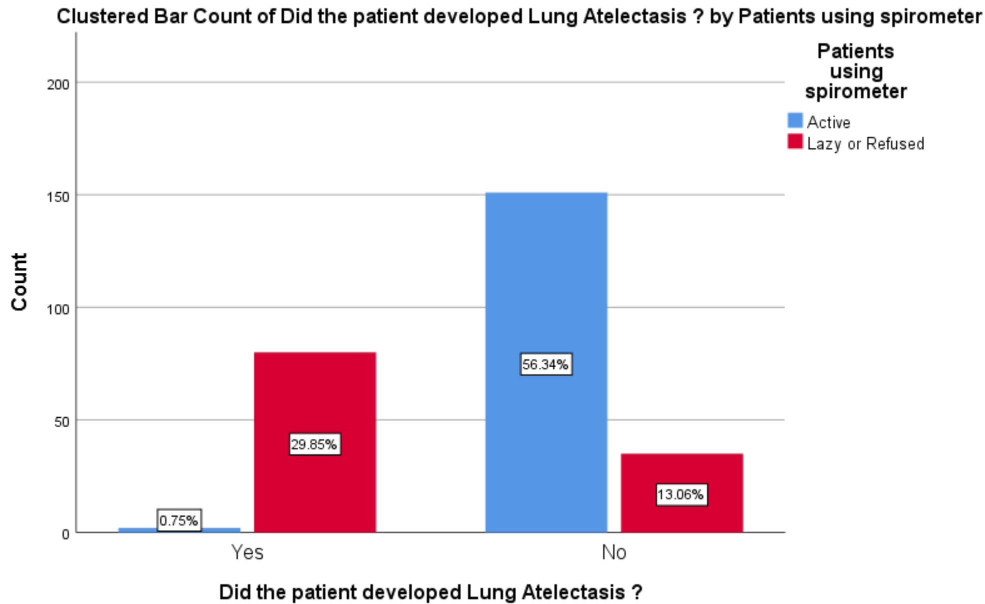

Figure 3

Using spirometer and atelectasis.

The following table 6 below, shows numerical data with PEEP levels, the mean age of the total sample was 61.1 years ±9.6, the mean BMI was 25±2.2, the mean pre-op EF was 39% ±6.8, mean used TV was 510ml ±24, the pressure support was the same in the whole taken sample 15, mean RR was 14.3bpm ±1.2, mean fraction of O2 used was 54.2% ±4.9, the mean peak air way pressure was 23.7cmH2O ±2.8, the mean time from closure to extubation was 209.5 minutes ±53.2, the mean total operation time was 221minutes ±29.2, the mean estimated blood loss was 532.2ml ±175, the mean length of stay was 5.5 days ± 0.9, the mean average of O2 sat 96% ±1.

BMI had a significant effect on the occurrence of lung atelectasis in all PEEP levels, patients with higher BMI are at higher risk of lung atelectasis, peak air way pressure had a significant effect on lowering the occurrence of lung atelectasis, patients with higher peak airway pressure at lower risk of lung atelectasis, patients with higher PEEP had a significant lower length of stay, the mean length of stay was 5.81 days ± 1.03 in patients with PEEP 5, while the mean length of stay in patients with PEEP 8 was 5.53 days ± 0.95, as for patients on PEEP 10 the mean length of stay was 5.2 days ±0.58 from the operation day until discharge.

Table 6

Comparison of variables based on PEEP with sig to developing lung atelectasis.

	PEEP 5		PEEP 8		PEEP 10		
	Mean	St.d	Mean	St.d	Mean	St.d	P
Age	61.24	8.89	60.65	10.03	64.48	8.78	0.094
Body Mass Index	22.87	.90	25.35	1.72	28.56	2.38	0.009
Pre op EF	39	6	40	7	35	8	0.236
tidal volume	497.14	11.69	508.38	18.73	558.0	27.69	0.075
respiratory rate	14.46	1.37	14.22	1.27	14.80	1.00	0.436
fraction of O2	54.29	4.98	54.28	4.96	54.00	5.00	0.3
Peak air way pressure	19.61	1.67	24.90	.86	27.72	.98	0.011
Time from end operation until extubation	211.29	53.19	213.82	46.72	175.2	80.16	0.987
Total operative time	216.43	30.17	220.98	29.82	234.0	17.32	0.761
Estimated Blood loss	499.29	151.44	534.10	174.69	612.0	220.45	0.849
Length of stay	5.81	1.03	5.53	.95	5.20	.58	0.001
average O2 saturation	96.54	1.05	96.47	1.05	96.32	.85	0.255

As for answering the main research question, our first questions was if a PEEP of 10 H2O decrease the probability of developing lung atelectasis in post CABG patient? as table 7 also shows that higher PEEP levels had lower occurrence rates, this effect was significant after testing.

Table 7

Atelectasis and PEEP levels

		positive end-expiratory pressure					
		PEEP 5		PEEP 8		PEEP 10	
		Count	N %	Count	N %	Count	N %
Did the patient developed Lung Atelectasis ?	Yes	32	45.7%	47	27.2%	3	12.0%
	No	38	54.3%	126	72.8%	22	88.0%

The second research question was if a higher PEEP result in shorter length of stay post CABG? , which was also proved in table 6 above that higher PEEP of 10 had the lowest length of stay from operation day until discharge, moreover showed in figure 4, patients who didn't had lung atelectasis clearly had a lower length of stay which was around 5 days, while in patient on PEEP 8 who had atelectasis, they had the highest length of stay with a mean of 6.94 days.

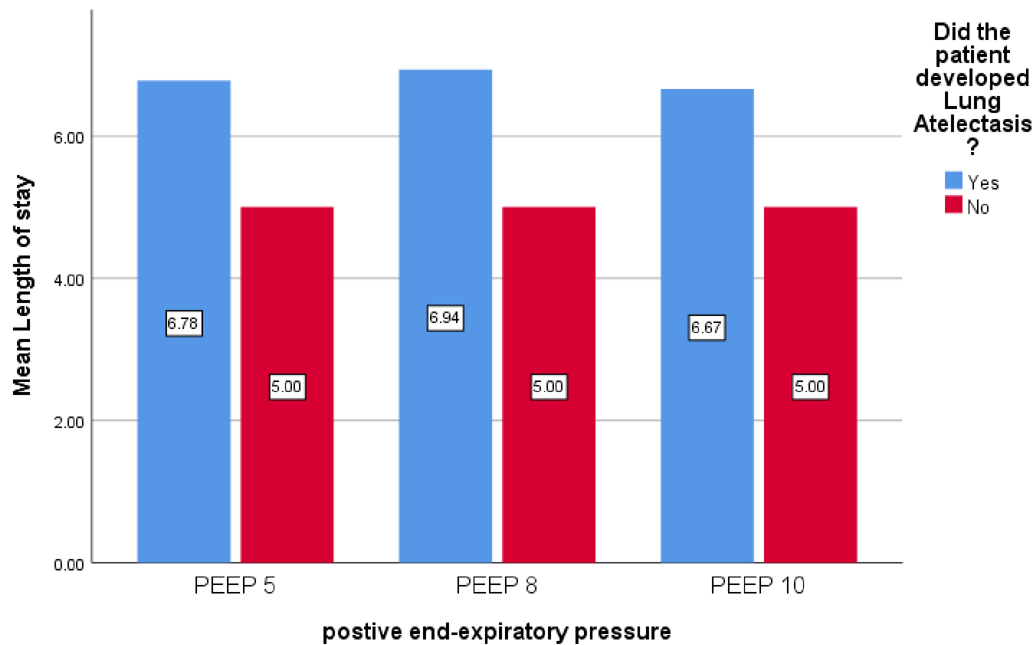

Figure 4

The mean length of stay with PEEP and atelectasis.

Our third research question was if MV time post op affect the probability of developing lung atelectasis? , which showed in table 6 that MV didn't had any significant effect on developing lung atelectasis in all PEEP levels, figure 5 below shows the mean extubation time for each PEEP group, it clearly shows that PEEP 10 group had the lowest time but with no significance, the mean extubation time for PEEP 10 group who didn't had lung atelectasis was 173.18 minutes and the highest extubation time was for PEEP 8 group who didn't had atelectasis with a mean of 216.19 minutes.

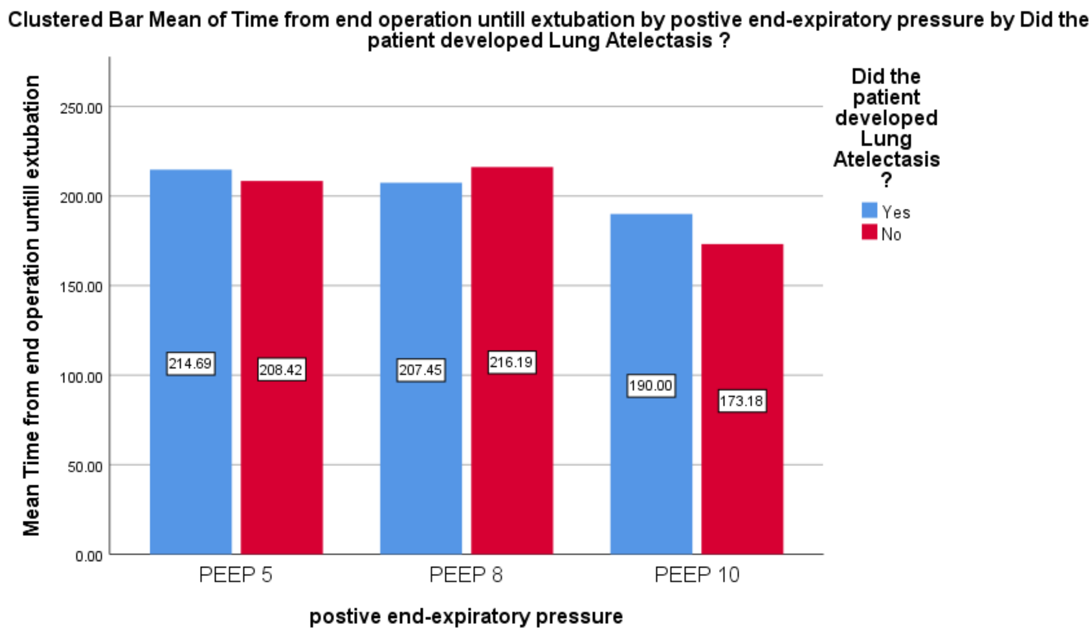

Figure 5

Mean extubation time with PEEP and atelectasis.

And the last research question was if the use of cardiopulmonary pump increase the probability of developing lung atelectasis? , also showed above in table 2 that the use of cardiopulmonary pump didn't had a significant effect on the probability of developing lung atelectasis.

Chapter Five: Discussion

5.1 Discussion

This research focused on the impact of positive end-expiratory pressure (PEEP) levels on the development of lung atelectasis in patients after coronary artery bypass grafting (CABG). We studied 268 patients who had CABG operations, looking at the association between PEEP levels, patient demographics, and postoperative outcomes. Based on the collected data from the mentioned period, the study results demonstrated that the lowest occurrence rate of developing lung atelectasis after CABG was in patients who were on a PEEP of 10 cm H2O with 12% compared with 27.2% and 45.7% in patients on PEEP 8 and 5 cm H2O respectively, most patients who developed lung atelectasis happened at the 1st day post CABG 67% and 31.7% developed it on the 2nd post op day, this study result goes along with the findings of a previous research by Moradi, B which was a RCT between two groups of PEEP levels, and stated that lung atelectasis incidence was significantly lower in patients with a PEEP of 10 cm H2O (Moradi, B et al., 2017)

Demographic data such as gender, smoking habits, and place of living were also evaluated. The bulk of our subjects were men, smokers with a history of diabetes, hypertension, or ischemic heart disease, Smoking appeared as a substantial risk factor for atelectasis, especially in individuals exposed to greater PEEP levels. Smoking may had this cause due to its harmful effect on lung compliance suggesting higher incidence of lung atelectasis. This emphasizes the importance of personalized therapies based on individual

patient features meaning that each patient should be taken as individual according to his previous history and current condition.

Niyayeh Saffari, (2015) in a research focusing on the frequency of lung atelectasis in post CABG reported that there were significant relationship between the incidence rates of lung atelectasis and the past medical history of the patients, smoking and blood transfusion during operation, however our findings were inconsistent on that since we didn't find any significant effect on the incidence rates on lung atelectasis from the previous variables, but our findings found a significant effect in patient who were on high vasopressors support during the 1st post op day (higher than 15mcg/m) such as Norepinephrine (Niyayeh Saffari, N. H. et al., 2015),

Moreover Yildiz et al, (2014) found that higher PEEP levels in off pump post CABG patients was significantly associated with higher bleeding amount from chest tubes, blood transfusion post op and longer length of stay for patients, although this research didn't focused on the on pump or off pump post CABG but our results didn't found a significant difference between the use of pump nor a higher LOS in off pump patient on higher PEEP levels (Yildiz, Y et al., 2014).

Our findings give light on the time course of atelectasis development at various PEEP levels. Patients on PEEP 8 had a larger incidence on the second postoperative day, whereas those on PEEP 5 had more equally distributed occurrence s on both the first and second postoperative days. Surprisingly, no cases of atelectasis were seen on the second postoperative day for patients receiving PEEP 10.

These findings highlight the complexities of atelectasis development and should influence more focused monitoring tactics. Setak-Berenjestanaki, also reported similar findings but as for the timing of lung atelectasis when it was diagnosed in our study all the patient who were found to had lung atelectasis were discovered on the second post op day at max but Setak-Berenjestanaki, M reported that the majority of the patients who developed lung atelectasis happened on the third post op day (Setak-Berenjestanaki, M et al., 2018).

Several variables were identified as contributing to the occurrence of pulmonary atelectasis. Higher BMI was linked to an increased risk, but higher peak airway pressure was associated with a lower occurrence. The use of a cardiopulmonary pump had no substantial influence on atelectasis development. Furthermore, our study found that using spirometry, removing chest drains early, and not having wound discharge all helped to reduce atelectasis rates. Similar findings were reported also by Sweity E regarding the use of spirometer in preventing respiratory complications (Sweity, E. M et al., 2021),

Early mobilization also contributes to minimizing respiratory complications as reported by Moradian, S. T who concluded that early mobilization in post CABG result in minimizing post op lung atelectasis which goes along our findings in this study, as for BMI Devarajan, J also reported similar results regarding high BMI rates and respiratory complications in post CABG patients. (Devarajan, J et al., 2016).

Our investigation into the relationship between PEEP levels and post-CABG length of stay revealed a compelling association. Higher PEEP levels, particularly PEEP 10, were linked to shorter lengths of stay. This implies that optimizing PEEP may not only minimize

atelectasis but also contribute to a more efficient recovery process, this was also confirmed by Setak-Berenjestanaki, (2018).

5.2 Conclusion

In conclusion, the findings of this study highlight the important role of PEEP levels in influencing pulmonary atelectasis after CABG with notably, higher PEEP levels, especially at 10 cm H2O, after CABG and pulmonary atelectasis are associated with lower occurrence, presenting a potential strategy for targeted intervention showed. Demographic factors such as smoking were identified as important contributors to atelectasis, emphasizing the need for a standardized approach based on patient characteristics. In addition to biological emphasis, various parameters such as BMI, peak airway pressure, and spirometry showed an association with the occurrence of atelectasis, moreover the study showed that higher PEEP levels had lower hospital stay after CABG. Together, these data provide valuable insights for clinicians, suggesting that optimizing PEEP levels may not only prevent atelectasis, but also contribute to more effective postoperative recovery, decreasing the LOS and post op management costs in total.

5.3 Recommendations

Based on the study findings, it is recommended that health care providers consider using elevated PEEP in the postoperative care of patients for CABG, in 10cm H2O in patients without a history of respiratory complications and who achieved the previously mentioned inclusion criteria. These changes may serve as a measure to prevent the

development of pulmonary atelectasis. Individualized interventions should be developed to identify greater vulnerability to atelectasis, especially in smokers.

Clinicians should also be alert to the timing of atelectasis and prepare surveillance programs accordingly. In addition, the incorporation of techniques such as the use of spirometry, early mobilization protocols and early chest drainage, which have been shown to reduce the occurrence of atelectasis, should be considered routine practice, and efforts to educate patients about lifestyle changes, especially in terms of BMI, these recommendations aim to enhanced patients' outcomes and may contribute to a more flexible postoperative recovery process.

5.4 Limitations

While the study provides valuable insights, it is important to acknowledge several limitations that may affect the generalizability and interpretation of the findings. First, the retrospective design and reliance on single-center status may introduce internal selection bias and limit the external validity of the results.

The study's focus on a specific population undergoing CABG may limit generalizability to other surgical populations. In addition, reliance on self-reported smoking status and other patient characteristics may introduce recall-report bias. The exclusion of certain comorbidities or surgical procedures from the analysis may also bias the findings.

The retrospective nature of the analysis, Future research could explore multi-center studies with larger sample sizes to validate the observed associations. Furthermore, the lack of long-term follow-up data limits the ability to assess the longevity of the observed effects.

Future research efforts should address these limitations, including larger surgical populations, and more comprehensive data collection with a prospective, multicenter design to strengthen the findings.

5.5 Implications for Practice

This study emphasizes the importance of optimal PEEP Settings in post CABG patients to avoid lung atelectasis, in specific the use of 10 cm H2O in patient without previous history of lung complications, in addition we confirm that other post-operative techniques had also a huge rule in avoiding lung atelectasis, these results can be employed in adding protocols for the management of post CABG.

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Appendix (1)

Data Collection Tool

Code No. ……….. Date of operation……… smoker: Yes / No Age……….. BMI ……….. Gender: Male / Female Residential area: City / Village / Camp High-risk operation: Yes / No PMH: DM / HTN / IHD / others………. Operation: x1 /x2 /x3 x4/ x5 Pre-op EF (%):……… surgeon: 1 / other heart pump used: Yes / No Blood units given in OR: 1 / 2 / 3 / 4 / 5+ High dose Vasopressors in 1st day: Yes / No MV settings: SIMV, TV ……../PEEP……../PS………/RR………/Fio2……….. /PIP…….. Blood gases before extubation: acceptable / abnormal. Extubation Time (m)………….. Operative time (m):…………. Estimated blood loss (ml) … Graft type: Total arterial / total Venous / Mixed Chest drains: Peri / Left.P / Right.P / M/S Patients using spirometer: Active / lazy / refusing

Chest drains removed on: 2nd day / 3rd day / 4th day+ Total drains discharge (ml)……………..

First chest x-ray after extubation: Acceptable / lung atelectasis / other abnormal result

1st day post op chest x-ray: Acceptable / lung atelectasis / other abnormal result ………..

3rd day post op chest x-ray: Acceptable / lung atelectasis / other abnormal result ………..

5th day post op chest x-ray: Acceptable / lung atelectasis / other abnormal result ………..

Pus wound discharge: Yes / No weaning off supplement O2: 3rd day / 4th day / +5th day

Length of stay from op day:……………… Average O2 sat: day zero…… 1st day ………

2nd

day …….. 3rd day ………. 5th day ……….. Operation cost ……………..

Appendix (2)

Arab American University- Palestine
Deanship of Scientific Research
IRB committee
Tel: 04-241-8888, ext 1196
E-mail: irb.aaup@aaup.edu

الجامعة العربية الامريكية- فلسطين
عمادة البحث العلمي
لجنة أخلاقيات البحث العلمي
تلفون: 8888-241-04 ext 1196
البريد الالكتروني: irb.aaup@aaup.edu

IRB Approval Letter

Study Title: The effect of different levels of positive end-expiratory pressure on the incidence rate of atelectasis after coronary artery bypass grafting in northern West bank. A retrospective study.

Submitted by: Ahmad Bassam Emran Abdallatif

Date received: 30th October 2023

Date reviewed: 5th November 2023

Date approved: 5th November 2023

Your Study titled "**The effect of different levels of positive end-expiratory pressure on the incidence rate of atelectasis after coronary artery bypass grafting in northern West bank. A retrospective study**" with archived number 2023/A/163/N was reviewed by the Arab American University IRB committee and was approved on 5th November 2023

Reham Khalaf-Nazzal, MD, PhD
IRB committee chairman
Arab American University of Palestine

General Conditions:

1. Valid for 6 months from the date of approval.
2. It is important to inform the committee with any modification of the approved study protocol.
3. The committee appreciates a copy of the research when accomplished.
4. # Refers to the date when IRB has received the full application.

Appendix (3)

Arab American University

Faculty of Graduate Studies

الجامعة العربية الأمريكية

كلية الدراسات العليا

التاريخ:2023/10/30

حضرة الدكتور محمد عبيد المحترم

المدير الطبي للمستشفى العربي التخصصي

الموضوع: تسهيل مهمة بحثية

تحية طيبة وبعد،،

تُهديكم كلية الدراسات العُليا في الجامعة العربية الأمريكية أطيب التحيات، وبالإشارة الى الموضوع أعلاه، وتماشيا مع سياسة دائرة التمريض في كلية التمريض/الجامعة العربية الأمريكية المتعلقة بتعزيز التعاون بين المؤسسات بإتاحة فرص الإثراء العلمي للطلبة والخريجين في المؤسسات الوطنية وإسهامها في تنمية قدراتهم وخبراتهم ونرجو من حضرتكم التكرم بالإيعاز للجهات المعنية لتسهيل مهمة الطالب **أحمد بسام عمران عبد اللطيف** والذي يحمل الرقم الجامعي 202113095 وهو طالب ماجستير في برنامج العناية المكثفة ويعمل على أطروحة الماجستير الخاصة به بعنوان:

"The effect of different levels of positive end-expiratory pressure on the incidence rate of atelectasis after coronary artery bypass grafting in northern West bank. A retrospective study".

تحت إشراف الدكتورة بسمة سلامة. في المستشفى العربي التخصصي-نابلس، وذلك لأغراض البحث العلمي حيث سيكون الهدف من الدراسة:" معرفة تاثير ضغط الزفير الايجابي بعد عملية القلب المفتوح على معدل حدوث انخماص الرئة، بحيث سيتم عمل مقارنة بين المقاييس المختلفة المستعملة بعد عملية القلب المفتوح، حيث انها ستكون دراسة بأثر رجعي وسيتم الرجوع الى سجلات المرضى المحوسبة ما بين فترة بداية العام 2021 الى نهاية العام 2022.

كما أود التنويه بأن الطالب أحمد بسام عمران عبد اللطيف سوف يقوم بالاطلاع على السجلات المحوسبة وذلك بعد الحصول على موافقة رسمية من حضرتكم وأيضا **نتعهد بعدم ذكرأسماء المرضى اللذين سيتم مراجعة ملفاتهم بالبحث او مشاركة اى معلومات اخرى لا تتعلق باهداف هذا البحث مع اى طرف اخر وتطبيق اخلاقيات البحث العلمي فى حال تم نشر البحث.**

مع فائق الشكر والتقدير

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الملخص

الخلفية: تبحث هذه الدراسة بأثر رجعي أحادية المركز تأثير مستويات ضغط الزفير الإيجابي على الانخماص الرئوي بعد عملية تحويل مسار الشريان التاجي حيث نجد أنه ذو أهمية للحد من مضاعفات الانخماص الرئوي بعد العملية.

الأهداف: كانت الأهداف الرئيسية هي تقييم الارتباط بين مستويات ضغط الزفير الإيجابي وانخماص الرئة ما بعد القلب المفتوح، للتحقيق في عوامل الخطر الديموغرافية للانخماص، وتحديد نمط توقيت تطور الانخماص.

الطريقة: تم تحليل البيانات من 268 مريضا من مرضى تحويل مسار الشريان التاجي بأثر رجعي، مع الأخذ في الاعتبار ثلاثة مستويات مختلفة من ضغط الزفير الايجابي، 5 سم ماء، 8 سم ماء و 10 سم ماء، والتركيبة السكانية ونتائج ما بعد الجراحة من خلال أداة جمع البيانات ذاتية التطوير. تم استخدام التحليل الإحصائي والمقاييس الإحصائية المناسبة لمعالجة أسئلة البحث.

النتائج: ارتبطت مستويات مستويات ضغط الزفير الإيجابي الأعلى، خاصة عند 10 سم ماء، بانخفاض الانخماص الرئوي. ظهر التدخين كعامل مهم في التأثير على الانخماص، وأظهرت التدخلات مثل قياس التنفس والتصريف الصدري المبكر آثارًا إيجابية في تقليل حدوث الانخماص. علاوة على ذلك، ارتبطت مستويات ضغط الزفير الإيجابي الأعلى بفترة إقامة أقصر في المستشفى بعد إجراء عملية تحويل مسار الشريان التاجي.

الاستنتاج: سلطت الدراسة الضوء على الفائدة المحتملة لتحسين مستويات ضغط الزفير الإيجابي لمنع الانخماص بعد تحويل مسار الشريان التاجي وفائدة استخدام ضغط الزفير الإيجابي بمقدار 10 سم ماء في مريض ما بعد تحويل مسار الشريان التاجي دون تاريخ من مضاعفات الجهاز التنفسي، مما يساهم في تقليل فترة الاقامة في المستشفى بعد عملية تحويل مسار الشريان التاجي.