An-Najah National University

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Preoperative incentive spirometry for preventing postoperative pulmonary complications in patients undergoing coronary artery bypass graft surgery: A prospective, randomized controlled trial

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الإقرار

انا الموقع أدناه مقدم الرسالة التي تحمل العنوان:

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أقر بأن ما اشتملت عليه هذه الرسالة إنما هي نتاج جهدي الخاص، باستثناء ما تم الإشارة إليه حيثما ورد، وان هذه الرسالة ككل آو اي جزء منها لم يقدم لنيل اي درجة او لقب علمي او بحثي لدى أي مؤسسة تعليمية او بحثية أخرى.

Declaration

The work provided in this thesis, unless otherwise referenced, is the researcher's own work and has not been submitted elsewhere for any other degree or qualification.

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Table of Contents

List of Tables

List of Figures

List of Appendix

List of Abbreviations

Abbreviations	Meaning
IS	Incentive spirometry
POLS	Postoperative hospital length of stay
NNUH	AN Najah National University Hospital
PPCs	Postoperative pulmonary complications
CABG	Coronary artery bypass graft
WHO	World Health Organization
IRB	Institutional review board
SPSS	Statistical Package for the Social Sciences
CAD	Coronary artery disease
IPPB	Intermittent positive-pressure breathing
PaO2	Partial Pressure of Oxygen
Sao2	Invasive Oxygen saturation
Spo2	Non- Invasive Oxygen saturation
PaCo2	Partial pressure of carbon dioxide
ICU	Intensive Care Unit
BMI	Body mass index
VS.	Versus
Cm	Centimeter
ECG	Electrocardiogram
Kg	Kilogram(s)
Min	Minute
RCT	Randomized control trial
COPD	Chronic obstructive pulmonary disease
ABG's	Arterial Blood Gases
OR	Operation Room
CPAP	Continuous positive airway pressure
BIPAP	Bilevel Positive Airway Pressure

Conceptual definition of the terms

Postoperative pulmonary complications (PPCs): There are various definitions available in the literature: respiratory complications that occur within 48–72 h following surgery; conditions affecting the respiratory tract that can adversely influence the clinical course of the patient after surgery; and any pulmonary abnormality occurring in the postoperative period that produces identifiable disease or dysfunction that is clinically significant and adversely affects the clinical course, which includes atelectasis, pulmonary infections such as pneumonia and bronchitis, pleural effusion, pulmonary edema, respiratory insufficiency, and other types of respiratory insufficiency (Davies et al., 2017).

Respiratory status: is described as the gas exchange when carbon dioxide moves out of the lungs and oxygen enters the lung inside the alveoli. It is reviewed by observing signs and symptoms such as: cough, sputum production, dyspnea, orthopnea, and tachypnea and chest pain. Further measures of pulmonary function include X-ray results, arterial blood gas's (ABG's) results and oxygenation by pulse oximeter (Almeida et al., 2017).

Atelectasis: is described as the collapse of a part of or the entire lung, which maybe acute or chronic. In this research it refers to the character such as X-ray , tracheal mediastinal shift deviation; reduced respiratory activity; diminished breath sounds; displacement of the trachea

to the affected side; new parenchymal thickening surrounded by hyperinflated lung (Davies et al., 2017).

Pneumonia: is described as the inflammation of the tissue of the lung affecting primarily alveoli with consolidation and exudation. In this research it refers to the character such as X-ray with at least one of the following: infiltrates, consolidation, capitation; plus at least one of the following: fever >38 °C with no other cause, white cell count <4 or > 12×10^9 litre^{-1}, >70 yrs of age with altered mental status with no other cause; plus at least two of the following: new purulent/changed sputum; increased secretions/suctioning; new/worse cough/dyspnea/tachypnea; bronchial breath sounds; worsening gas exchange (Miskovic et al., 2017).

Pleural effusion: is described by inflammation and excess of fluid that accumulates in the cavity around the pleura. In this research it refers to the character such as X-ray with blunting of the costophrenic angle, loss of sharp silhouette of the ipsilateral hemidiaphragm in upright position, displacement of adjacent anatomical structures, or (in supine position) hazy opacity in one hemithorax with preserved vascular shadows (Miskovic, et al., 2017).

Pneumothorax: is the presence of air inside the pleural space revealed with chest x-ray, or loss of lung sliding of gliding sign when examining the lung with ultrasound (Elena, 2017).

Hospital length of stay: the duration of a single episode of hospitalization. Inpatient days are calculated by subtracting day of admission from day of discharge (Carter & Potts, 2014).

Oxygenation status: Oxygenation may be assessed by clinical assessment, pulse oximetry (SPO2) arterial oxygen saturation (SaO2) and arterial blood gases (ABGs). Pulse oximetry is commonly used to obtain a rapid and continuous assessment of oxygenation, which reflects how hemoglobin carries oxygen by percentage, but ABG analysis quantifies arterial partial pressures of oxygen and carbon dioxide and blood pH and is often regarded as the "gold standard" by which to assess oxygenation, as well as Sao2, defined as the percentage of hemoglobin saturated with oxygen. This can be measured by ABG analysis (Theodore et al., 2018).

Cough: The definition of cough is the sudden expulsion of air through the large breathing passages that can help clear them of fluids, irritants, foreign particles and microbes and can be the result of an infection (Chung; & Pavord., 2008).

Crackles: The definition of crackles is the bubbling or exploding sounds that exemplify the existence of fluid or secretions, or the unexpected opening of clogged airways, differing from the coarse crackles heard in pneumonia or congestive cardiac failure (Chalaby.& Peters,. 2010).

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Abstract

Background: Postoperative pulmonary complications (PPCs) often occur after cardiac operations, and are a leading cause of morbidity, inhibits oxygenation, increase hospital length of stay and mortality. Although clinical evidence for PPCs prevention is often unclear and crucial measures take place to reduce PPCs. One device usually used for this reason is the incentive spirometry (IS). The Aim of the study is to evaluate the effect of preoperative incentive spirometry to prevent postoperative pulmonary complications, improve postoperative oxygenation and decreases hospital stay following coronary artery bypass graft (CABG) surgery patients.

Methods: This was a clinical randomized prospective study. A total of 80 patients were selected as candidates for CABG at An-Najah National University Hospital, Nablus-Palestine. Patients had been randomly assigned into two groups: incentive spirometry group (IS), SI performed before surgery (study group) and control group, preoperative spirometry was not performed. The 40 patients in each group received the same protocol of anesthesia and ventilation in the operating room.

Result: The study findings showed that there was a significant difference between the IS group and control group in the incidence of post-operative atelectasis, there were 8 patients (20.0%) in IS group and 17 patients (42.5 %) in control group (p= 0.03). Mechanical ventilation duration was significantly less in group IS group, median was four hours versus six hours in control group ($p < 0.001$). Hospital length of stay was significantly less in group IS group, median was six days versus seven days in control group ($p < 0.001$). Median of amount of arterial blood oxygen and oxygen saturation was significantly effective improvement in IS group with ($p < 0.005$).

Conclusion: Preoperative incentive spirometry for 2 days along with exercises of deep breathing, encouraged coughing and early ambulation following CABG are in connection with prevention and decrease incidence of atelectasis, hospital stay, mechanical ventilation duration and improved postoperative oxygenation with better pain control. A difference that can be considered both significant and clinically relevant.

Keywords: incentive spirometry; postoperative pulmonary complication; atelectasis; oxygenation; ventilation time; coronary artery bypass grafting; CABG; length of stay

Chapter One
Introduction

1. Introduction

Coronary artery disease (CAD) is the leading cause of death and disability worldwide (WHO, 2018). Coronary artery bypass grafting (CABG) is indicated for patients with angina and suitable coronary anatomy, especially those with stenosis of the left main coronary artery or patients with multi-vessel disease (Hillis et al., 2011).

Postoperative pulmonary complications (PPCs) are a frequent incident following cardiac, thoracic and abdominal surgeries (Branson, 2013). PPCs are very common following CABG surgery and the incidence is between 30% and 60% (Mullen-Fortino et al., 2009). PPC complications contribute significantly to morbidity, mortality and hospitalization costs. (Miskovic & Lumb, 2017). These complications include atelectasis, pulmonary infections such as pneumonia and bronchitis, pleural effusion, pulmonary edema, and respiratory insufficiency (Hulzebos et al., 2006).

Atelectasis is a highly prevalent complication following coronary artery bypass graft (CABG) surgery (Ferreira et al., 2010). There is no clear cause yet for atelectasis, but several factors may contribute, such as impairment in the function of the diaphragm, general anaesthesia, ‘abdominal distension, chest wall shift, pain and pleural effusions (Yánez-Brage et al., 2009).

The pain and postoperative fear associated with changes in lung mechanics resulting from the surgery affect the performance of periodic deep inspiration and effective cough, allowing the accumulation of secretion, alveolar collapse and changes in gas exchange (Renault et al., 2009).

Oshvandi et al. (2020) verified that atelectasis postoperatively can be decreased by obtaining several deep breath plus 3 seconds holding the breath concurrent with IS, while another study revealed that there is no benefit of IS in decreasing PPCs in patients following CABG surgery (Freitas et al., 2012)

Although clinical evidence regarding PPC prevention is often unclear, crucial measures take place to reduce PPCs. These include carefully individualized strategies for preventing atelectasis and aspiration of oral secretions, increasing the patient's ability to mobilize, expectorate secretions and restore functional residual capacity (Grooms MSHS, 2012). There are several measures applied for preventing PPCs, such as deep-breathing exercises, IS, early ambulation and positive airway pressure (Wynne & Botti, 2004; Zarbock et al., 2009).

Incentive spirometry (IS) is one tool frequently used for this purpose (Branson, 2013). The IS is a handheld device used postoperative to reach effective inspiration. Patients practicing IS provide visual and positive feedback after inhaling at a determined flow or volume rate and holding the inflation for at least 3 seconds. Westwood et al., (2008) IS intended to

mimic normal sighing or yawning by supporting the patient to take long and slow deep breaths. This reduces pleural tension, supporting enhanced lung expansibility and improving ventilation perfusion. While practices of IS is being on an ordered basis, atelectasis may be avoided or reduced (Anandhi & Divya, 2018).

IS was found to decrease the incidence of PPCs and length of stay after upper abdominal surgery (Nardi et al., 2019). By contrast, many study publications have questioned its effectiveness (Carvalho et al., 2011; Overend et al., 2001).

Monitoring, instruction and teaching the patient how to use the IS are the responsibility of nursing and respiratory therapy staff. Respiratory therapy that involves periods of IS each day in addition to deep-breathing applications, guided coughing, early mobilization and pain control can reduce the incidence of PPCs (Restrepo et al., 2011). Incentive spirometry may prevent PPCs in patients following CABG surgery (Yánez-Brage. et al., 2009).

Applications of deep breathing are shown to reduce the occurrence and severity of PPCs , such as pneumonia and atelectasis. Through application instruction, the nurse clarifies and displays how to take a deep and gradual breath, also how to exhale gradually, three to five times every 1 to 2 hours. Patients who carried out deep-breathing exercises had improved pulmonary function in contrast with non-practicing groups (Ünver et al., 2018).

Afrasiabi et al. (2006) conducted a study about the influence of IS on oxygenation status of arterial blood gases following a CABG operation. Throughout 6 h after extubation patients was handled the IS and preoperative, 1 h, 7 h after extubation arterial blood gases obtained. The researcher revealed there was no significant benefit in oxygenation status measured by ABG's after using IS. Carvalho et al. (2011), Eltorai et al. (2018) and Overend et al., (2001) have declared that, to date, there is no evidence to support the practice of IS to decrease PPCs. although IS is still usually requested to reduce PPCs, despite the narrow evidence to support its advantages and the absence of a harmonized protocol and they recommend that additional research is necessary to clarify this issue. Agostini and Singh, (2009) differ from this opinion and have stated that this practice can improve pulmonary function.

Preoperative education gives health-related information for patients, which prepares them for surgery and helps to decrease the development of PPCs Gürlek and Yavuz (2013). In numerous studies it is suggested that postoperative incentive spirometry is practiced to decrease PPCs and decrease length of stay (LOS), but the success of postoperative incentive spirometry is dependent not only on the postoperative, but also the preoperative period, which has been shown to improve oxygenation, decrease the incidence of PPCs and to decrease hospital LOS (Fayyaz et al., 2016). Another study has shown that the rate of pneumonia and atelectasis reduced with breathing exercise and IS in obese patients prior to CABG surgery (Diken & Özyalçın, 2018a).

IS training before and after the operation significantly improved lung inspiratory capacity and arterial oxygenation in CABG patients (Balandiuk & Kozlov, 2004).

Since PPCs exhibit elevated rates of hospital costs, morbidity, mortality, and increased length of hospital stay following CABG surgery, it is evident that it is essential to discuss the use of IS preoperatively to reduce PPCs and to decrease post-operative length of stay in the intensive coronary care unit (ICCU) and in the hospital. The aim of the study is to evaluate the effect of preoperative incentive spirometry in preventing postoperative pulmonary complications, improving postoperative oxygenation and decreasing length of stay at hospital in patients following CABG surgery**.**

1.2 Problem statement

IS is not recommended for practice in the pre- and postoperative setting but doctors still frequently order IS in an attempt to somewhat decrease PPCs, albeit with no consensus on exactly what should be prescribed in terms of the work required by the patient, and with a relatively low adherence level. Further experiments are needed to conclude exactly which patient groups, if any, could benefit from IS (Eltorai et al., 2018) .

Pulmonary complication following cardiac surgery has been found to be independently associated with several outcomes and can lead to increased patient discomfort, increased consumption of resources and

longer length of stay after coronary artery bypass surgery (Brooks-Brunn, 1995).

Postoperative complication following coronary artery bypass graft (CABG) surgery has been shown to impede the oxygenation outcome (Fayyaz et al., 2016).

There is still controversy about the clinical benefits of using IS as there is no standardization of approach pre- and postoperatively (Restrepo et al., 2011).

1.3 Significance of study

Respiratory complications usually follow CABG surgery. These complications negatively impact the oxygenation status of the patient, which prolongs the patient's recovery and increases the length of hospital stay (O'Donohue, Jr, 1992). These complications contribute significantly to morbidity, mortality, and costs related to changed respiratory physiology and the existence of risk factors (Kips, 1997; Miskovic & Lumb, 2017). Atelectasis, pleural effusion, pulmonary edema and postoperative pneumonia are the main radiological changes that can be defined as PPCs (Hulzebos et al., 2006). These alterations in normal gas exchange are one of the greatly destructive risk factors (Weissman, 2004).

Delayed recovery is very familiar in patients following CABG surgery (Tenling et al., 1998). The reason for prolonged recovery and consequent length of hospital stay is mysterious and challenging because

they can be triggered by a multiplicity of factor, – for example, malfunction or dysfunction (Massard & Wihlm, 1998).

PPC causes are complex and may include a contribution of various factors, such as the general anaesthesia, diaphragmatic dysfunction, abdominal distension, chest wall alterations, pleural effusions and pain (Yánez-Brage, et al., 2009). Certain practices are also used to prevent PPCs, including IS with deep-breathing exercises, positive airway pressure therapy and early mobilization (Wynne & Botti, 2004; Zarbock et al., 2009).

Hulzebos et al.(2006). revealed that intensive inspiratory muscle training (7 times per week, for at least 2 weeks preoperatively) reduced the incidence of PPCs and hospital length of stay after CABG.

In several studies preoperative IS is usually prescribed to decrease PPCs, regardless of narrow evidence to prove its advantages and the absence of harmonized protocols for the use of IS. While several reviews and meta-analyses have explored the effect of using IS, they have shown limited evidence of its advantages in avoiding PPCs. Evidence-based practice recommendations are opposed to the use of IS routinely in postoperative care until other evidence of its advantages from experimental studies are presented (Eltorai et al., 2018).

1.4 Aims of the study

The aims of the present study are to evaluate the effect of preoperative incentive spirometry to prevent postoperative pulmonary complications, improve postoperative oxygenation and decrease hospital stay in patients undergoing coronary artery bypass graft (CABG) surgery.

1.5 Hypotheses

1) Hypothesis (H1): Preoperative and postoperative use of incentive spirometry reduces significantly the incidence of postoperative atelectasis at a level of ≤ 0.05 compared to postoperative use of incentive spirometry only, in patients undergoing coronary artery bypass graft (CABG) surgery.

2) Hypothesis (H2): Preoperative and postoperative use of incentive spirometry improves significantly the oxygenation status at a level of ≤ 0.05 compared to postoperative use of incentive spirometry only, in patients undergoing coronary artery bypass graft (CABG) surgery.

3) Hypothesis (H3): Preoperative and postoperative use of incentive spirometry decreases significantly ICCU length of stay at a level of ≤ 0.05 compared to postoperative use of incentive spirometry only, in patients undergoing coronary artery bypass graft (CABG) surgery.

4) Hypothesis (H4): Preoperative and postoperative use of incentive spirometry decreases significantly hospital length of stay at a level of ≤ 0.05 compared to postoperative use of incentive spirometry only, in patients undergoing coronary artery bypass graft (CABG) surgery.

Chapter Two

Background

2. Background

2.1 Incentive spirometry (IS)

In the 1960s, intermittent positive pressure breathing (IPPB) was frequently practiced to avoid PPCs. In spite of this, IPPB was reviewed at the Sugarloaf Conference, where it was recommended that there was a lack of evidence to support its practice (Baker, 1974; Cheney et al., 1974).

Realizing that continuous inspiration of yawning in an exertion trial generated some benefit in the reduction and/or avoidance of atelectasis, a device was created for patients to simulate continuous yawning to achieve maximum inspiration. The creators' revealed that progress in V/Q mismatch and alveolar PaO2 gradient. they expressive of inflation of alveoli and following decrease in shunt intrapulmonary. PaO2 levels stayed near normal, when continual maximal inspirations were repeated each hour. These primary results appeared to describe the physiological expected effects of IS. In 1973, Bartlett–Edwards, stated that IS device was created to encourage deep breathing by delivering light visual feedback while patients attained their required inspiratory indicator level (Bartlett et al., 1973).

The Spirocare device in 1975 improved on the IS electronic visual feedback through locating the exhibit lights on a level representative progressively higher inspiratory volume, trying to motivate patient adherence and commitment (Lederer et al., 1980). These electronic visual feedback were prescribed for numerous years but have been replaced with less expensive and one-use items.

2.2 Device types

IS devices are either flow-oriented or volume-oriented. Flow-oriented devices involve three chambers connected with columns settled with lightweight plastic floats. The chamber is linked to an elastic tube with a mouthpiece used to inhale breath, the aim being to elevate the floats throughout the inspiratory flow, which is initiated by negative intrathoracic pressure. Volume-oriented IS devices involve an elastic pipe including a mouthpiece linked to a visual numeral chamber that shows the volume level. Once the patient takes a breath, the piston in the chamber upswings to the maximum level of air shifted. Evidence guidelines recommend that volume-oriented spirometers are desirable because they reduce the enforced work/effort of breathing (Restrepo et al., 2011).

Figure (1): Flow-oriented and volume-oriented incentive spirometry.

2.3 Clinical application

A diversity of clinical protocols for the use of IS have been recommended. Certainly, no standardization of the IS approach exists until these day. IS has been suggested to be practiced every 10 min (Restrepo et al., 2011), hourly(Wilkins, 1999), every 2 h (Wilkins, 1999), 2 times per day (Romanini et al., 2007), 4 times per day (Rafea et al., 2009), 5 times per day(Matte et al., 2000), 12 times per day (Kulkarni et al., 2010), every 4 h (Celli et al., 1984), 4 times per hour(Renault et al., 2009), 3 times per hour (Schwieger et al., 1986), 10 times per hour (Kundra et al., 2010), or 30 times per hour (Lyager et al., 1979). The length of time for holding the inspiratory breath has been suggested as 5 sec (Rafea et al., 2009), 3 s (Kundra et al., 2010), or for as long as possible (Matte et al., 2000). IS has been prescribed for the first 3 d (Schwieger et al., 1986) or 4 d (Lyager et al., 1979) following surgery, starting 4–72 h postoperatively (Restrepo et

al., 2011), together with preoperatively and through the first 5 days postoperatively (Savci et al., 2006), for 3 d (Glover, 2010) or 5 d (Agostini & Singh, 2009) following surgery, starting 1 h and lasting for the next 3 days postoperatively (Hall et al., 1996) or starting 4 h after extubation (Stock et al., 1985).

2.4 Procedures

Incentive spirometry, described as a continual maximum inspiration, is reached via using a device that gives visual light feedback when the patient inhales at a fixed flow or volume then holds the inflation for at least 5 s. Then the patient is taught to sustain the spirometry in an upright position, normally exhaling and then placing the lips tightly around the mouthpiece. The subsequent action is a slow inhalation to elevate the ball or the piston/ plate in the chamber to the appointed target. At maximum inhalation, followed by a breath hold and then exhaling normally and the mouthpiece may be removed if preferable,. Instruction in the practices of IS by a close relative and health-care provider may assist the patient in using the IS correctly in practice and support adherence to the treatment through encouragement (Restrepo et al., 2011).

2.5 Equipment

Volume-oriented incentive spirometers are commonly associated with a lower enforced work of breathing and higher inspiratory lung volume than flow-oriented incentive spirometers (Yamaguti et al., 2010).

The device used in this study is flow incentive spirometer as they are readily available and easy to acquire (Kumar et al., 2016). It has been shown that flow and volume incentive spirometry can be safely recommended to patients following abdominal and thoracic surgery as there have been no adverse outcomes noted. Moreover, they have led to obvious improvement in pulmonary function and exercise adherence.

2.6 Monitoring

Close supervision of each patient's use of incentive spirometry is not required once the patient has established mastery of the technique. However, intermittent reassessment is crucial to optimal performance (Restrepo et al., 2011) with regard to: observation of patient's actions and utilization; rate of sessions; number of breaths; inspiratory volume; flow; breath-hold goals reached; effort and motivation; device within scope of patient to support acting without supervision.

2.7 Frequency

Evidence is absent regarding the exact frequency with which to use IS and these are just some of the recommendations that have been reported by clinical trials:

-10 breaths each 1 (Rafea et al., 2009) to 2 (Bellet et al., 1995) hours while awake

-10 breaths, five times a day (Renault et al., 2009).

-10 breaths every 4 hours (Kundra et al., 2010).

Following proper instruction and return demonstration, the patient should be encouraged to perform incentive spirometry alone. The frequency for using incentive spirometry for this study was according to the An-Najah hospital protocol and Kundra et al. (2010), which uses incentive spirometry 10 min every 4 hours. Incentive spirometry will be utilized by the patient with 10 breaths, 6 times per day for a period of 10 minutes in every session.

2.8 Deep-breathing exercise and cough protocol

Deep-breathing exercises and coughing are used to restore lung volume and avert the restrictive postoperative ventilator pattern; the technique for teaching how to perform the breathing exercises varies in the literature.

The technique is to breathe in deeply and slowly through the nose, expanding the lower ribcage, and letting the abdomen move forward. Hold for a count of 3 to 5. Breathe out slowly and completely through pursed lips and cough. Do not force the breath out. Finally rest and repeat 10 times every 1 to 2 hours. Rest longer if the client becomes dizzy or lightheaded (Smetana et al., 2018).

Chapter Three

Literature Review

3. Literature Review

Many standard treatment guidelines from the American Association for Respiratory Care have published the experimental application of IS and a systematic review consists of four systematic reviews and standard treatment guidelines exploring the efficacy of IS in postoperative thoracic and abdominal operation patients conducted to generate evidence-based guidelines .Their recommendations do not encourage the use of IS to prevent PPCs. These recommendations published in 2011 (Restrepo et al., 2011). IS only is not suggested for usual use in the pre- and postoperative setting to prevent PPCs. It is not suggested for usual use of incentive spirometry to prevent atelectasis following CABG surgery. The usual prophylactic use of IS is not suggested for postoperative patient. Rather, early mobilization and ambulation is suggested to decrease PPCs and stimulate airway clearance from the standards reported in 2013 (Strickland et al., 2013). Incentive spirometry has been demonstrated to be only as effective as coughing and deep-breathing regimens and other means of postoperative pulmonary prophylaxis. However, Incentive spirometry, along with most other prophylactic practices, is better at preventing PPCs than no intervention at all. (Rupp et al., 2013)

Carvalho et al. conducted a systematic review, examining 30 studies related to IS. The aim was to evaluate the evidence of the use of incentive spirometry for the prevention of postoperative pulmonary complications and for the recovery of pulmonary function in patients undergoing abdominal, cardiac and thoracic surgeries. They searched the database Scopus to select randomized controlled trials in which IS was used pre- and/or postoperatively. They concluded that there was no evidence to support the use of IS following bypass surgery and that further studies were needed to clarify the effect and align the use of this practice (Carvalho et al., 2011).

A systematic review study following CABG surgery included 592 participants from seven studies (Freitas et al. 2012). The review objective was to evaluate the effects of IS for preventing PPCs in adults following CABG surgery. There was no significant relevant difference in the incidence of PPCs between the IS and control group with physical therapy, positive-pressure breathing practices, effective cycle of breathing or preoperative patient training. The IS group showed worse pulmonary function, PaO2 and no improvement in the muscle strength compared to the control group who were given positive-pressure breathing technique. The review concluded that there was no evidence that the use of IS reduced PPCs or the negative effects on pulmonary function in patients following CABG surgery (Freitas et al., 2012).

Cassidy et al. (2013) reported the result of a program described by the acronym I COUGH, which focused on deep breathing with incentive spirometry, coughing, and oral care (e.g., applying mouthwash when brushing teeth twice daily), perception (i.e., patient and family teaching), ambulation out of bed more than 3 times each day and raising the head of the bed. Application of this protocol showed a decrease in postoperative pneumonia and unexpected intubations. Unfortunately, each element of the protocol package were not examined alone, and therefore it is not possible to know the extent to which IS contributed to reducing pneumonia. As mentioned earlier, although the use of incentive spirometry is not recommended alone, its use concurrent with deep-breathing exercise and physiotherapy has shown significant decreases on PPCs (Cassidy et al., 2013).

Fayyaz et al. (2016) conducted a randomized control trial, comprising 170 patients at the Institute of Cardiology Multan. The authors' aim was to evaluate postoperative oxygenation status in patients following CABG surgery with and without preoperative IS. Two equal groups were randomly assigned by using a binary number generator system: Group I (incentive spirometry group) performed preoperative IS and Group C (control group) did not perform preoperative IS. The authors followed all patients to observe preoperative IS and postoperative improvement in oxygenation. The researchers revealed that the preoperative IS group had better postoperative oxygenation status and a decreased incidence of PPCs in patients undergoing CABG surgery, but the spirometry remarkable

improved lung function as improved oxygenation. However, this study did not show decreases in hospital length of stay for either group, but did report a significant improvement in oxygenation status when preoperative incentive spirometry was used (Fayyaz et al., 2016) .

Diken and Özyalçın, 2018 conducted a randomized control trial. Their aim was to evaluate the influence of preoperative precautions for atelectasis, such as incentive spirometers, on postoperative pulmonary outcome. A total of 108 hemodynamically stable patients scheduled for elective isolated coronary artery bypass surgery with a body mass index over 30 kg/m2 and without previous pulmonary disease were included in the study. The patients underwent pulmonary function tests prior to surgery and results were considered in normal limits, The authors concluded that there was a lower rate of atelectasis and pneumonia when preoperative incentive spirometry was used; on the other hand oxygenation status for both groups was the same. (Diken & Özyalçın, 2018b)

A study by Yazdannik, et al. (2016) in an Iranian population assessed the effects of IS on arterial blood gases following CABG. The randomized control trial comprised 50 patients who were randomly assigned into two equal groups – intervention and control. These two groups were y compared preoperatively, on the first (after extubation), second and third postoperative days for arterial blood gases' level. The authors concluded that IS showed a remarkable improvement in PO2 and PCO2. As detailed earlier, IS technique improved PO2, and likewise the other blood gas

parameters (PaO2, SaO2, and PaCO2) following CABG surgery (Yazdannik et al., 2016).

In a study by (Moradyan et al., 2012) the aim wa to evaluate the effect of planned breathing exercises on oxygenation in patients undergoing coronary artery bypass surgery. One hundred patients undergoing CABG were randomly allocated and received a breathing exercise protocol (deep breathing, incentive spirometry and directed cough maneuvers) and the patients in the control group received daily routine hospital physiotherapy. Arterial blood gases were compared between groups before the operation and on the first, second and third postoperative day. The study revealed that IS can enhance PaO2 and SaO2 on the postoperative day following CABG. On the other hand, there are alternative results stated by Afrasiabi et al.(2007), who revealed that IS does not have a significant influence on oxygenation status postoperatively. Brage et al., (2009) also revealed that improvement in postoperative oxygenation status with the use of IS is temporary and this improvement is very quickly reversed.

Although Balandiuk and Kozlov (2004) conducted a randomized control trial regarding preoperative training with IS in patients undergoing CABG surgery, the study aim was to examine the efficacy of preoperative IS in CABG patients. Sixty-five CABG patients aged 41 to 73 years had been randomly allocated into two groups of intervention and control. Patients in the intervention group (37) used IS preoperatively for 2 days before surgery, while the control group (28 patients) did not. IS practicing

was achieved for 10 min each hour until the second postoperative day. Anaesthesia and ventilation parameters were the same in both groups. Balandiuk and Kozlov revealed that IS significantly improved lung inspiratory capacity, arterial blood gas oxygenation and lung shunt after cardiopulmonary bypass 2004). However, there is a lack of evidence to prove the advantage of using IS to decrease PPCs and in the reduction of the negative effects of pulmonary function in patients following CABG surgery. (Freitas et al., 2012; Overend et al., 2001; Renault et al., 2009).

Gilani et al. (2016) conducted a randomized control trial (RCT) that included 170 patients with the aim to evaluate the impact of preoperative IS on postoperative atelectasis in patients, following CABG surgery, Patients were randomly allocated into two groups of intervention and control, with 85 patients in each group. In the intervention group patients used IS preoperatively, while the control group did not. The authors reported that the positive smoking history in the intervention group was 42.4%, whereas only 24.7% patients smoked in the control group (p-value 0.02). Mechanical ventilation time was significantly less in the intervention group: 5.49+2.28 hours versus 6.74+5.46 hours in control group with (p-value 0.05). Incidence of atelectasis postoperatively was 14.10% in the intervention group and 27.10% in control group with (p-value 0.04). The authors concluded that preoperative IS reduced the incidence of atelectasis postoperatively and that it could also decrease mechanical ventilation time. This study showed that the use of IS preoperatively reduces the incidence of atelectasis and mechanical ventilator duration compared to the group

using incentive spirometry postoperatively in combination with chest physiotherapy(Gilani et al., 2016).

Yánez-Brage et al. (2009), conducted an observational study of a total of 263 patients presented for off-pump CABG surgery at the A Coruña University Hospital (Spain). The authors' aim was to decide whether preoperative respiratory physiotherapy decreases the incidence of PPCs. Physiotherapist provided a daily session that include- IS, deep breathing training, coughing and early ambulation. The incidence of PPCs was reported as "yes" or "no," regardless of the degree with 02 saturation assessment (SpO2) to measure oxygenation and length of stay. The most frequent complications were postoperative hypoventilation (90.7%), pleural effusion (47.5%) and atelectasis (24.7%). The study concluded that pre-surgery physiotherapy (involving IS, deep-breathing training, assisted coughing and early ambulation) after off-pump CABG surgery is linked to the reduction in the incidence of atelectasis (Yánez-Brage et al., 2009).

Eltorai et al. (2018) conducted an online survey looking to assess health-care professionals' perspectives on IS efficiency and use techniques, by comparing IS attitudes among the American Association for Respiratory Care (AARC) and the nursing societies. The author concluded that there is a major discrepancy between health-care professionals' beliefs and the published clinical effectiveness data supporting IS; regardless of adequate education on IS, the variability in what health-care professionals believed

to be appropriate use underscoring the literature's lack of standardization and evidence for specific use procedures (Eltorai et al., 2018).

On the other hand, Eltorai et al. (2018) published a systemic review study into the clinical efficiency of IS for the prevention of PPCs. The authors asked why IS is usually suggested to decreases PPCs, despite there being narrow evidence to support its advantages and an absence of a harmonized protocol for its use, and several reviews with meta-analyses have studied the effects of using IS. The study revealed that clinical evidence-based practice recommends against the routine use of IS in postoperative care until more evidence of its advantage from further clinical trials becomes available (Eltorai et al., 2018)

Nardi et al. (2019) conducted a short-term results randomized clinical trial on 59 clients, in three groups. Group A underwent a preoperative respiratory and motor physiotherapy protocol, Group B received no preoperative specific physiotherapy protocol and Group C received only a simplified preoperative standard physiotherapy protocol. The study aimed to evaluate whether a preoperative physiotherapy protocol with or without musculoskeletal mobilization may provide a significant improvement in pulmonary and musculoskeletal recovery postoperatively in patients undergoing elective cardiac surgery. The author concluded that better clinical results for respiratory and musculoskeletal function were found in the groups preoperatively treated with physiotherapeutic protocols immediately before as well as after cardiac surgery (Nardi et al., 2019a).

Oshvandi et al. (2020) conducted a clinical trial on 80 patients undergoing coronary artery bypass graft surgery. The study was performed to determine the effect of breathing exercises on the occurrence of atelectasis in patients undergoing coronary artery bypass graft surgery. respiratory exercises 30 deep breathing per hour for 3 days postoperatively with only received routine care in the other group postoperatively. The authors concluded that deep breathing, effective perforation and use of motivational spirometry were more effective in lower incidence of atelectasis after coronary artery bypass grafting compared to routine hospital performance. Despite there being no preoperative intervention, the study showed that using incentive spirometry concurrent with deep-breathing exercise with cough reduces the incidence of atelectasis(Oshvandi *et al.*, 2020).

On the other hand, Moradian et al. (2019) revealed that preoperative breathing exercise does not reduce pulmonary complications and hypoxemia in patients undergoing CABG after conducting a single-blinded randomized clinical trial on 100 clients. Fifty patients in the experimental group were enrolled preoperatively in a protocol that included deep breathing, coughing and incentive spirometer, and the control group received routine hospital physiotherapy. The result did not support the use of incentive spirometry and deep-breathing exercise with cough. However, the sample comprised 67 males and 33 females, which may have led to a bias to the male patients. In addition, the protocol was to use the IS once a day for 2 to 3 minutes in the first 4 days postoperatively, which were

decreases the airway clearance and there was no difference between groups (Moradian et al., 2019).

Shaban et al. (2002) reported that preoperative breathing exercise decreased the incidence of atelectasis, improved ventilation status and decreased length of hospital stay after conducting quasi-experimental research with the aim of evaluating the effect of respiratory exercise in acute respiratory complications and the length of hospitalization time for patients undergoing coronary artery bypass surgery. The experimental group received education in two sessions of video teaching preoperatively and the control group received routine cares (Shaban et al., 2002).

In a study conducted by Cattano et al. (2010) aimed at determining whether a systematic use of IS prior to surgery could help patients preserve their respiratory function better in the postoperative period. Forty-one morbidly obese (body mass index [BMI]. 40 kg/m2) candidates undergoing laparoscopic bariatric surgery consented to participating in the study. All patients were taught how to use an incentive spirometer. Participants were randomized blindly into two groups. The control group was instructed to use the incentive spirometer for 3 breaths, once per day. The treatment group was requested to use the incentive spirometer for 10 breaths, 5 times per day. The study results indicate that preoperative use of IS does not lead to significant enhancements in inspiratory capacity and that it is not a beneficial resource to prevent postoperative decreases in lung function (Cattano et al., 2010).

A prospective RCT study examined the effects of preoperative incentive spirometry (IS) education (POISE) on postoperative outcomes for knee and hip total joint replacement patients. The study was conducted on 140 patients randomized to group one (n = 50) (POISE intervention) or group two (n = 56) (no intervention). Official training was provided for the intervention group's at home preoperatively and postoperatively and IS volumes were documented. However, the control group's patients received no intervention. Patients' postoperative IS volumes were recorded, which were used to decide patients back to baseline volume. While the IS volumes were not significantly different between groups, POISE patients had improved results and ranked the intervention as beneficial. The results showed a better outcome in patients who used the incentive spirometry preoperatively but the study used an insufficient sample size and there was a lack of compliance for group one patients in using the instructions for IS (Bergin et al., 2014).

Another study compared the effects of preoperative and postoperative incentive spirometry in 50 normal healthy adults undergoing laparoscopic cholecystectomy in a prospective study and revealed that preoperative patients who were instructed to use IS for 7 days before surgery, 15 times every 4 hours for 1 week had significantly better lung function with shorter [prolonged length of stay (Kundra et al., 2010)

Chapter Four
Methodology

4. Methodology

This chapter presents an overview of the research methodology that was used for this study. It includes: study design; setting; population; inclusion and exclusion criteria; sample size and sampling process; pre-enrollment assessment; randomization; blindness; ethical consideration; project timetable; data collection; and data analysis plan.

4.1. Study design

A prospective randomized control trial (RCT) was used for the present study. RCT involves the manipulation of an independent variable, that is, the use of preoperative IS. Randomization minimizes the bias feature that characterizes true experimental study.

4.2 Population

Participants are adult patients scheduled for coronary artery bypass surgery, aged 18 or older, and patients who were well motivated and compliant.

4.3. Study site and setting

The study was conducted at AN Najah National University Hospital. Data was collected from CCU and Intermediate CCU wards. An-Najah National University Hospital has 200 beds, 5 beds for CCU and 16 beds for

Intermediate CCU. It is a nonprofit hospital, located in the Northern of West Bank, Palestine.

4.4 Sample and sampling

To investigate the optimal sample magnitude for the trial that safeguards an adequate effect to identify statistical significance, the effect of the trial was estimated at 80 percent power, with alpha levels at ($p \leq 0.05$). Sample magnitude was computed as 37 patients for each group.

To raise the potential of the current trial, we recruited 40 patients in every group as has also been done in early studies

4.5. Sample size

Sample size was calculated as a formula (i.e., Pocock's sample size formula), which can be directly applied for comparison of proportions P_1 and P_2 in two equally sized groups.

$$n = \frac{[P_1 (1-P_1) + P_2 (1-P_2)]}{(P_1-P_2)^2} (Z_{\alpha/2} + Z_{\beta})^2$$

where:

n: required sample size

P_1: estimated proportion of study outcome in the exposed group (i.e., combination therapy) ($P_1 = 0.25$)

P_2: estimated proportion of study outcome in the unexposed group (no intervention) ($P_2 = 0.50$).

α: level of statistical significance

$Z_{\alpha/2:}$ represents the desired level of statistical significance (typically 1.96 for $\alpha = 0.05$)

$Z_{\beta:}$ represents the desired power (typically 0.84 for 80% power)

$$n = \frac{[0.25\ (1-0.25) + 0.50\ (1-0.50)]\ (1.96 + 0.84)^2}{(0.25-0.50)^2}$$

$$n = \frac{[0.25\ (0.75) + 0.50\ (0.50)]\ (2.8)^2}{(0.25)^2}$$

$$n = \frac{[0.18+ 0.25]\ (7.84)}{0.06}$$

$$n = \frac{[0.43]\ (7.84)}{0.09}$$

$n \approx 37$ patients

Thus, a total of 74 patients (37 for each group) should be targeted for recruitment into the study. We recruited 40 patients in each group, a total of 80 patients, to cover the dropout.

4.6 Inclusion criteria

Patients who met the following inclusion criteria were included in this study

- 18 years or older
- Scheduled to have **coronary artery bypass grafting** (**CABG)**
- Patients who were well motivated and compliant.

4.7 Exclusion criteria

- Patients who are expected not to be able to conduct or comply with IS, such as patients with cognitive or neurological deficits
- Patients with coexisting acute or chronic respiratory disorders
- Patients unable to understand or show the proper use of the incentive spirometer
- Patients who cannot be instructed or supervised to assure appropriate use of the device
- Patients in whom cooperation is absent or patients unable to understand or demonstrate proper use of the device

- Patients who are confused or delirious

- Patients undergoing any other surgery along with CABG, having prolonged mechanical ventilation (more than 24 hours) or reintubation.

- Patients undergoing emergency CABG surgery.

- chronic obstructive pulmonary disease (COPD), asthma, restrictive lung disease

- Preoperative major chest infection e.g. pulmonary tuberculosis, chest deformities such as pectus carinatum, pectus excavatum, thoracolumbar scoliosis, diaphragmatic hernias diagnosed on history.

4.8 Study measures (variables)

- **Dependent variables**:

- Postoperative pulmonary complication (PPC)

- Atelectasis

- Oxygenation status

- ICU length of stay

- Hospital length of stay

- Mechanical ventilation duration

- **Independent variables**:

Preoperative and postoperative incentive spirometry (IS).

4.9 Pre-enrollment assessment

The patients who were recruited in the study had to have an assessment of respiratory problems, smoking habits, motivation and compliance by a nurse who was not involved in the patients' care postoperatively. They also needed an ABGs test to check oxygenation status. Thus, excluded patients included those who had had recent or chronic respiratory problems and who were unable to understand or show the proper use of the incentive spirometry.

4.10 Randomization

The participants who met the inclusion criteria were randomized into two groups according to a randomization list formatted by www.randomization.com.

Group 1: Incentive spirometry was utilized by the patient with 10 breaths, 6 times per day for a period of 10 minutes in every session with a breathing technique for 2 days preoperatively. The patients were taught how to use IS by a nurse who would not be involved in the patient's postoperative care. (Experimental group) (IS).

Group 2: No IS preoperatively, only IS postoperatively (Control Group)

Table (4): The computerized randomization list

N	Group	N	Group	N	Group	N	Group	N	Group	N	Group	N	Group	N	Group
1	Control	**11**	IS	**21**	Control	**31**	Control	**41**	IS	**51**	Control	**61**	IS	**71**	Control
2	Control	**12**	IS	**22**	Control	**32**	Control	**42**	IS	**52**	IS	**62**	Control	**72**	IS
3	IS	**13**	Control	**23**	IS	**33**	Control	**43**	Control	**53**	Control	**63**	IS	**73**	IS
4	IS	**14**	IS	**24**	Control	**34**	IS	**44**	IS	**54**	Control	**64**	IS	**74**	IS
5	IS	**15**	IS	**25**	Control	**35**	Control	**45**	IS	**55**	Control	**65**	Control	**75**	Control
6	IS	**16**	IS	**26**	Control	**36**	IS	**46**	IS	**56**	Control	**66**	IS	**76**	IS
7	Control	**17**	Control	**27**	IS	**37**	IS	**47**	Control	**57**	Control	**67**	Control	**77**	Control
8	Control	**18**	Control	**28**	IS	**38**	IS	**48**	Control	**58**	Control	**68**	IS	**78**	IS
9	IS	**19**	Control	**29**	IS	**39**	IS	**49**	Control	**59**	Control	**69**	Control	**79**	IS
10	Control	**20**	Control	**30**	IS	**40**	Control	**50**	IS	**60**	IS	**70**	IS	**80**	Control

4.11 Blindness

The patients and health-care providers included in the patient care were unaware of the treatment group allocation.

4.12 Ethical considerations

The institutional Review Board of An-Najah National University approved the study. Consent forms were obtained from the patients prior to participation. All patients were given both verbal and written information about the aim and objectives of the study before considering participation in the study. The study followed the World Health Organization Declaration on the Ethical Principles of Helsinki for Medical Research on Humans (World Medical Association, 2013).

4.13. Project time

June 2019 to December 2019.

4.14. Data collection procedure

After obtaining the study approval by the Institutional Review Board (IRB) of An-Najah National University, written informed consent was obtained from all patients after full explanations of the goals and procedures of the study. Eighty patients who were scheduled for elective CABG took part.

On the day of admission to hospital, as well as explaining to the patients the regulations regarding the way the cardiac surgery unit worked, the

nursing staff performed a physical assessment, assessed patients for respiratory status, obtained blood samples for regular lab test, and an ABG sample was obtained for all patients.

A data sheet containing the following information was filled out for each patient: name; age; height; weight; body mass index; respiratory status. The participants who met the inclusion criteria and according to randomization list formatted by www.randomization.com, the participants were randomized into two groups. Then the patients randomized to the intervention group were given a flow-based incentive spirometer (IS) (POLYCISER – A Lung Exerciser, POLYMED Medical Devices), its use was explained and they were taught how to use the device with deep-breathing exercise until operation day.

The patients were asked to use the spirometry with deep-breathing exercise 2 days preoperatively until surgery. They were asked to hold the spirometer in the upright position, place their lips tightly across the spirometer mouthpiece, and then they were ask to slowly inhale air into the lungs to raise the ball to the target position. After that the mouthpiece was removed and patients were asked to hold their breath for at least 5 seconds followed by normal expiration. Incentive spirometry was done with 10 breaths, 6 times per day for a period of 10 minutes every session before surgery.

4.15 Anaesthesia protocol

(AN-Najah National University Hospital protocol)

All patients in both groups received the same anesthesia technique and ventilation in the operation room.

A standard induction for cardiac anaesthesia started with inhalation with sevoflurane 0–8% in 100% oxygen and fresh gas flow of 3 L/min for 5 min with facial mask. After that patients were given IV anaesthesia Propofol 2 mg/kg IV and tracheal intubation was facilitated with rucoronium 1.5 to 2 mg/kg with fentanyl 2-20mcg/kg/dose initially.

4.15.1Maintenance of anaesthesia

Anaesthesia was maintained with sevoflurane 0–3% in 50% oxygen and 50% air. Neuromuscular blockade was maintained with increments of atracurium with this equation: 0.3(dose)*kg/4(concentration/ml)= ml/hr, fentanyle was used to provide intraoperative analgesia with this equation: 2(dose)*kg/20(concentration/ml) = ml/hr as 1-2mcg/kg/hr maintenance.

For special cases like decreased ejection fraction and left main coronary disease, etomidate 0.3–0.6 mg/kg was used.

4.16 Postoperative Care

Both groups postoperative received the same intervention: the exercises began on the morning after surgery with incentive spirometry, deep-breathing exercise and physiotherapy after extubation, and early

mobilization, in accordance with An-Najah University Hospital protocol (Gilani et al., 2016; Moradyan et al., 2012; Yazdannik et al., 2016).

The patients who had not performed preoperative incentive spirometry were informed how to use the device, and from then on all of the patients completed a daily session, under the supervision of the unit nurse, for the rest of their hospital stay.

Data collection sheets for PPCs and oxygenation status were obtained postoperatively for 3 days according to the literature and because PPCs occur within 48–72 h following surgery (Kelkar, 2015). Data were filled Q6 hr: immediately postoperatively, and continued on the first, second and third days, as on the first day patients were mobilized, chest X-rays and ABGs were obtained; extubation depends on patient status and mobilization was the next morning. Furthermore, ICU and hospital length of stay data were collected until patient discharge, and pain scale was measured with numerical rating scales (NRS) with a pain scale from 0 to 10, with scores ≤ 5 corresponding to mild, scores of 6–7 to moderate and scores ≥8 corresponding to severe pain.

Thoracic X-rays were taken during the preoperative period, as well as immediately following surgery in the intensive cardiac care unit (ICCU), on the ward, once the drains had been removed (48 hours after surgery), and on discharge from hospital. X-ray examinations were performed with the same frequency with all patients in both groups.

Additionally, any postoperative complications were noted (fever, atelectasis on chest X-ray, postoperative pneumonia, desaturation episodes, shortness of breath, and cough), and any interventions undertaken to improve respiratory status were also documented (nebulizer/inhaled medication use, CPAP, BiPAP, reintubation, and respiratory physiotherapy).

4.17. Data collection plan

The data collection sheet was prepared after going throughout the linked literature and with the supervision of experts in the field. Content validity is defined as "the degree to which objects in an instrument reflect the content universe to which the instrument will be generalized" (Straub, Boudreau et al., 2004). Content validity was applied while the data sheet was developed to ensure that it included all items that was essential (Boudreau et al., 2001; Lewis et al., 1995). The assessment method for determining the validity of the data sheet included literature reviews and then follow-ups with evaluation by expert judges or panels (two intensivists, one anaesthesiologist and three nurses with critical care), all the experts' suggestions were taken into account.

The data collection sheet consisted of: (Appendix 1)

Part I: Demographic data.

Part II: Observational checklist for assessment of vital signs and respiratory status.

Part III: Observational checklist for respiratory complications.

Part IV: Observational checklist for length of stay.

Part V: Observational checklist for mechanical ventilator period.

Part VI: Observational checklist for oxygenation status.

Part VII: Observational checklist for pan assessment.

Part I:

Part I consists of personal data of the client, which includes name, age, sex,

Smoking history, history of diabetes and hypertension, weight, height, BMI, mechanical ventilation period (hour) and other.

Part II:

The observational checklist consists of **2** parts, **vital signs** and **respiratory status.**

Part **1** consist of six items (respiratory rate, heart rate, blood pressure, temperature, SPO2, ECG rhythm).

Part **2** consists of five items (cough, wheezing, breath sound, use of accessory muscles and air entry.) for assessing respiratory status. The checklist consists of normal and abnormal respiratory characteristics. A score of 0 was allotted for each normal characteristic (absent value) and a

score of 1 was allotted for each abnormal characteristic feature (present value).

Part III:

The observational checklist consists of respiratory characteristics like fever, diminished respiratory movements, diminished breath sounds, tracheal displacement toward affected side, tachypnea, cough , dyspnea on exertion, reduced chest expansion and limited diaphragm movement, frothy white or pink mucoid sputum, pleuritic chest pain, dullness to percussion over effusion and X-ray features for assessing respiratory complications. The checklist consists of abnormal respiratory characteristics.

A score of one (1) was allotted for presence of each finding and a score of zero (0) for absent findings.

Part IV:

Observational checklist for length of stay consists of patient length of stay in the intensive care unit and hospital length of stay.

Part V:

Observational checklist for mechanical ventilator period. Measured by how many hour stay at ventilator.

Part VI:

Observational checklist for oxygenation status, by obtaining arterial blood gases preoperatively, postoperatively, on the first, second and third day post-surgery.

Part VII:

Observational checklist for pan assessment by using in numerical rating scales (NRS) from 0-10 with NRS scores ≤ 5 correspond to mild, scores of 6–7 to moderate and scores ≥8 to severe pain.

3.18. Data analysis plan

The data were analyzed with SPSS version 22 for Windows (IBM Corp., Armonk, NY, USA). Data normality was tested using Kolmogorov–Smirnov test. The data were not normally distributed. Thus, nonparametric statistics tests were used. The scale data are expressed as the median (quartile 1 [Q1]–quartile 3 [Q3]). The groups were compared with the Mann–Whitney U test. Categorical variables (YES/NO questions) were statistically analyzed with chi-square tests, and the student t-test for continuous data. A P value ≤ 0.05 was considered to indicate a statistically significant difference.

Chapter Five

Results

Consort diagram (Figure 1) presents a flowchart of the screening and allocation of the patients. One hundred clients were assessed for eligibility; 20 did not meet the inclusion criteria. The remaining 80 clients were enrolled and randomized into the treatment or

control group.

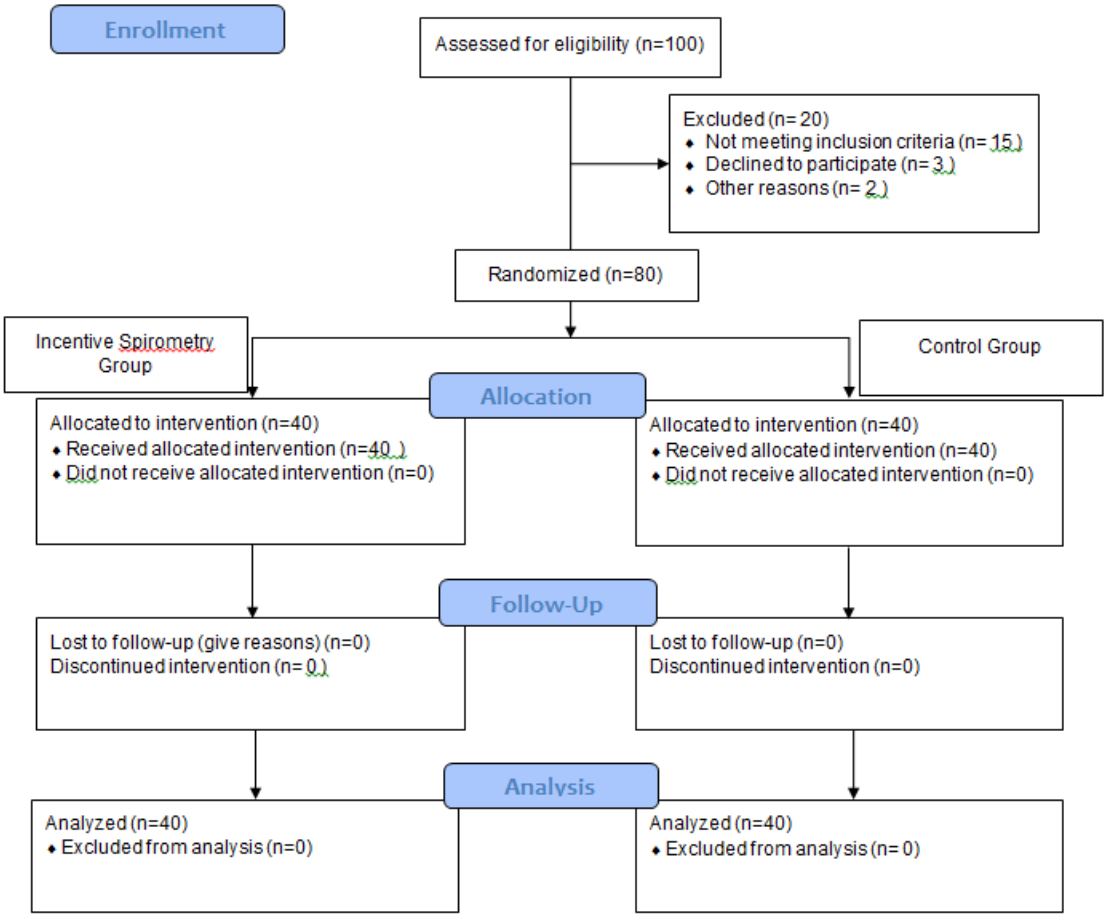


Figure 1. Flowchart of patient screening and allocation.

Table 1: Demographic data + History

Variable	Total (Mean ± SD)	IS Group (Mean ± SD)	Control Group (Mean ± SD)	P value
Age	54.3±4.5	54.4±3.8	54.3±5.1	0.961
Table 1: Demographic data + History				
Variable	**Yes/ No**	**IS Group n (%)**	**Control Group n (%)**	**P value**
Gender	Male	22(55.0%)	21(52.5%)	0.823
	Female	18(45.0%)	19(47.5%)	
DM	Yes	17(42.5%)	20(50.0%)	0.501
	No	23(57.5%)	20(50%)	
HTN	YES	15(37.5%)	15 (37.5%)	> 0.999
	NO	25 (62.5%)	25 (62.5%)	
IHD	YES	18(45.0%)	15(37.5%)	0.496
	NO	22(55.0%)	25(62.5%)	
PCI	YES	5(12.5%)	8(20.0%)	0.363
	NO	35(87.5%)	32(80.0%)	
SMOKING	YES	14(35.0%)	16(40.0%)	0.644
	NO	26(65.0%)	24(60.0%)	
BMI		26.5±2.6	26.4±2.1	0.967
BMI CATEGORY	Normal weight	12(30.0%)	9 (22.5%)	0.727
	Overweight	24(60.0%)	28(70.0%)	
	Obesity	4(10.0%)	3(7.5%)	

Table (1) above shows that there are no significant differences between the IS Group and the Control Group in all general characteristics of patients exhibited in the table above at the 0.05 level (the p-values>0.05), The groups were similar to the patient's demographic data that are (age, gender, co-morbidity, smoking and BMI).

5.1 Hemodynamic measurements

5.1.1 Respiratory status

Table 2 and Figure (2) below show that at baseline and immediately postoperatively, there were no significant differences in respiratory rate between the IS Group and the Control Group (P = 0.542), but there are significant differences between the groups at 12,18,24,30 hours postoperatively with P value = 0.008, 0.002, 0.001, 0.003, respectively. Further, there were no significant differences in RR between the two groups from 36 to 90 hours.

Table 2: Respiratory Rate (RR)

Variable	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
RR PRE	16 [14 -19]	16 [14 -18]	0.542
RR POST	16 [14 -15]	16 [15 -16]	0.205
RR 6 HR	16 [15 –16]	16 [15 –16]	0.877
RR 12 HR	17 [16 -18]	18 [17 -19]	0.008*
RR 18 HR	18 [15 -20]	19 [18 -22]	0.002*
RR 24 HR	18 [15 -20]	20 [18 -28]	0.001*
RR 30 HR	17 [14 -21]	20 [20 -30]	0.003*
RR 36 HR	18 [14 -22]	19 [17 -33]	0.054
RR 42 HR	19 [16 -22]	19 [17 -34]	0.222
RR 48 HR	18 [17 -22]	20 [17 -30]	0.237
RR 54 HR	18 [16 -21]	19 [16 -32]	0.273
RR 60 HR	19 [17 -21]	18 [17 -28]	0.280
RR 66 HR	19 [16 -22]	19 [17 -26]	0.151
RR 72 HR	18 [16 -19]	19 [16 -21]	0.289
RR 78 HR	18 [17 -20]	18 [17 -19]	0.953
RR 84 HR	18 [15 -19]	18 [16 -20]	0.760
RR 90 HR	17 [15 -19]	18 [16 -19]	0.058

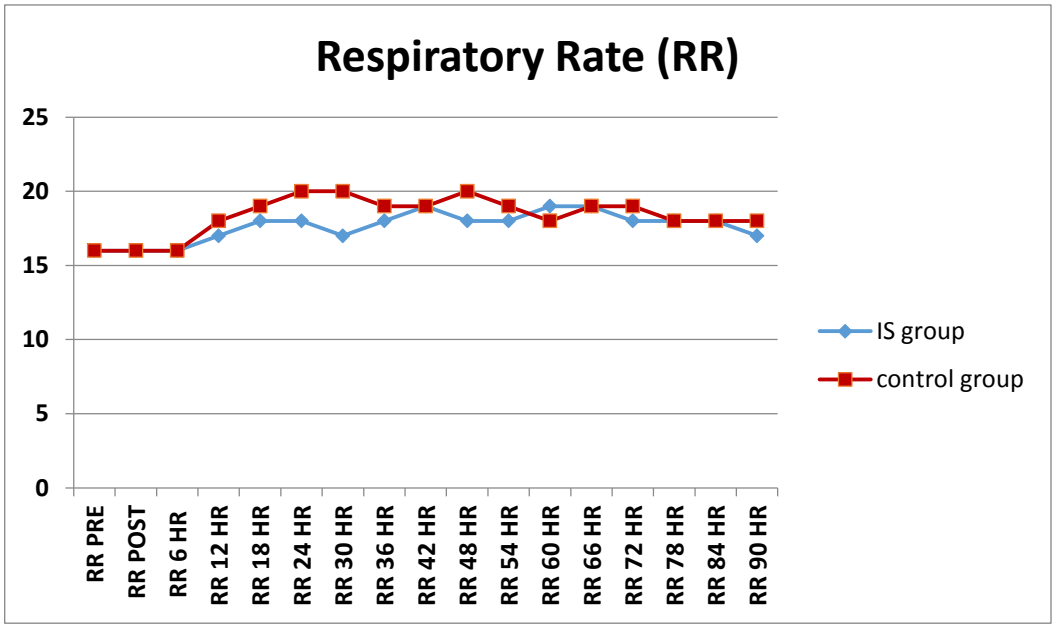


Figure (2). Graphical comparison of changes in median respiratory rate between IS and control groups.

5.1.2 Heart rate

Table 3: Heart Rate

Variable	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
HR PRE	82 [78 -87]	82 [76 -85]	0.711
HR POST	92 [86- 105]	90 [82- 104]	0.874
HR 6HR POST	85 [82- 91]	85 [79- 90]	0.576
HR 12 HR	85 [79- 90]	85 [76-92]	0.082
HR 18 HR	81 [76-89]	83 [77- 88]	0.923
HR 24 HR	87 [78- 92]	82 [75- 95]	0.528
HR 30 HR	88 [79- 94]	87 [79- 98]	0.919
HR 36 HR	85 [78- 92]	85 [79-96]	0.518
HR 42 HR	85 [78- 90]	84 [79-94]	0.776
HR 48 HR	86 [78- 95]	81 [77- 87]	0.079
HR 54 HR	85 [77-100]	83 [77- 87]	0.165
HR 60 HR	84 [79- 93]	80 [77- 89]	0.119
HR 66 HR	84 [79-92]	83 [77-90]	0.397
HR 72 HR	85 [79-91]	82 [76- 90]	0.637
HR 78 HR	83 [77- 90]	80 [76- 87]	0.360
HR 84 HR	83 [77- 87]	80 [77- 87]	0.257
HR 90 HR	83 [79- 88]	82 [79- 85]	0.332

Table 3 and Figure 3 show the heart rate of the IS Group and the Control Group with a normal HR IS 60–100 beats per minute (bpm) and, as shown, there were no statistically significant differences between the two groups pre- and postoperatively.

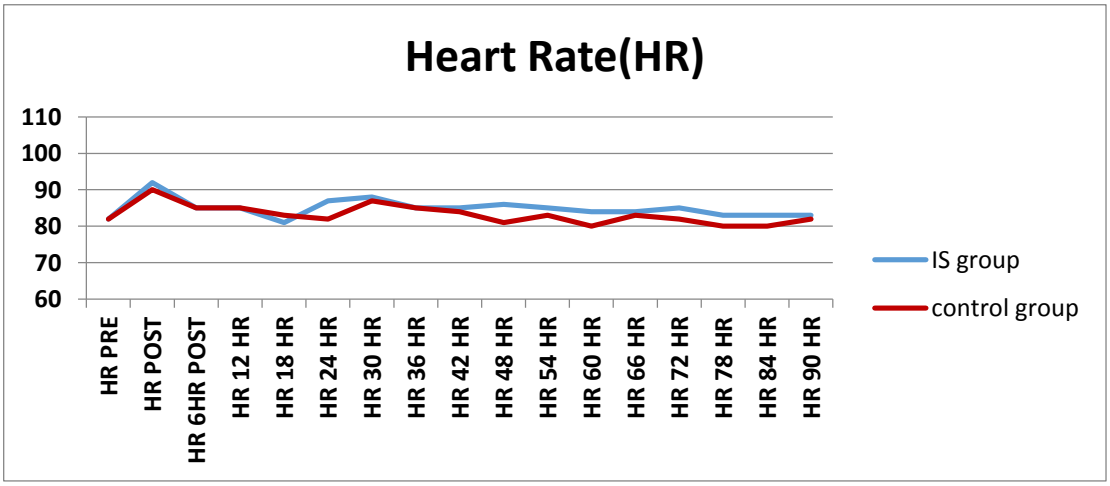


Figure 3. Graphical comparison of changes in median heart rate between IS and control groups.

5.1.3 Systolic blood pressure

Table 4 and Figure 4 below show the systolic blood pressure of the IS Group and the Control Group with a normal systolic blood pressure IS 100–140 millimeter of mercury (mmHg) and, as shown, there were no statistically significant differences between the two groups pre- and postoperatively.

Table 4: Systolic blood pressure

Variable	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
SBP PRE	125 [118- 132]	122 [112- 132]	0.525
SBP POST	124 [117- 132]	123 [113- 127]	0.256
SBP 6HR POST	123 [112- 134]	120 [110- 126]	0.121
SBP 12 HR	121 [112- 132]	118 [110- 130]	0.232
SBP 18 HR	122[110- 132]	117 [110- 131]	0.509
SBP 24 HR	122 [114- 136]	119 [109- 129]	0.113
SBP 30 HR	121 [114- 129]	118 [110- 129]	0.396
SBP 36 HR	123 [113- 130]	120 [109- 129]	0.312
SBP 42 HR	124 [115- 133]	120 [112- 129]	0.317
SBP 48 HR	124 [112- 129]	119 [115- 128]	0.729
SBP 54 HR	122 [113- 132]	117 [110- 129]	0.200
SBP 60 HR	122 [113- 128]	119 [111- 128]	0.689
SBP 66 HR	124 [114- 132]	118 [114- 129]	0.205
SBP 72 HR	118 [114- 129]	117 [111- 126]	0.503
SBP 78 HR	115 [110- 128]	121 [113- 127]	0.207
SBP 84 HR	119 [110- 126]	120 [115- 129]	0.427
SBP 90 HR	118 [110- 128]	118 [110- 125]	0.881

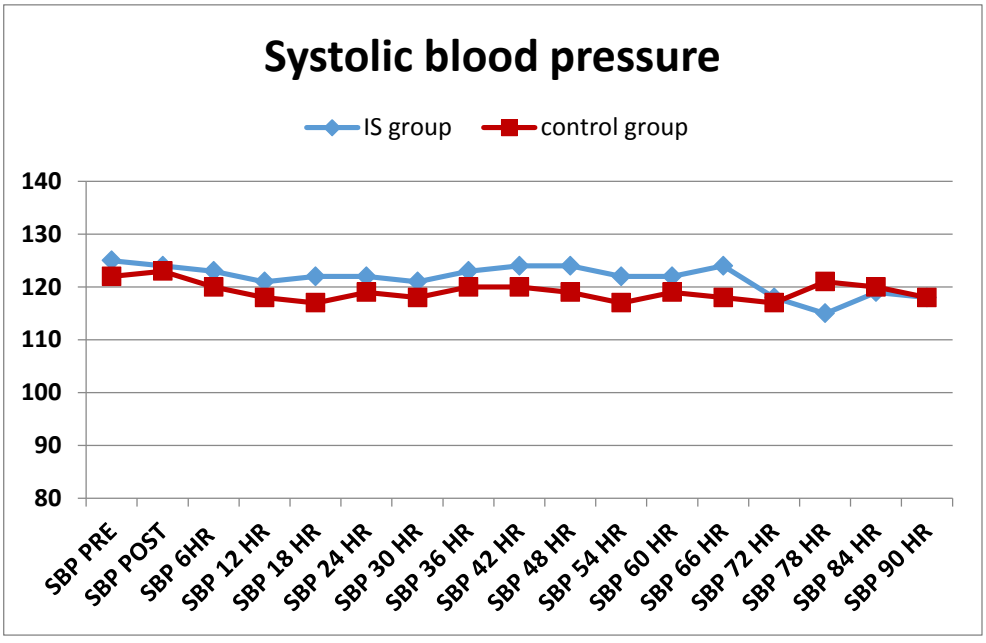


Figure 4. Graphical comparison of changes in median systolic blood pressure between IS and control groups.

5.1.4 Diastolic blood pressure

Table 5 and Figure 5 below show the diastolic blood pressure of the ISGroup and the Control Group with a normal diastolic blood pressure IS 60–90 millimeters of mercury (mmHg) and, as shown, there were no statistically significant differences between two groups pre- and postoperatively.

Table 5: Diastolic blood pressure

Variable	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
DBP PRE	74 [70- 84]	73 [66- 86]	0.609
DBP POST	76 [72- 81]	72 [65- 82]	0.120
DBP 6HR POST	75 [68- 79]	72 [61- 80]	0.368
DBP 12 HR	73 [69- 82]	72 [66- 81]	0.576
DBP 18 HR	73 [68- 79]	72 [65- 81]	0.836
DBP 24 HR	72 [69- 82]	72 [65- 81]	0.350
DBP 30 HR	73 [67- 79]	72 [63- 79]	0.473
DBP 36 HR	75 [68- 81]	73 [65- 79]	0.519
DBP 42 HR	73 [67- 80]	72 [65- 80]	0.467
DBP 48 HR	74 [65- 79]	74 [65- 80]	0.988
DBP 54 HR	72 [69- 77]	75 [65- 81]	0.780
DBP 60 HR	72 [69- 80]	74 [63- 79]	0.606
DBP 66 HR	74 [70- 79]	71 [65- 80]	0.347
DBP 72 HR	72 [69- 77]	72 [65- 79]	0.810
DBP 78 HR	70 [68- 77]	75 [65- 80]	0.696
DBP 84 HR	72 [69- 81]	72 [68- 83]	0.919
DBP 90 HR	75 [70- 79]	73 [68- 84]	0.721

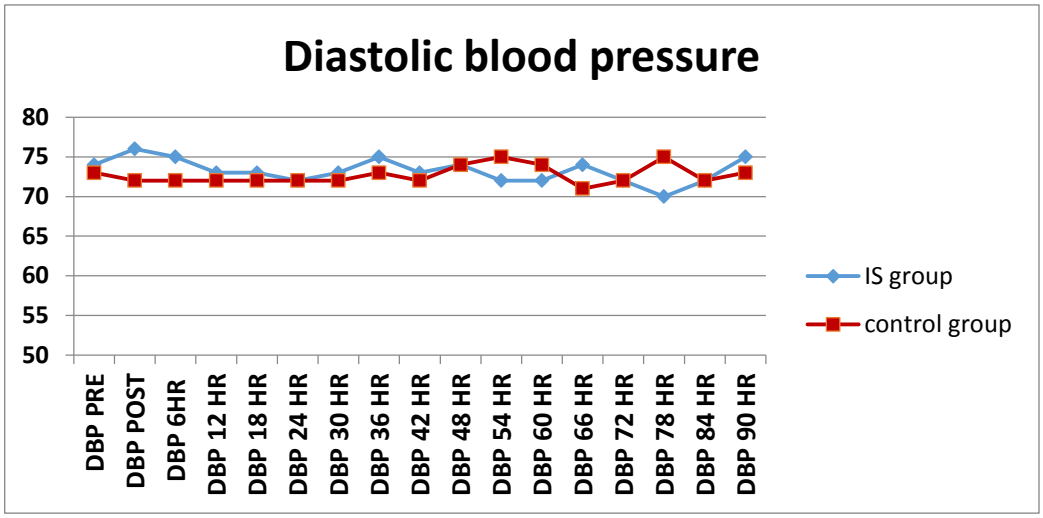


Figure 5. Graphical comparison of changes in median diastolic blood pressure between the IS and control groups**.**

5.1.5 Temperature

Table 6 below shows the temperature of the IS Group and the Control Group with a normal temperature IS 36.5–37.5 °C and, as shown, there were no statistically significant differences between two groups pre- and postoperatively.

Table 6: Temperature

Variable	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
TEMP PRE	36.2 [36.1- 36.4]	36.3 [36.0- 36.8]	0.614
TEMP POST	35.0 [34.5- 35.4]	35.0 [34.5- 35.4]	0.896
TEMP 6HR POST	36.0 [35.7- 36.7]	36.0 [35.7- 36.2]	0.514
TEMP 12 HR	36.2 [36.0- 36.5]	36.1 [36.0- 36.2]	0.290
TEMP 18 HR	36.2 [36.0- 36.5]	36.2 [36.1- 36.5]	0.726
TEMP 24 HR	36.3 [36.1- 36.7]	36.2 [36.1- 36.5]	0.720
TEMP 30 HR	36.4 [36.2- 36.7]	36.4 [36.2- 36.7]	0.801
TEMP 36 HR	36.4 [36.1- 36.7]	36.3 [36.1- 36.5]	0.884
TEMP 42 HR	36.5 [36.1- 36.9]	36.4 [36.2- 36.7]	0.973
TEMP 48 HR	36.5 [36.2- 36.7]	36.5 [36.1- 36.7]	0.950
TEMP 54 HR	36.4 [36.2- 36.8]	36.4 [36.2- 36.8]	0.858
TEMP 60 HR	36.5 [36.2- 36.7]	36.5 [36.2- 36.7]	0.746
TEMP 66 HR	36.3 [36.0- 36.7]	36.4 [36.0- 36.6]	0.442
TEMP 72 HR	36.3 [36.1- 36.6]	36.4 [36.0- 36.6]	0.996
TEMP 78 HR	36.3 [36.1- 36.7]	36.4 [36.1- 36.5]	0.950
TEMP 84 HR	36.2 [36.0- 36.5]	36.2 [36.0- 36.5]	0.676
TEMP 90 HR	36.2 [36.0- 36.5]	36.2 [36.0- 36.5]	0.870

5.1.6 Electrocardiogram (ECG) Strip

Table 7.2 below shows the Strip electrocardiogram (ECG) of the IS Group and the Control Group, regular, sinus ECG consider normal ECG and other consider abnormal, as shown there were no statistically significant differences between the two groups pre and postoperatively.

Table 7: Strip Electrocardiogram (ECG)

Variable	Regular vs Irregular	IS Group n (%)	Control Group n (%)	P Value
ECG PRE	Regular	39 (97.5%)	40 (100%)	0.314
	Irregular	1 (2.5%)	0 (0.0%)	
ECG POST	Regular	34 (85.0%)	34 (85.0%)	> 0.999
	Irregular	6 (15.0%)	6 (15.0%)	
ECG 6HR	Regular	36 (90.0%)	39 (97.5%)	0.166
	Irregular	4 (10.0%)	1 (2.5%)	
ECG 12 HR	Regular	38 (95.0%)	39 (97.5%)	0.556
	Irregular	2 (5.0%)	1 (2.5%)	
ECG 18 HR	Regular	39 (97.5%)	35 (87.5%)	0.090
	Irregular	1 (2.5%)	5 (12.5%)	
ECG 24 HR	Regular	37 (92.5%)	32 (80.0%)	0.105
	Irregular	3 (7.5 %)	8 (20.0%)	
ECG 30 HR	Regular	36 (90.0%)	32 (80.0%)	0.330
	Irregular	4 (10.0%)	8 (20.0%)	
ECG 36 HR	Regular	36 (90.0%)	34 (85.0%)	0.499
	Irregular	4 (10.0%)	6 (15.0%)	
ECG 42 HR	Regular	36 (90.0%)	34 (85.0%)	0.499
	Irregular	4 (10.0%)	6 (15.0%)	
ECG 48 HR	Regular	35 (87.5%)	33 (82.5%)	0.531
	Irregular	5 (12.5%)	7 (17.5%)	
ECG 54 HR	Regular	33 (82.5%)	34 (85.0%)	0.762
	Irregular	7 (17.5%)	6 (15.0%)	
ECG 60 HR	Regular	36 (90.0%)	36 (90.0%)	1.000
	Irregular	4 (10.0%)	4 (10.0%)	
ECG 66 HR	Regular	36 (90.0%)	37 (92.5%)	0.692
	Irregular	4 (10.0%)	3 (7.5%)	
ECG 72 HR	Regular	36 (90.0%)	37 (92.5%)	0.692
	Irregular	4 (10.0%)	3 (7.5%)	
ECG 78 HR	Regular	36 (90.0%)	37 (92.5%)	0.692
	Irregular	4 (10.0%)	3 (7.5%)	
ECG 84 HR	Regular	37 (92.5%)	37 (92.5%)	1.000
	Irregular	3 (7.5%)	3 (7.5%)	
ECG 90 HR	Regular	37 (92.5%)	38 (95.0%)	0.644
	Irregular	3 (7.5%)	2 (5.0%)	

5.2 Respiratory status

5.2.1 Dyspnea

Table 8: Respiratory Status Dyspnea

Variable	Normal/ Present	IS Group n (%)	Control Group n (%)	P Value
DYSPNEA PRE	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
DYSPNEA POST	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
DYSPNEA 6 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
DYSPNEA 12 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
DYSPNEA 18 HR	Normal	39 (97.5%)	39 (97.5%)	> 0.999
	Present	1 (2.5%)	1 (2.5%)	
DYSPNEA 24 HR	Normal	33 (82.5%)	24 (61.5%)	0.038*
	Present	7 (17.5%)	15 (38.5%)	
DYSPNEA 30 HR	Normal	33 (82.5%)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5%)	
DYSPNEA 36 HR	Normal	33 (82.5%)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5%)	
DYSPNEA 42 HR	Normal	33 (82.5%)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5%)	
DYSPNEA 48 HR	Normal	31(77.5 %)	24 (60.0%)	0.091
	Present	9 (22.5%)	16 (40.0%)	
DYSPNEA 54 HR	Normal	31(77.5 %)	25 (62.5%)	0.143
	Present	9 (22.5%)	15 (37.5%)	
DYSPNEA 60 HR	Normal	31(77.5 %)	25 (62.5%)	0.143
	Present	9 (22.5%)	15 (37.5%)	
DYSPNEA 66 HR	Normal	31(77.5 %)	25 (62.5%)	0.143
	Present	9 (22.5%)	15 (37.5%)	
DYSPNEA 72 HR	Normal	38 (95.0%)	36 (90.0%)	0.396
	Present	2 (5.0%)	4 (10.0%)	
DYSPNEA 78 HR	Normal	38 (95.0%)	36 (90.0%)	0.396
	Present	2 (5.0%)	4 (10.0%)	
DYSPNEA 84 HR	Normal	38 (95.0%)	36 (90.0%)	0.396
	Present	2 (5.0%)	4 (10.0%)	
DYSPNEA 90 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	

Table 8 above shows the dyspnea among the IS Group and the Control Group and as shows there were no statistically significant differences between the two groups preoperatively, postoperatively and 18 hr post-op. On the other hand, the table shows significant differences between the groups (P value = 0.045) at 30, 24, 30, 36, 42 hours postoperatively, when dyspnea was twofold greater in the Control Group than in the IS Group, while the following hours show no significant differences between the groups.

5.2.2 Cough

Table 9 below shows there were statistically significant differences between the two groups at 60 and 66 hours postoperatively with 7 clients in IS group and 15 clients in the Control Group with (P value = 0.045), On the other hand, at 24,30,36,42,48 and 54 hours it shows a margin of statistical significance between the groups with (P value = 0.075, 0.075, 0.075, 0.075, 0.051 and 0.084), respectively. Along with other hours there are no statistically significant differences. (Table 9).

Table 9: Respiratory Status Cough

Variable	Normal/ Present	IS Group n (%)	Control Group n (%)	P Value
COUGH PRE	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
COUGH POST	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
COUGH 6 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
COUGH 12 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
COUGH 18 HR	Normal	38 (95.0%)	38 (95.0%)	1.000
	Present	2 (5.0%)	2 (5.0%)	
COUGH 24 HR	Normal	33 (82.5%)	26 (65.0%)	0.075
	Present	7 (17.5%)	14 (35.0%)	
COUGH 30 HR	Normal	33 (82.5%)	26 (65.0%)	0.075
	Present	7 (17.5%)	14 (35.0%)	
COUGH 36 HR	Normal	33 (82.5%)	26 (65.0%)	0.075
	Present	7 (17.5%)	14 (35.0%)	
COUGH 42 HR	Normal	33 (82.5%)	26 (65.0%)	0.075
	Present	7 (17.5%)	14 (35.0%)	
COUGH 48 HR	Normal	32(80.0 %)	24 (60.0%)	0.051
	Present	8 (20.0%)	16 (40.0%)	
COUGH 54 HR	Normal	32(80.0 %)	25 (62.5%)	0.084
	Present	8 (20.0%)	15 (37.5%)	
COUGH 60 HR	Normal	33(82.5 %)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5%)	
COUGH 66 HR	Normal	33(82.5 %)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5%)	
COUGH 72 HR	Normal	38 (95.0%)	36 (90.0%)	0.396
	Present	2 (5.0%)	4 (10.0%)	
COUGH 78 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
COUGH 84 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
COUGH 90 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	

5.2.3 Crackles

Table 10 below shows there were statistically significant differences between the two groups at 60 and 66 hours postoperatively with 7 clients in the IS group and 15 clients in the control group with (P value = 0.045). On the other hand at 24,30,36,42,48 and 54 hours the margin of statistical

significance between the groups is shown with (P value = 0.075, 0.075, 0.075, 0.075, 0.051 and 0.084), respectively. Along with other hours there are no statistically significant differences. (Table 10)

Table 10: Respiratory Status Crackles

Variable	Normal/ Present	IS Group n (%)	Control Group n (%)	P Value
CRACKLES PRE	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
CRACKLES POST	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
CRACKLES 6 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
CRACKLES 12 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
CRACKLES 18 HR	Normal	40 (100.0%)	39 (97.5%)	0.314
	Present	0 (0.0%)	1 (2.5%)	
CRACKLES 24 HR	Normal	33 (82.5%)	26 (65.0%)	0.075
	Present	7 (17.5%)	14 (35.0%)	
CRACKLES 30 HR	Normal	33 (82.5%)	26 (65.0%)	0.075
	Present	7 (17.5%)	14 (35.0%)	
CRACKLES 36 HR	Normal	33 (82.5%)	26 (65.0%)	0.075
	Present	7 (17.5%)	14 (35.0%)	
CRACKLES 42 HR	Normal	33 (82.5%)	26 (65.0%)	0.075
	Present	7 (17.5%)	14 (35.0%)	
CRACKLES 48 HR	Normal	32(80.0 %)	24 (60.0%)	0.051
	Present	8 (20.0%)	16 (40.0%)	
CRACKLES 54 HR	Normal	32(80.0 %)	25 (62.5%)	0.084
	Present	8 (20.0%)	15 (37.5%)	
CRACKLES 60 HR	Normal	33(82.5 %)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5%)	
CRACKLES 66 HR	Normal	33(82.5 %)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5%)	
CRACKLES 72 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
CRACKLES 78 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
CRACKLES 84 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
CRACKLES 90 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	

5.2.4 Sweating

Table 11 below shows there were statistically significant differences regarding sweating between the IS Group and the Control Group at 24,30,36 and 42 hours postoperatively, with 6 clients in the IS Group and 15 clients in the Control Group with (P value = 0.022). On the other hand, the other hours show no statistically significant differences. (Table 11)

Table 11: Respiratory Status Sweating

Variable	Normal/ Present	IS Group n (%)	Control Group n (%)	P Value
SWEATING PRE	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
SWEATING POST	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
SWEATING 6 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
SWEATING 12 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
SWEATING 18 HR	Normal	40 (100.0%)	39 (97.5%)	0.314
	Present	0 (0.0%)	1 (2.5%)	
SWEATING 24 HR	Normal	34 (85.0%)	25 (62.5%)	0.022*
	Present	6 (15.0%)	15 (37.5 %)	
SWEATING 30 HR	Normal	34 (85.0%)	25 (62.5%)	0.022*
	Present	6 (15.0%)	15 (37.5 %)	
SWEATING 36 HR	Normal	34 (85.0%)	25 (62.5%)	0.022*
	Present	6 (15.0%)	15 (37.5 %)	
SWEATING 42 HR	Normal	34 (85.0%)	25 (62.5%)	0.022*
	Present	6 (15.0%)	15 (37.5 %)	
SWEATING 48 HR	Normal	31(77.5 %)	23 (57.5%)	0.056
	Present	9 (22.5%)	17 (42.5%)	
SWEATING 54 HR	Normal	31(77.5 %)	24 (60.0%)	0.091
	Present	9 (22.5%)	16 (40.0%)	
SWEATING 60 HR	Normal	31(77.5 %)	24 (60.0%)	0.091
	Present	9 (22.5%)	16 (40.0%)	
SWEATING 66 HR	Normal	31(77.5 %)	24 (60.0%)	0.091
	Present	9 (22.5%)	16 (40.0%)	
SWEATING 72 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
SWEATING 78 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
SWEATING 84 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
SWEATING 90 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	

5.2.5 Use of accessory muscles

Table 12 below shows the use of accessory muscles between the IS Group and the Control Group and there were statistically significant differences between the two groups at 24, 30, 36, 42 and 48 hours postoperatively with 7 clients in the IS Group and 15 clients in the Control Group with (P value = 0.045, 0.045, 0.045, 0.045 and 0017), respectively, On the other hand, the other hours show no statistically significant differences. (Table 12)

Table 12: Respiratory Status , USE ACCESSORY MUSCLE

Variable	Normal/ Present	IS Group n (%)	Control Group n (%)	P Value
USE ACCESSORY MUSCLE PRE	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
USE ACCESSORY MUSCLE POST	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
USE ACCESSORY MUSCLE 6 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
USE ACCESSORY MUSCLE 12 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
USE ACCESSORY MUSCLE 18 HR	Normal	39 (97.5%)	39 (97.5%)	1.000
	Present	1 (2.5%)	1 (2.5%)	
USE ACCESSORY MUSCLE 24 HR	Normal	33 (82.5%)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5 %)	
USE ACCESSORY MUSCLE 30 HR	Normal	33 (82.5%)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5 %)	
USE ACCESSORY MUSCLE 36 HR	Normal	33 (82.5%)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5 %)	
USE ACCESSORY MUSCLE 42 HR	Normal	33 (82.5%)	25 (62.5%)	0.045*
	Present	7 (17.5%)	15 (37.5 %)	
USE ACCESSORY MUSCLE 48 HR	Normal	32 (80.0%)	22 (55.0%)	0.017*
	Present	8 (20.0%)	18 (45.0%)	
USE ACCESSORY MUSCLE 54 HR	Normal	31(77.5 %)	24 (60.0%)	0.091
	Present	9 (22.5%)	16 (40.0%)	
USE ACCESSORY MUSCLE 60 HR	Normal	31(77.5 %)	24 (60.0%)	0.091
	Present	9 (22.5%)	16 (40.0%)	
USE ACCESSORY MUSCLE 66 HR	Normal	31(77.5 %)	24 (60.0%)	0.091
	Present	9 (22.5%)	16 (40.0%)	
USE ACCESSORY MUSCLE 72 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	

USE MUSCLE	ACCESSORY 78 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
		Present	1 (2.5%)	4 (10.0%)	
USE MUSCLE	ACCESSORY 84 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
		Present	1 (2.5%)	4 (10.0%)	
USE MUSCLE	ACCESSORY 90 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
		Present	1 (2.5%)	4 (10.0%)	

Table 13: Respiratory Status , DIMINISHED AIR ENTRY

Variable	Normal/ Present	IS Group n (%)	Control Group n (%)	P Value
DIMINISHED AIR ENTRY PRE	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
DIMINISHED AIR ENTRY POST	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
DIMINISHED AIR ENTRY 6HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
DIMINISHED AIR ENTRY 12 HR	Normal	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	
DIMINISHED AIR ENTRY 18 HR	Normal	39 (97.5%)	39 (97.5%)	1.000
	Present	1 (2.5%)	1 (2.5%)	
DIMINISHED AIR ENTRY 24 HR	Normal	34 (85.0%)	25 (62.5%)	0.022
	Present	6 (15.0%)	15 (37.5 %)	
DIMINISHED AIR ENTRY 30 HR	Normal	34 (85.0%)	25 (62.5%)	0.022
	Present	6 (15.0%)	15 (37.5 %)	
DIMINISHED AIR ENTRY 36 HR	Normal	34 (85.0%)	25 (62.5%)	0.022
	Present	6 (15.0%)	15 (37.5 %)	
DIMINISHED AIR ENTRY 42 HR	Normal	34 (85.0%)	25 (62.5%)	0.022
	Present	6 (15.0%)	15 (37.5 %)	
DIMINISHED AIR ENTRY 48 HR	Normal	31(77.5 %)	23 (57.5%)	0.056
	Present	9 (22.5%)	17 (42.5%)	
DIMINISHED AIR ENTRY 54 HR	Normal	32(80.0 %)	24 (60.0%)	0.051
	Present	8 (20.0%)	16 (40.0%)	
DIMINISHED AIR ENTRY 60 HR	Normal	32(80.0 %)	24 (60.0%)	0.051
	Present	8 (20.0%)	16 (40.0%)	
DIMINISHED AIR ENTRY 66 HR	Normal	32(80.0 %)	24 (60.0%)	0.051
	Present	8 (20.0%)	16 (40.0%)	
DIMINISHED AIR ENTRY 72 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
DIMINISHED AIR ENTRY 78 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
DIMINISHED AIR ENTRY 84 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	
DIMINISHED AIR ENTRY 90 HR	Normal	39 (97.5%)	36 (90.0%)	0.166
	Present	1 (2.5%)	4 (10.0%)	

5.2.6 Diminished air entry

Table 13 above shows the diminished air entry between the IS Group and the Control Group and there were statistically significant differences between the two groups at 24, 30, 36 and 42 hours postoperatively with 6 clients in the IS Group and 15 clients in the control group with (P value = 0.022). On the other hand, 48, 54, 60 and 66 hours show the margin of statistical significance between the groups, with 8 clients in the IS Group and 16 clients in the Control Group with (P value = 0.056, 0.051, 0.051 and 0.051), respectively. Along with other hours show no statistically significant differences. (Table 13)

5.3 Respiratory complications

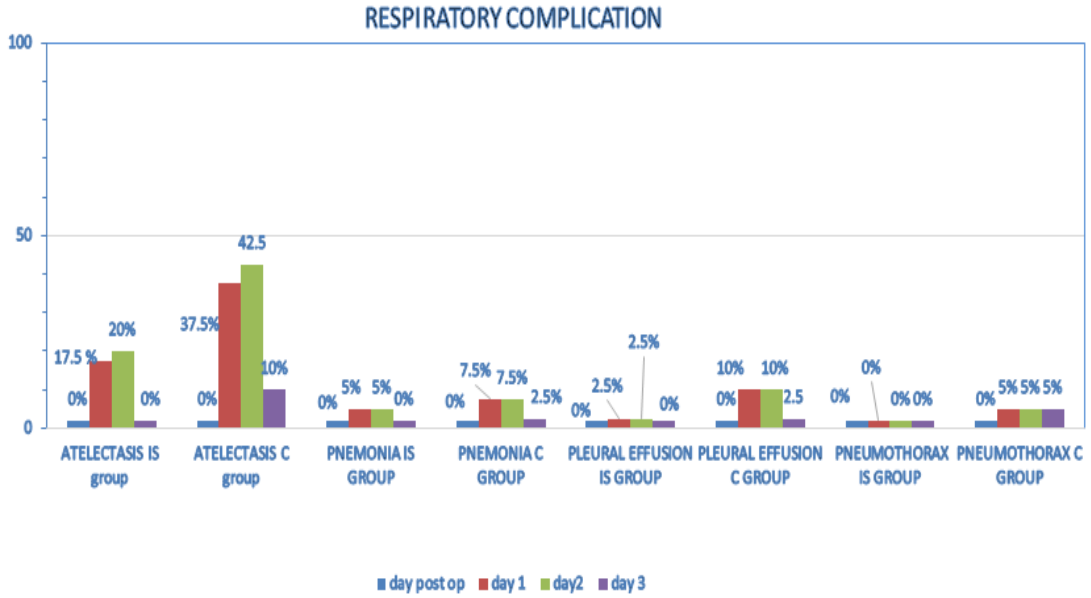


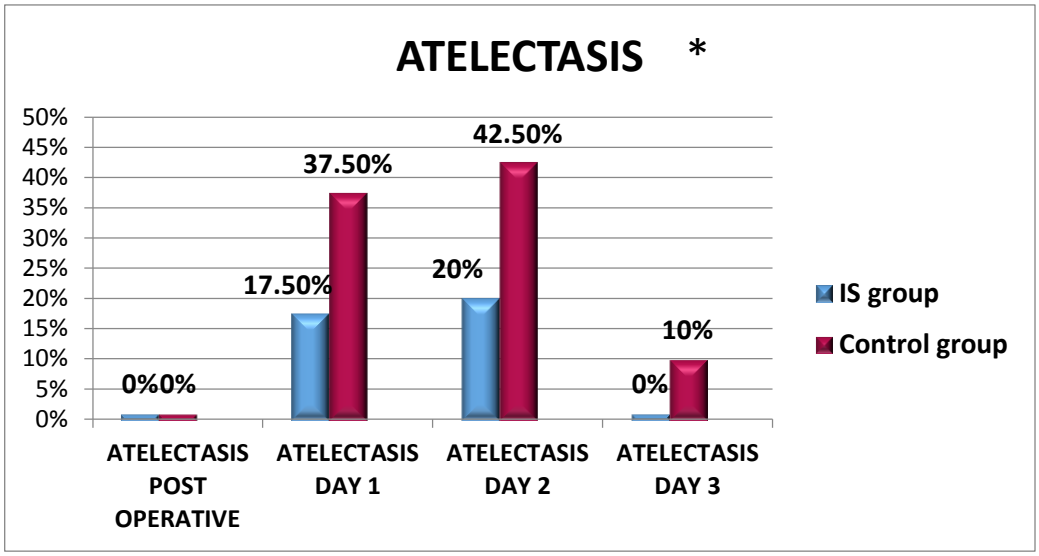
Figure 6. The percentage of respiratory complications (atelectasis, pneumonia, pleural effusion and pneumothorax), in the IS and control groups.

5.3.1 Atelectasis

Table 14 below shows the respiratory complication of atelectasis among the IS Group and the Control Group. On operation day there is no atelectasis diagnosed in either group. On the first day, of 22 patients with atelectasis, 7 were in the IS Group and 15 in the Control Group, ~~as~~ showing statistically significant differences with (P value = 0.045). On the next day the number of patients in the Control Group with atelectasis was 17, and in the IS group it was 8, with statistically significant differences (P value = 0.030). Further, the third day shows 4 clients with atelectasis in the Control Group and zero patients in the IS group, with statistically significant differences with (P value = 0.040). (Table 14) and (Figure 7).

Table 14: RESPIRATORY COMPLICATION, ATELECTASIS

Variable	Normal/ Present	Total n (%)	IS Group n (%)	Control Group n (%)	P Value
ATELECTASIS POST OPERATIVE	Normal	80 (100%)	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	0 (0.0%)	
ATELECTASIS DAY 1	Normal	58 (72.5%)	33 (82.5%)	25 (62.5%)	0.045*
	Present	22 (27.5%)	7 (17.5%)	15 (37.5 %)	
ATELECTASIS DAY 2	Normal	55 (68.8%)	32 (80.0%)	23 (57.5%)	0.030*
	Present	25 (31.3%)	8 (20.0%)	17 (42.5 %)	
ATELECTASIS DAY 3	Normal	76 (95.0%)	40 (100.0%)	36 (90.0%)	0.040*
	Present	4(5.0%)	0 (0.0%)	4 (10.0%)	



***: indicate p value of ≤ 0.05**

Figure 7. Percentage rate of atelectasis occurrence among IS and control groups.

5.3.2 Pneumonia

Table 15 and Figure 8 below show the respiratory complication pneumonia among the IS Group and the Control Group. On the day of surgery, no pneumonia was diagnosed in either group. The following next 3 days there were no statistically significant differences between the groups. However, the incidence of pneumonia in the Control Group was three clients on the first and second day with one client on the third day. In contrast, in the IS Group there were two clients on days one and two, with no pneumonia on day three. (Table 15)

Table 15: RESPIRATORY COMPLICATION, PNEUMONIA

Variable	Normal/ Present	Total n (%)	IS Group n (%)	Control Group n (%)	P Value
PNEUMONIA POST OPERATIVE	Normal	80 (100%)	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	0 (0.0%)	
PNEUMONIA DAY 1	Normal	75 (93.8%)	38 (95.0%)	37 (92.5%)	0.644
	Present	5 (6.3%)	2 (5.0%)	3 (7.5%)	
PNEUMONIA DAY 2	Normal	74 (92.5%)	38 (95.0%)	37 (92.5%)	0.644
	Present	6 (7.5%)	2 (5.0%)	3 (7.5%)	
PNEUMONIA DAY 3	Normal	79 (98.8%)	40 (100%)	39 (97.5%)	0.314
	Present	1(1.3%)	0 (0.0%)	1 (2.5%)	

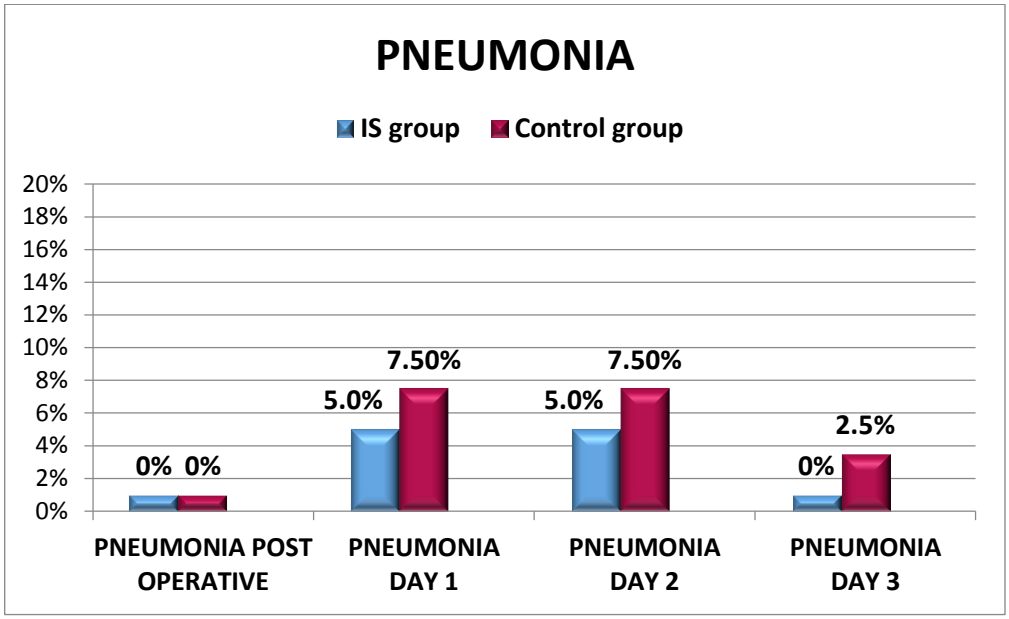


Figure 8. Percentage rate of pneumonia occurrence among IS and control groups**.**

5.3.3 Pleural effusion

Table 16 below shows the respiratory complication pleural effusion among the IS Group and the Control Group. On operation day there was no pleural effusion diagnosed in either group. The following next 3 days there were no statistically significant differences between the groups. However, the

incidence of pleural effusion in the Control Group was four patients on the first and second day, with one client on the third day. In contrast, in the IS Group there was one client on day 1, two clients on day 2 and no clients with pleural effusion on day 3. (Table 16).

Table 16: RESPIRATORY COMPLICATION, PLEURAL EFFUSION

Variable	Normal/ Present	Total n (%)	IS Group n (%)	Control Group n (%)	P Value
PLEURAL EFFUSION POST OPERATIVE	Normal	80 (100%)	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	0 (0.0%)	
PLEURAL EFFUSION DAY 1	Normal	75 (93.8%)	39 (97.5%)	36 (90.0%)	0.396
	Present	5 (6.3%)	1 (2.5%)	4 (10.0%)	
PLEURAL EFFUSION DAY 2	Normal	74 (92.5%)	39 (97.5%)	36 (90.0%)	0.396
	Present	6 (7.5%)	1 (2.5%)	4 (10.0%)	
PLEURAL EFFUSION DAY 3	Normal	79 (98.8%)	40 (100%)	39 (97.5%)	0.314
	Present	1(1.3%)	0 (0.0%)	1 (2.5%)	

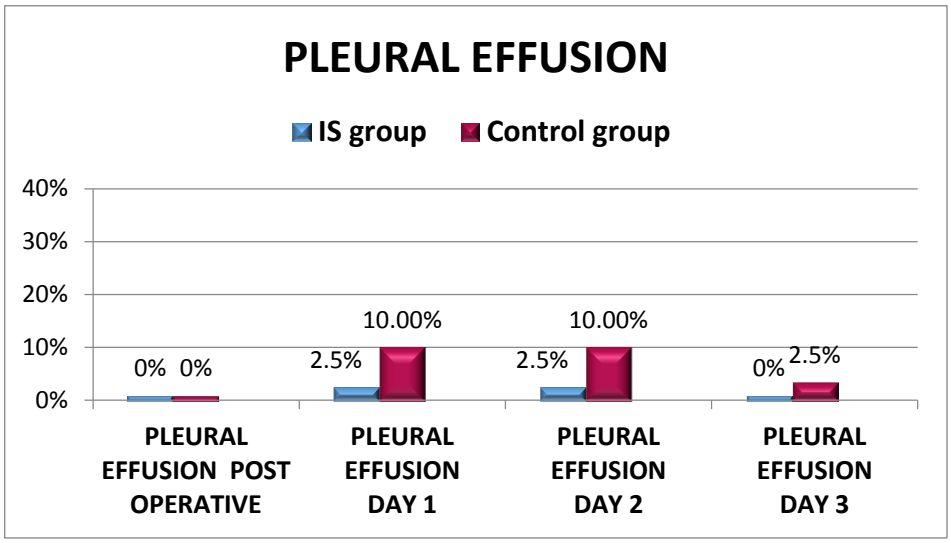


Figure 9, Percentage rate of pleural effusion occurrence among IS and control groups**.**

5.3.4 Pneumothorax

Table 17 below shows the respiratory complication pneumothorax among the IS Group and the Control Group. On operation day there was no pneumothorax diagnosed in either group. The following next 3 days there were no statistically significant differences between the groups. However, the incidence of pneumothorax in the Control Group was two clients. In contrast, no pneumothorax was diagnosed in the IS Group. (Table 17)

Table 17: RESPIRATORY COMPLICATION, PNEUMOTHORAX

Variable	Normal/ Present	Total n (%)	IS Group n (%)	Control Group n (%)	P Value
PNEUMOTHORAX POST OPERATIVE	Normal	80 (100%)	40 (100%)	40 (100%)	> 0.999
	Present	0 (0.0%)	0 (0.0%)	0 (0.0%)	
PNEUMOTHORAX DAY 1	Normal	78 (97.5%)	40 (100%)	38 (95.0%)	0.152
	Present	2(1.3%)	0 (0.0%)	2 (5.0%)	
PNEUMOTHORAX DAY 2	Normal	78 (97.5%)	40 (100%)	38 (95.0%)	0.152
	Present	2(1.3%)	0 (0.0%)	2 (5.0%)	
PNEUMOTHORAX DAY 3	Normal	78 (97.5%)	40 (100%)	38 (95.0%)	0.152
	Present	2(1.3%)	0 (0.0%)	2 (5.0%)	

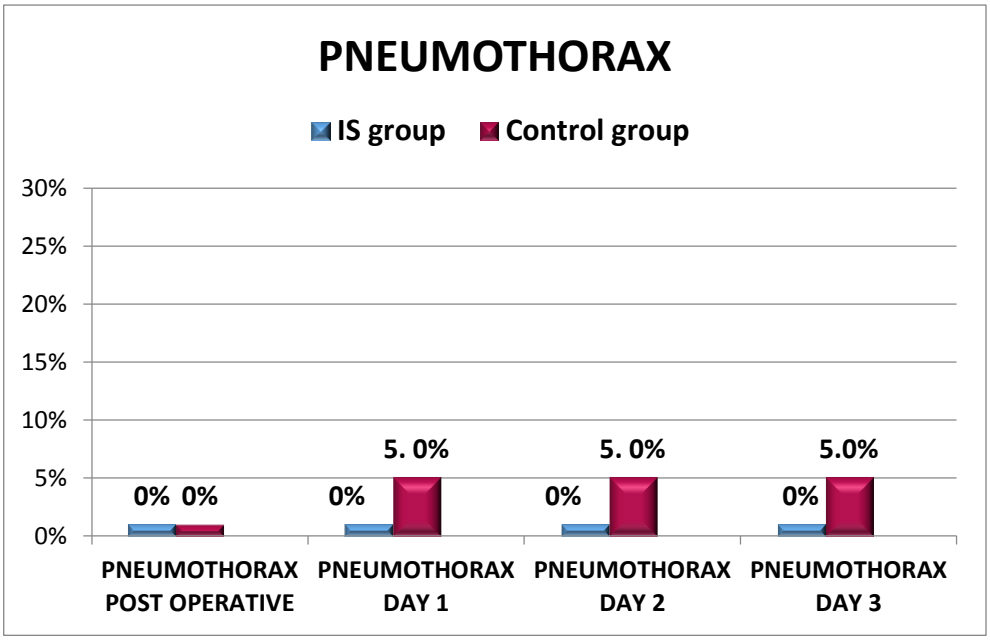


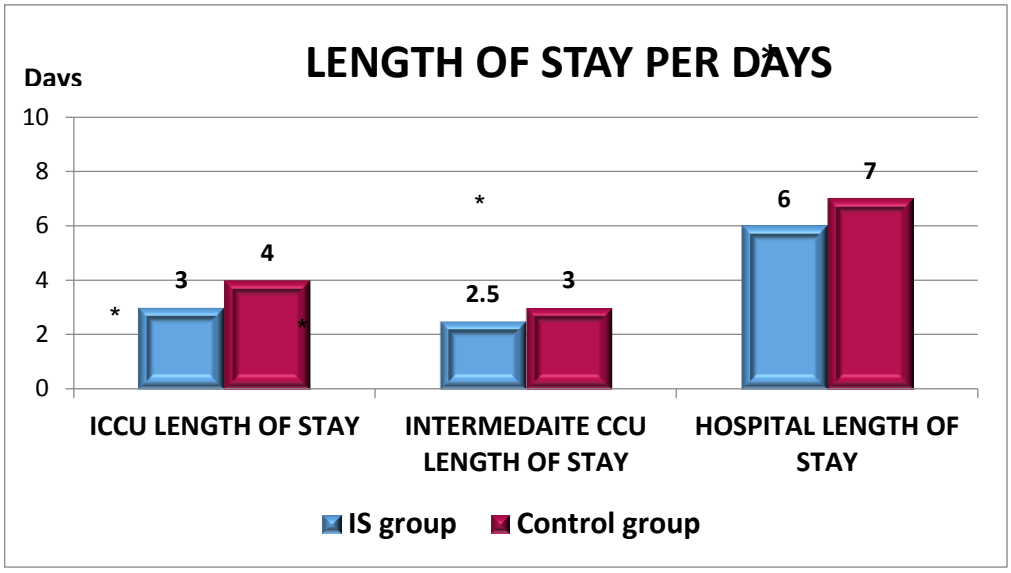
Figure 10. Percentage rate of pneumothorax occurrence among IS and control groups**.**

5.4 Length of stay

Table 18 and Figure 11 below show that there are significant differences between the IS Group and the Control Group in length of stay in the intensive cardiac care unit (ICCU), intermediate cardiac care unit(IMCCU) and hospital until discharge with (P value = < 0.001). The IS Group average was 3 days in ICCU, two and half days in IMCCU. Whereas, the Control Group average was 4 days in ICCU and 3 days in IMCCU.

Table 18: LENGTH OF STAY

Variable	Total Median [Q1-Q3]	IS Group Median [Q1-Q3]	Control Median [Q1-Q3]	P Value
ICCU LENGTH OF STAY	3 [3-4]	3 [3-3]	4 [4-4]	< 0.001*
INTERMEDAITE CCU LENGTH OF STAY	3 [2-3]	2.5 [2-3]	3 [3-4]	< 0.001*
HOSPITAL LENGTH OF STAY	6 [6-7]	6 [5-6]	7 [6-8]	< 0.001*



***: indicate p value of ≤ 0.05**

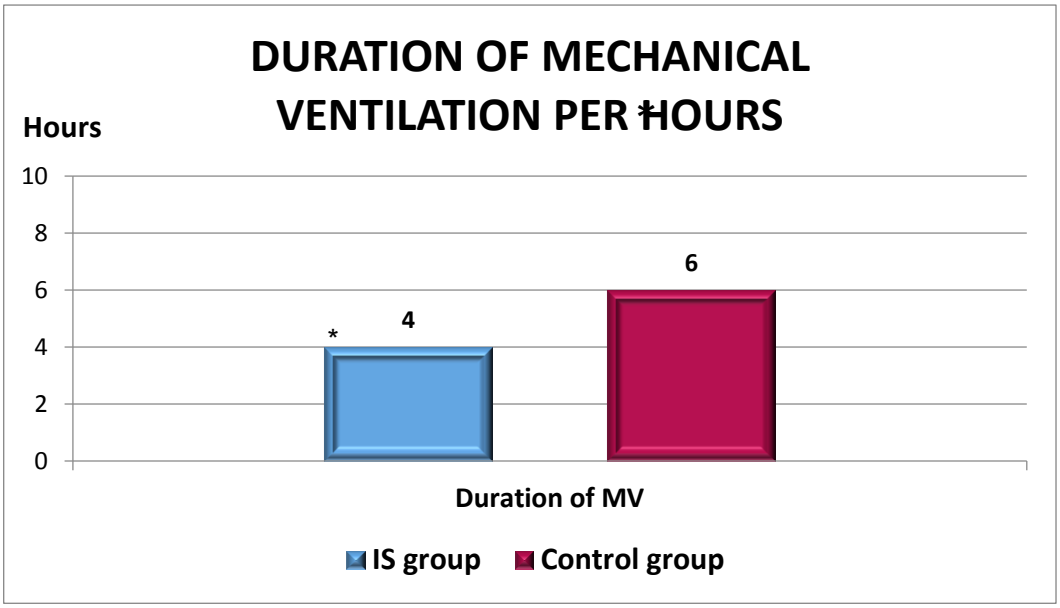
Figure 11. Graphical comparison of median length of stay at hospital per days between IS and control groups**.**

5.5 Duration of mechanical ventilation

Table 19 and Figure 12 below show that there are significant differences between the IS Group and the Control Group in the duration of time spent in mechanical ventilation in the intensive cardiac care unit (ICCU). Patients in the IS Group spent 4 hours, while patients in the Control Group spent 6 hours with (P-value = <0.001). The median hours spent was 5 hours.

Table 19: DURATION OF MECHANICAL VENTILATION

Variable	Total Median [Q1-Q3]	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
DURATION OF MECHANICAL VENTILATION PER HOURS	5 [4-6]	4 [4-6]	6 [5-7]	< 0.001*



***: indicate p value of ≤ 0.05**

Figure 12. Graphical comparison of median duration of mechanical ventilation per hours between IS and control groups**.**

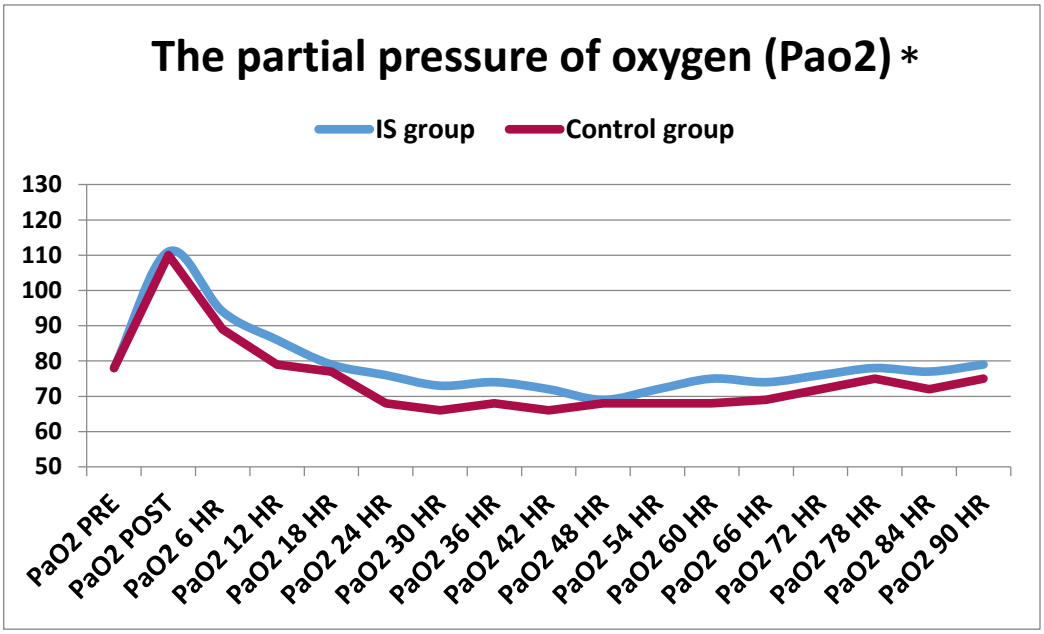
5.6 Oxygenation

5.6.1 The partial pressure of oxygen (Pao2)

Table 20 and Figure 13 below show that there were significant differences between the IS Group and the Control Group in the partial pressure of oxygen (Pao2), with obvious improvement in Pao2 in the IS Group, as shown in the P Value from 6 hr–90 hr. On the other hand, there were no significant differences between the groups pre and postoperatively with (P-value = 0.900 and 0.149), respectively.

Table 20: OXYGENATION The partial pressure of oxygen (Pao2)

Variable	Total Median [Q1-Q3]	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
PaO2 PRE	82 [78 -89]	78 [71 -82]	78 [74- 82]	0. 900
PaO2 POST	124 [110 -140]	111 [105- 132]	110 [108- 121]	0.149
PaO2 6 HR	100 [90-109]	94 [82- 105]	89 [79- 99]	0.027*
PaO2 12 HR	89 [80 - 92]	86 [79- 91]	79 [76-83]	<0.001**
PaO2 18 HR	83 [77 - 92]	79 [69-85]	77 [75- 82]	0.083
PaO2 24 HR	79 [69 -87]	76 [65- 82]	68 [65- 76]	0.006*
PaO2 30 HR	79 [68 -84]	73 [62- 82]	66 [62- 75]	0.007*
PaO2 36 HR	77 [68 -82]	74 [65- 79]	68 [65- 69]	0.005*
PaO2 42 HR	76 [68 -81]	72 [68- 79]	66 [62- 70]	0.004*
PaO2 48 HR	74 [69 -81]	69 [68- 79]	68 [65- 72]	0.003*
PaO2 54 HR	74 [70 -81]	72 [69- 77]	68 [66- 72]	0.004*
PaO2 60 HR	75 [69 -82]	75 [68- 81]	68 [65- 70]	< 0.001*
PaO2 66 HR	75 [71 -82]	74 [70- 79]	69 [69- 72]	0.001*
PaO2 72 HR	77 [74 -83]	76 [72- 79]	72 [69- 75]	0.003*
PaO2 78 HR	79 [76 -83]	78 [75- 80]	75 [70- 77]	0.007*
PaO2 84 HR	79 [74 -85]	77 [72- 80]	72 [70- 77]	0.030*
PaO2 90 HR	82 [77 -77]	79 [72- 82]	75 [72- 79]	0.047*



***: indicate p value of ≤ 0.05**

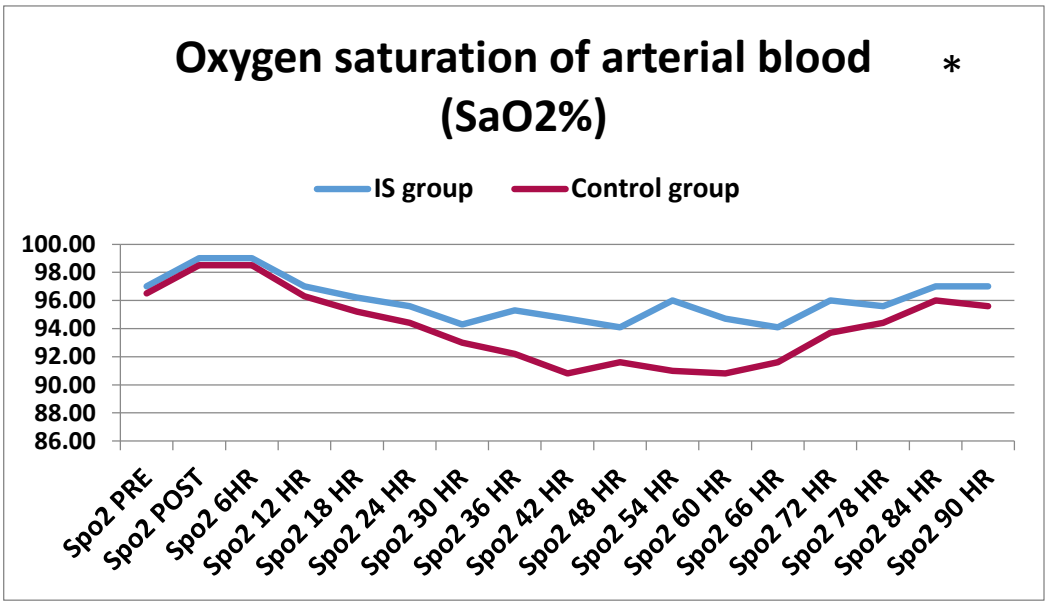
Figure 13. Graphical comparison of median the partial pressure of oxygen (Pao2) between IS and control groups**.**

5.6.2 Oxygen saturation of arterial blood (SaO2%)

Table 21 and Figure 14 below show that there are significant differences between the IS Group and the Control Group in the oxygen saturation of arterial blood (Sao2) with obvious differences, as shown in the P Value in all postoperative measurement times. On the other hand, there were no significant differences between the groups preoperatively with (p- value = 0.335).

Table 21: oxygen saturation of arterial blood (SaO2%)

Variable	Total Median [Q1-Q3]	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
SaO2 PRE	97.6 [96.8 - 98.9]	97.0 [95.5 - 97.7]	96.5 [96.0- 97.6]	0.335
SaO2 POST	99.2 [98.9 - 99.8]	99.0 [99.7- 99.9]	98.5 [98.0-99.0]	< 0.001*
SaO2 6 HR	99.2 [98.9 - 99.8]	99.0 [99.7- 99.9]	98.5 [98.0-99.0]	< 0.001*
SaO2 12 HR	97.0 [96.5 - 97.7]	97.0 [96.3- 97.4]	96.3 [95.1-96.5]	< 0.001*
SaO2 18 HR	96.7 [96.0 - 97.6]	96.2 [94.0-97.2]	95.2 [94.0- 96.5]	0.071
SaO2 24 HR	96.5 [95.0 - 97.6]	95.6 [94.3- 96.8]	94.4 [92.0- 96.0]	0.013*
SaO2 30 HR	95.7 [93.2 - 97.3]	94.3 [93.0- 96.4]	93.0 [90.2- 96.0]	0.022*
SaO2 36 HR	95.5 [93.0 - 96.8]	95.3 [91.0- 96.4]	92.2 [87.6- 94.1]	0.002*
SaO2 42 HR	96.1 [93.3 - 97.4]	94.7 [92.3- 96.9]	90.8 [88.0- 94.0]	0.008*
SaO2 48 HR	96.3 [92.3 - 97.5]	94.1 [91.1- 96.4]	91.6 [88.4- 94.4]	0.005*
SaO2 54 HR	96.1 [93.0 - 97.3]	96.0 [91.3- 96.8]	91.0 [88.5- 95.0]	0.001*
SaO2 60 HR	96.1 [93.3 - 97.4]	94.7 [92.3- 96.9]	90.8 [88.0- 94.0]	0.008*
SaO2 66 HR	96.3 [92.3 - 97.5]	94.1 [91.1- 96.4]	91.6 [88.4- 94.4]	0.005*
SaO2 72 HR	96.5 [94.6 - 97.5]	96.0 [93.0- 97.0]	93.7 [92.0- 95.8]	0.033*
SaO2 78 HR	96.5 [95.0 - 97.6]	95.6 [94.3- 96.8]	94.4 [92.0- 96.0]	0.013*
SaO2 84 HR	97.0 [96.0 - 97.7]	97.0 [95.5- 97.5]	96.0 [93.4- 96.5]	< 0.001*
SaO2 90 HR	97.0 [96.5 - 98.0]	97.0 [96.0- 98.0]	95.6 [94.0- 97.0]	0.001*



***: indicate p value of ≤ 0.05**

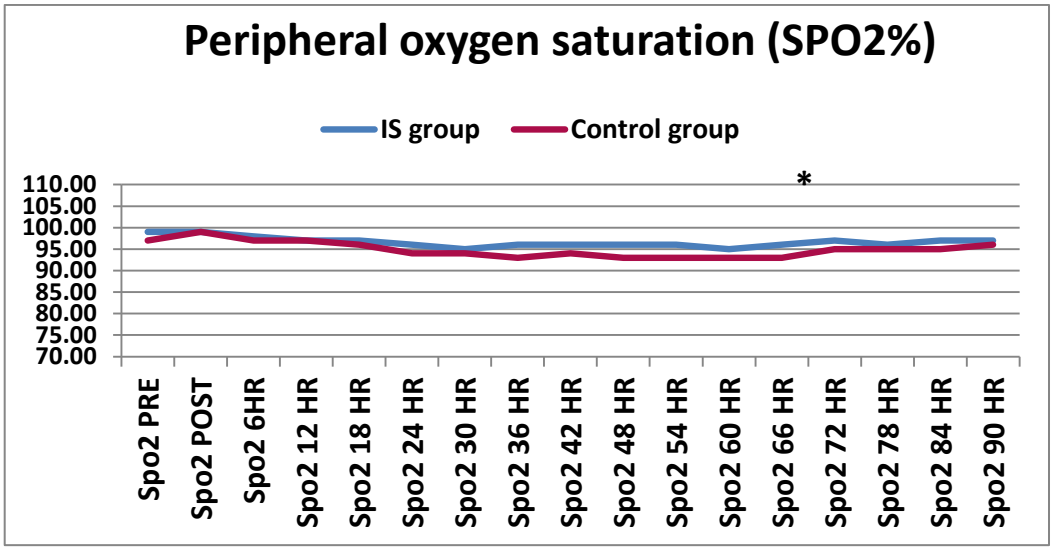
Figure 14. Graphical comparison of median oxygen saturation of arterial blood (SaO2%) among IS and control groups**.**

5.6.3 Peripheral oxygen saturation (SPO2%)

Table 22 and Figure 15 below show that there are significant differences between the IS Group and the Control Group in peripheral oxygen saturation measured with pulse oximetry (SPo2), with obvious differences, as shown in P Value.

Table 22: peripheral oxygen saturation (SPO2%)

Variable	Total Median [Q1-Q3]	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
Spo2 PRE	99 [98- 99]	99 [98- 99]	97 [97- 99]	0.005
Spo2 POST	99 [99- 100]	99 [99- 100]	99 [98- 99]	<0.001*
Spo2 6HR	99 [98- 99]	98 [97- 99]	97 [97- 98]	0.002*
Spo2 12 HR	98 [97- 98]	97 [96- 98]	97 [97- 97]	0.001*
Spo2 18 HR	97 [97- 98]	97 [95- 97]	96 [96- 97]	0.041*
Spo2 24 HR	97 [95- 97]	96 [93- 97]	94 [92- 97]	0.070
Spo2 30 HR	96 [95- 98]	95 [94- 97]	94 [92- 95]	0.005*
Spo2 36 HR	97 [95- 97]	96 [94- 97]	93 [90- 95]	<0.001*
Spo2 42 HR	97 [95- 97]	96 [94- 97]	94 [90- 96]	<0.001*
Spo2 48 HR	97 [95- 98]	96 [95- 97]	93 [91- 95]	<0.001*
Spo2 54 HR	96 [94- 97]	96 [94- 97]	93 [90- 95]	<0.001*
Spo2 60 HR	97 [94- 97]	95 [94- 97]	93 [90- 95]	<0.001*
Spo2 66 HR	96 [94- 98]	96 [93- 97]	93 [89- 95]	0.001*
Spo2 72 HR	97 [95- 98]	97 [95- 97]	95 [92- 96]	<0.001*
Spo2 78 HR	97 [96- 98]	96 [96- 97]	95 [94- 96]	0.002*
Spo2 84 HR	97 [96- 98]	97 [95- 98]	95 [94- 96]	<0.001*
Spo2 90 HR	97 [97- 98]	97 [96- 98]	96 [95- 98]	<0.001*



***: indicate p value of ≤ 0.05**

Figure 15. Graphical comparison of median peripheral oxygen saturation (SPO2%) between IS and control groups**.**

5.6.4 The partial pressure of carbon dioxide (PaCO2)

Table 23 below shows that there were no significant differences between the IS Group and the Control Group in the partial pressure of carbon dioxide (PaCO2) pre- and postoperatively between groups, except immediately post-op p=0.039.

Table 23: The partial pressure of carbon dioxide (PaCO2)

Variable	Total Median [Q1-Q3]	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
PaCO2 PRE	37.8 [36.5- 39.3]	37.8 [36.5- 39.4]	37.8 [36.7- 38.9]	0.732
PaCO2 POST	36.0 [34.0- 36.9]	35.4 [33.1- 36.3]	36.4 [34.2- 36.9]	0.039*
PaCO2 6HR POST	36.3 [34.6- 37.0]	36.1 [34.3- 37.0]	36.4 [34.4- 37.0]	0.473
PaCO2 12 HR	36.4 [36.0- 37.4]	36.0 [36.0- 37.4]	36.4 [36.0- 37.4]	0.866
PaCO2 18 HR	36.7 [35.9- 37.7]	36.7 [35.4- 37.8]	36.5 [36.0- 37.7]	0.817
PaCO2 24 HR	36.4 [35.0- 37.5]	36.3 [35.0- 37.4]	36.4 [32.1- 37.5]	0.942
PaCO2 30 HR	36.7 [35.4- 37.8]	36.4 [36.0- 37.8]	37.0 [34.2- 37.8]	0.780
PaCO2 36 HR	36.9 [36.0- 38.3]	37.0 [36.0- 38.0]	36.8 [34.7- 38.3]	0.973
PaCO2 42 HR	37.4 [36.0- 38.4]	37.3 [36.3- 38.0]	37.4 [35.0- 38.4]	0.988
PaCO2 48 HR	37.4 [35.2- 38.3]	37.5 [36.0- 38.0]	37.7 [35.0- 38.3]	0.360
PaCO2 54 HR	37.5 [35.4- 39.0]	38.0 [36.3- 39.0]	37.1 [34.0- 39.0]	0.268
PaCO2 60 HR	36.9 [36.0- 38.5]	37.3 [36.0- 38.9]	36.5 [35.4- 38.5]	0.435
PaCO2 66 HR	37.4 [36.0- 38.7]	37.7 [36.7- 38.9]	37.2 [35.5- 38.7]	0.131
PaCO2 72 HR	37.5 [36.5- 39.0]	37.8 [37.0- 39.0]	37.5 [36.4- 39.0]	0.230
PaCO2 78 HR	37.6 [36.5- 38.8]	38.0 [36.9- 39.0]	37.4 [36.4- 38.8]	0.177
PaCO2 84 HR	38.0 [36.8- 39.2]	38.0 [36.8- 39.5]	38.0 [36.7- 39.2]	0.515
PaCO2 90 HR	38.6 [37.4- 40.0]	39.1 [38.0- 40.0]	38.0 [37.0- 40.0]	0.144

5.7 Continuous positive airway pressure (CPAP) non-invasive ventilation

Table 24 below shows that there were no significant differences between IS Group and the Control Group in using continuous positive airway pressure (CPAP) non-invasive ventilation. However, CPAP utilization in the

Control Group was twice as long as that in the IS Group. In the Control Group, six patients used CPAP on day 1; on day 2 there were nine clients and on day 3 there were four clients. On the other hand, in the IS Group there were three patients on day 1, four clients on day 2 and two clients on day 3 on whom CPAP was used after atelectasis occurred.

Table 24: Continuous positive airway pressure (CPAP) non-invasive ventilation

Variable	YES/ NO	Total n (%)	IS Group n (%)	Control Group n (%)	P Value
CPAP DAY 1	YES	9 (11.3%)	3 (7.5%)	6 (15.0%)	0.288
	NO	71 (88.8%)	37 (92.5%)	34 (85.0%)	
CPAP DAY 2	YES	13 (16.3%)	4 (10.0%)	9 (22.5%)	0.130
	NO	67 (83.8%)	36 (90.0%)	31 (77.5%)	
CPAP DAY 3	YES	6 (7.5%)	2 (5.0%)	4 (10.0%)	0.396
	NO	74 (92.5%)	38 (95.0%)	36 (90.0%)	

5.8 Reintubation

Table 25 below shows that there was no incidence of reintubation among the IS Group and the Control Group.

Table 25: REINTUBATION EVENT

Variable	YES/ NO	Total n (%)	IS Group n (%)	Control Group n (%)	P Value
REINTUBATION DAY 1	YES	80 (100%)	40 (100%)	40 (100%)	> 0.999
	NO	0 (0.0%)	0 (0.0%)	0 (0.0%)	
REINTUBATION DAY 2	YES	80 (100%)	40 (100%)	40 (100%)	> 0.999
	NO	0 (0.0%)	0 (0.0%)	0 (0.0%)	
REINTUBATION DAY 3	YES	80 (100%)	40 (100%)	40 (100%)	> 0.999
	NO	0 (0.0%)	0 (0.0%)	0 (0.0%)	

5.9 Nebulizer event

Table 26 below shows that there were no significant differences between IS Group and the Control Group in the use of bronchodilator nebulizers rather than the regular use of ipratropium bromide in all clients. However, the IS Group shows less than the Control Group regarding the use of a nebulizer, although the difference was not significant.

Table 26: Nebulizer Event

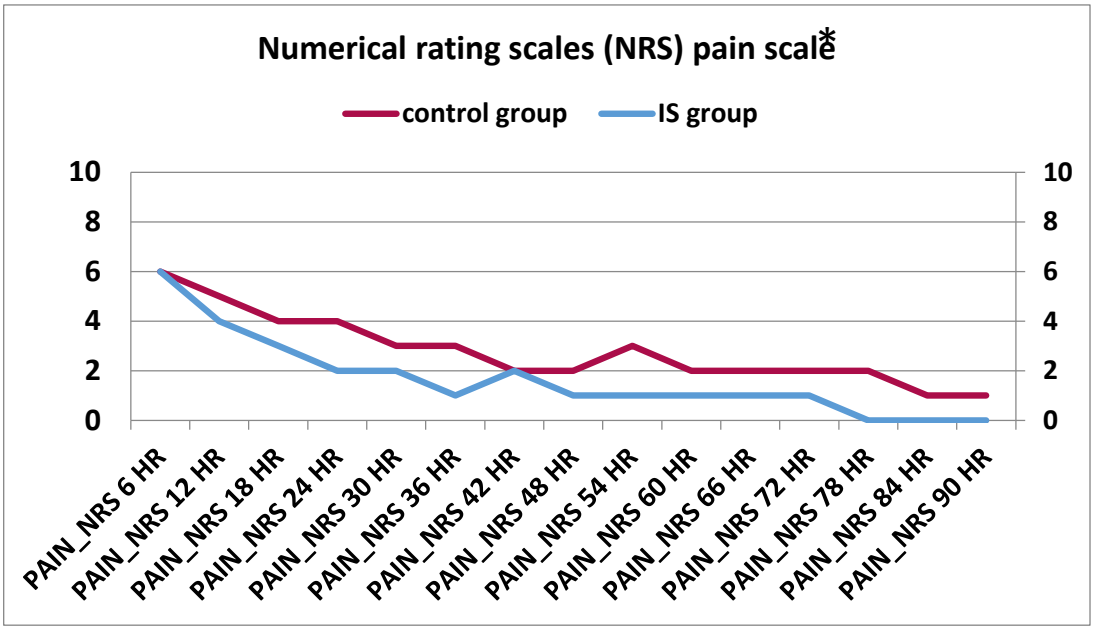
Variable	YES/ NO	Total n (%)	IS Group n (%)	Control Group n (%)	P Value
Nebulizer Event DAY 1	YES	9 (11.3%)	2 (5.0%)	7 (17.5%)	0.077
	NO	71 (88.8%)	38 (95.0%)	33 (82.5%)	
Nebulizer Event DAY 2	YES	12 (15.0%)	4 (10.0%)	8 (100%)	0.210
	NO	68 (85.0%)	36 (90.0%)	32 (20.0%)	
Nebulizer Event DAY 3	YES	5 (6.3%)	2 (5.0%)	3 (7.5%)	0.644
	NO	75 (93.8%)	38 (95.0%)	37 (92.5%)	

5.10 Numerical rating scales (NRS) pain scale

Table 27 and Figure 16 below show that there were significant differences between the IS Group and the Control Group in numerical rating scales (NRS) pain scale, with obvious less pain in the IS Group than the control when using the same analgesic plan, as shown in the P value below in all measurements at all times except at 12 hours. In the NRS scores ≤ 5 corresponded to mild, scores of 6–7 to moderate and scores ≥ 8 corresponded to severe pain.

Table 27: Numerical rating scales (NRS) pain scale

Variable	Total Median [Q1-Q3]	IS Group Median [Q1-Q3]	Control Group Median [Q1-Q3]	P Value
PAIN_NRS 6 HR	6 [6- 6]	6 [5- 6]	6 [6- 6]	0.035*
PAIN_NRS 12 HR	5 [5- 6]	4 [3- 5]	5 [4- 5]	0.172
PAIN_NRS 18 HR	4 [4- 5]	3 [3- 4]	4 [3- 5]	0.001*
PAIN_NRS 24 HR	4 [3- 6]	2 [2- 3]	4 [3- 5]	<0.001*
PAIN_NRS 30 HR	4 [2- 5]	2 [1- 2]	3 [2- 4]	<0.001*
PAIN_NRS 36 HR	3 [2- 5]	1 [1- 3]	3 [2- 4]	0.067*
PAIN_NRS 42 HR	3 [2- 5]	2 [1- 2]	2 [1- 3]	0.222
PAIN_NRS 48 HR	3 [2- 5]	1 [1- 2]	2 [1- 3]	0.067*
PAIN_NRS 54 HR	3 [2- 5]	1 [1- 2]	3 [3- 4]	<0.001*
PAIN_NRS 60 HR	3 [2- 4]	1 [1- 2]	2 [2- 4]	<0.001*
PAIN_NRS 66 HR	2 [2- 3]	1 [1- 2]	2 [2- 3]	<0.001*
PAIN_NRS 72 HR	2 [1- 3]	1 [1- 2]	2 [1- 2]	<0.001*
PAIN_NRS 78 HR	2 [1- 2]	0 [0- 1]	2 [1- 2]	<0.001*
PAIN_NRS 84 HR	2 [1- 2]	0 [0- 1]	1 [1- 2]	<0.001*
PAIN_NRS 90 HR	1 [1- 2]	0 [0- 1]	1 [1- 2]	<0.001*



***: indicate p value of ≤ 0.05**

Figure 16) Graphical comparison of median numerical rating scales (NRS) pain scale among IS and control groups**.**

Chapter Six

Discussion

6. Discussion

The results of this study indicate that IS used preoperatively for patients with CABG surgery reduces postoperative atelectasis, length of hospital stay and improved postoperative oxygenation.

One hundred clients were assessed for eligibility, but 20 were excluded, 15 of them not meeting the inclusion criteria, three declined to participate, and two converted to PCI. The patients who did not meet the criteria switched to the hospital routine (using incentive spirometry with deep-breathing exercise postoperatively only). The remaining 80 clients were enrolled in the study and randomly allocated into two groups. (Figure 1). Demographic data were comparable between the two groups ($P > 0.05$; Table 1). All patients in the two groups were comparable in terms of age, gender, co-morbidity, smoking and BMI. Hemodynamic parameters and other observations were recorded before operation, postoperatively, and 3 days postoperatively, without any differences observed in pre- and postoperative parameters, i.e., heart rate, systolic and diastolic blood pressure. The ECG between the two groups was statistically insignificant, with significant differences in respiration rate in the IS Group compared to the Control Group at 12,18,24,30 hours, postoperatively, and this finding is consistent with Oshvandi et al. (2020).

6.1 The effect of preoperative incentive spirometry on PPCs

6.1.1 Atelectasis

In the current study there was a significant decrease in the incidence of atelectasis in the IS Group. This finding is consistent with Diken and Özyalçın (2018), who conducted an RCT that involved 108 patients divided into two groups: IS preoperative and routine care for control, with a body mass index over 30 kg/m2 and without previous pulmonary disease. In Diken and Özyalçın's study, patients with atelectasis were predominantly higher in the Control Group compared to the IS Group ~~1~~ (18 vs. 7 patients, respectively) (P = 0.0036). The current findings also agree with Gilani et al. (2016), who conducted an RCT that showed the incidence of postoperative atelectasis was 14.10% in Group I (IS) and 27.10% in Group II patients (control) (p= 0.04). Moreover, the current study results are consistent with Oshvandi et al. (2020), who were showed that the occurrence of atelectasis, respiratory status, dyspnea and sweating showed a significant difference between the IS and control groups at all hours after surgery (P<0/001). Furthermore, the results are also in agreement with Shaban et al. (2002), who showed the incidence rate of atelectasis in the experimental group was (26.7%), less than control group (56.7%) with (P = 0.01). In addition, the study results also agree with Nardi et al. (2019), who revealed that better clinical results for respiratory and musculoskeletal function were found in the groups preoperatively treated with physiotherapeutic protocols immediately before as well as after

cardiac surgery. Just the same results were confirmed by Yánez-Brage et al. (2009) in their observational study, which was conducted on 263 patients and revealed that preoperative physiotherapy (involving incentive spirometry, deep-breathing exercises, assisted coughing and early ambulation) after off-pump CABG surgery was related to a lower incidence of atelectasis.

Conversely, the current study is inconsistent with a study conducted by Tayeb et al. (2019). This study examined 100 participants and found no significant differences between the IS and control groups in terms of atelectasis and hypoxemia (p value>0.05). Freitas, et al. (2012) also revealed no evidence of a difference between groups in the incidence of PPCs with IS and treatment with physical therapy, positive-pressure breathing techniques, active cycle of breathing, or preoperative patient education and worse pulmonary function and arterial oxygenation. Eltorai et al. (2018) investigated the clinical effectiveness of incentive spirometry and found that there was narrow evidence to support its advantages and an absence of harmonized protocol for its use. In addition, Overend,et al. (2001) conducted a systematic review study and concluded that evidence does not support the use of IS for decreasing the incidence of PPCs.

6.1.2 Pneumonia

The current results showed that there was no statistically significant difference between the groups regarding the incidence of pneumonia. However, the incidence of pneumonia in the Control Group was 3 (7.5%)

patients while in the IS Group there were 2 (5%). Fayyaz et al. (2016) presented results consistent with current results, showing that there was no record of pneumonia in any group of patients. On the other hand, these results are not in agreement with Cassidy et al. (2013), who, after the program was designated by the abbreviation COUGH, which consisted of using IS preoperatively, showed that the reduction in the incidence of postoperative pneumonia was from 2.6% in the control group, falling to 1.6% in the IS group. The results of the current study discovery are not in agreement with Diken and Özyalçın (2018), who explained that two patients had pneumonia and needed long-term antibiotic treatment in the control group during the postoperative course with a significant lower rate of pneumonia.

6.1.3 Pleural effusion and pneumothorax

There was no significant decrease in the incidence of pleural effusion and pneumothorax in the IS Group compared to the Control Group. However, the incidence in the IS Group was lower than in the Control Group. This finding is consistent with Yánez-Brage et al. (2009) and Oshvandi et al. (2020).

6.2 The effect of preoperative incentive spirometry on oxygenation

6.2.1 The partial pressure of oxygen (Pao2), oxygen saturation of arterial blood (SaO2%) and peripheral oxygen saturation (SPO2%)

The current results showed a significant improvement in Pao2, Sao2 and SPO2 in the IS Group compared to the Control Group. These results are consistent with Fayyaz et al. (2016), where preoperative spirometry had improved postoperative oxygenation in the IS group to 97.29 while the control group was 93.27. Yazdemik, et al. (2016) also concluded that incentive spirometry caused a remarkable improvement of Pao2, Sao2 and SPO2. Another study conducted by Moradyan et al. (2012) corresponds to the current study results and revealed that protocols for breathing exercises (deep breathing, incentive spirometry and directed maneuvers) can improve PaO2 and SaO2. While Balandiuk and Kozlov, (2004) revealed that the use of incentive spirometer preoperatively for cardiac surgery significantly improved arterial oxygenation.

Freitas et al. (2012) presented results that contradict the current results. They found no differences between the study group in terms of incentive spirometry used and found poorer lung function and status of arterial oxygenation competed with those treated with positive pressure ventilation. Diken and Özyalçın (2018) also disagree with our study results after conducting RCT on two groups and showed no change in oxygenation status for both groups. Even Afrasiabi et al. (2007) reported that incentive spirometry had no significant effect on improvement in postoperative

oxygenation. In addition, Brage et al. (2009) also reported that improvement in postoperative oxygenation using incentive spirometry is not permanent; this improvement is reversible after a short period of time. Carvalho et al. (2011), in a systematic review study, reviewed 30 studies in relation to IS. They reported that there was no strong evidence to support the use of IS after CABG, and there is a need for studies to clarify the effect and justify the use of this technique.

6.2.2 Partial pressure of carbon dioxide (PCO2)

The present results showed no significant differences between two groups regarding partial pressure of carbon dioxide (PCO2). This finding is consistent with Moradyan et al. (2012), who showed no difference between IS and the control groups. Our current study also agrees with Diken and Özyalçın, (2018), who reported no differences between the groups of IS and control in PCO2. On the other hand, these results are incompatible with Yazdemik et al. (2016), who revealed preoperative incentive spirometry improved PCO2 levels. Afrasiabi et al. (2007) also reported improving PCO2 in the IS group compared to the control. Furthermore, Fayyaz et al. (2016) declared that PCO2 was reduced in the incentive spirometry group compared to the control group.

6.3 The effect of preoperative incentive spirometry on hospital length of stay

The current results showed that the incidence of hospital length of stay for the IS Group was 6 days, while in the Control Group it was 7 days. ICU LOS for the IS Group was also reduced compared with the Control Group. This finding is consistent with Nardi et al. (2019), who revealed that the hospital stay was further reduced for the IS group. In addition, Shaban et al. (2002) reported the same results when they declared that the hospital length of stay decreased for the IS group compared to the control group. On the other hand, Fayyaz et al. (2016) presented results that contradict the current results. They revealed that there were no differences between groups in length of hospital stay.

6.4 The effect of preoperative incentive spirometry on mechanical ventilation time

The current results showed significant differences between the two groups (IS and Control) regarding mechanical ventilation time (duration), which was 4 hours for the IS Group and 6 hours for the Control Group. This finding is consistent with Gilani et al. (2016), who showed that mechanical ventilation time was significantly less in Group I patients (IS): it was 5.49 + 2.28 hours versus 6.74 + 5.46 hours in Group II patients (control) (p-value 0.05). This finding also agrees with Balandiuk and Kozlov (2004), who reported that a significant decrease in the duration of MV in the IS group was 7.3 hours compared to 10.4 hours ($P < 0.05$) in the

control group. Tayeb et al. (2019) presented results that contradict the current study results. They revealed that there were no differences between groups in mechanical ventilation time, with 10.5 hours for the IS group and 11.5 hours for the control group. Yazdemik et al. (2016) also reported the same duration of mechanical ventilation in both groups following coronary artery bypass surgery. However, Afrasiabi et al. (2007) presented results that contradict the current study results. They found no differences in mechanical ventilation time between study groups. Furthermore, Yánez-Brage et al. (2009) in an observational study, showed that no statistical differences were observed during the time of mechanical ventilation between the study groups.

6.5 IS clinical application

The current study demonstrated the clinical application and IS protocol that showed important results in reducing atelectasis occurrence in CABG patients. Meanwhile, some of clinical trials question the effectiveness of IS use and why it is still prescribed to patients in different locations, especially after cardiac surgery (Eltorai et al., 2018; Restrepo et al., 2011).

6.6 Recommendations

This study was performed on patients who receive invective spirometry for 2 days preoperative and did not have lung problems. Therefore, it is recommended to conduct a clinical study with the aim of examining incentive spirometry with deep breathing and cough trial in

patients who will undergo CABG surgery with lung problems such as chronic obstructive pulmonary disease and asthma.

6.7 Conclusions

Preoperative incentive spirometry along with deep-breathing exercises, assisted coughing and early ambulation after coronary bypass surgery is related to the prevention and lower incidence of atelectasis, hospital length of stay, duration of mechanical ventilation and improved postoperative oxygenation. A difference that can be considered both significant and clinically relevant.

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Appendices

Appendices (1): Consent form

نموذج طلب موافقة على المشاركة في بحث علمي

عنوان الدراسة: استخدام جهاز قياس التنفس الحافز(جهاز النفخ بالكرات) قبل الجراحة للوقاية من المضاعفات الرئوية بعد العملية الجراحية في المرضى الذين يخضعون لجراحة ترقيع الشريان التاجي(القلب المفتوح).

اسم الباحث الرئيسي: عيسى سويطي

المشرفين على البحث: د. عايدة القيسي (مشرفاً اكاديمياً) د. وفيق عثمان (مشرفاً سريرياً) .

ملخص البحث: نقوم بهذه الدراسة استيفاءاً لمتطلبات التخرج من برنامج ماجستير العناية المكثفة للتمريض في جامعة النجاح الوطنية وهي دراسة سريرية لاستخدام جهاز قياس التنفس الحافز(جهاز النفخ بالكرات) قبل الجراحة للوقاية من المضاعفات الرئوية بعد العملية الجراحية، الأوكسجين بعد العملية وطول مدة الإقامة في المستشفى في المرضى الذين يخضعون لجراحة ترقيع الشريان التاجي(القلب المفتوح). وسوف يتم اعطاء المرضى الموضوعين على قائمة الانتظار للعملية والذين يوافقون على المشاركة بالدراسة جهاز قياس التنفس الحافز(جهاز النفخ بالكرات) قبل البدأ بالعملية بيومين ومراقبة المضاعفات الرئوية بعد العملية الجراحية.

معلومات عن العينة المنتقاة والفترة الزمنية المقدرة لاستكمال المقابلة أو الاستبيان:

تم اختيار فئة المرضى الذين يخضعون لجراحة ترقيع الشريان التاجي(القلب المفتوح)لاجراء هذا البحث العلمي عليهم لانهم اكثر عرضة لل المضاعفات الرئوية بعد العملية الجراحية ولما فيه من نتائج ايجابية متوقعة على المريض ، وستبدأ الدراسة من لحظة دخول المشارك الى المستشفى وصولا الى خروجه من المستشفى.

المخاطر المتوقعة والخصوصية:

ليست هنالك اي مخاطر للدراسة سواء نفسية ام جسدية، سيتم حفظ خصوصويتك كمشاركة بالدراسة وسوف يتم التكتم على هويتك وسيبقى اسمك طي الكتمان والمكان الوحيد الذي سيتم ذكر اسمك فيه هو نموذج الموافقة على المشاركة في الدراسة. سوف يتم التعامل مع العينة والمعلومات الخاصة بك بطريقة الترميز حماية لخصوصيتك، ويحق لك الانسحاب من البحث متى شئت من دون أن يأثر ذلك عليك او على الرعاية الطبية التي سوف تتلقينها.

المنافع المتوقعة:

تتطلع هذه الدراسة للوصول الى دراسة اداة تُحد من نسب حدوث المضاعفات الرئوية بعد العملية الجراحية، الأوكسجين بعد العملية وطول مدة الاقامة في المستشفى في المرضى الذين يخضعون لجراحة ترقيع الشريان التاجي(القلب المفتوح) وسيكون لهذا إنعكاساً ايجابا على صحة المريض.

طريقة التواصل مع الباحث:

إذا كانت لديك اي سؤال او استسفار عن الدراسة يمكنك التواصل مع الباحث (عيسى سويطي) بكل رحابة وفي اي وقت عن طريق (الهاتف: 0598428085) أو البريدالإلكتروني (Essasweity@gmail.com).

توقيع المشاركة في البحث:

لقد حصلت على شرح مفصل عن الدراسة وأهدافها وإجراءاتها، ومنافعها، والمخاطر المحتملة. ولقد فهمت كافة المعلومات التي قدمت لي وتمت الإجابة كل أسئلتي. لذا فأنني أوافق وبمحض ارادتي على ألمشاركة في هذه الدراسة.

الاسم:.....

التوقيع:.....

التاريخ:.....

Appendices (2)

Data collection Sheet

Data Collection Sheet

Part I : Demographic data	
Name	
Age	
Sex	
History of Diabetes	
History of Hypertension	
History of Smoking	
If Yes, How many cigarette per day	
Diagnosis	
Weight	
Height	
BMI	
Other	

Part II: (A)
OBSERVATIONAL CHECK LIST TO ASSESS VITAL SIGNS

Part II : Vital Signs																
Observation																
	Pre-op assessment	**Post OP. tests**														
		DAY0				**DAY1**				**DAY2**				**DAY3**		
Respiratory rate																
Heart rate																
Blood Pressure																
Temperature																
ECG rhythm																

Part II: (B)

- A **score of (0)** mark will be given for each ***normal*** (**Absent**) findings.
- A **score of (1)** marks will be given for each ***altered***(**Present**) findings.

OBSERVATIONAL CHECK LIST TO ASSESS RESPIRATORY STATUS: RESPIRATORY STATUS

Part II (B) : Respiratory Status																
Observation	**Pre-op assessment**	**Post OP. tests**														
		DAY0				**DAY1**				**DAY2**			**DAY3**			
Dyspnea																
Cough																
Wheezing																
Breath sound																
Use of accessory Muscles																
Air entry																

Part III:

OBSERVATIONAL CHECK LIST TO ASSESS RESPIRATORY COMPLICATION

- A **score of (0)** mark will be given for each *normal* (**Absent**) findings.
- A **score of (1)** marks will be given for each *altered* (**Present**) findings.

Part III : RESPIRATORY COMPLICATION																
Complication	**Score Post Op**															
	DAY0				**DAY1**				**DAY2**				**DAY3**			
Atelectasis																
Pneumonia																
Respiratory insufficiency																
Pleural effusion																
Pneumothorax																

Part IV:

OBSERVATONAL CHECKLIST FOR LENGHTH OF STAY.

Consists of patient length of stay at intensive care unit and hospital length of stay.

Part IV : LENGHTH OF STAY	
Observation	**Number of Day's**
ICU Length of Stay	
Hospital length of stay	

Part V:

OBSERVATONAL CHECKLIST FOR MECHANICAL VENTILATION PERIOD

Part IV : Mechanical ventilation	
Observation	**Number of Hours**
Mechanical ventilation period (Hours)	

Part VI:
OBSERVATONAL CHECKLIST FOR OXYGENATION STATUS.

Part V : OXYGENATION STATUS																	
Observation	**Preoperative assessment**	**Post op tests**															
		DAY0				**DAY1**				**DAY2**				**DAY3**			
PaO2																	
SaO2																	
SPO2																	
PaCO2																	

Part VII:

OBSERVATONAL CHECKLIST FOR CPAP USING & RE-INTUBATION.

CPAP using & RE-INTUBATION							
DAYS	**CPAP using**			**Re-intubation**		**Nebulizer Event**	
	Yes	**NO**	**Frequency**	**Yes**	**NO**	**Yes**	**No**
DAY1							
DAY2							
DAY3							

Part VIII:

OBSERVATONAL CHECKLIST FOR PAIN ASSESSMENT

Part III : PAIN ASSESSMENT																
Pain (VAS)	**DAY0**				**DAY1**				**DAY2**				**DAY3**			

Appendices (3)

Definition of postoperative pulmonary complications (PPCs) Table.

Part III : RESPIRATORY COMPLICATION	
Complication	**Characteristics**
Atelectasis	**•X –ray :** **mediastinal shift** **Tracheal deviation** **•Diminished respiratory movements** **•Diminished breath sounds** **•Tracheal displacement toward affected side.** **•new parenchymal thickening surrounded by hyperinflated lung**
Pneumonia	**•X –ray: lobar consolidation/ interstitial** **Infiltrates plus at least <u>two</u> of the following criteria:** **•Fever > 38 C ,** **•WBC <4 or>12 *10^9 L** **•Tachypnea** **•Cough, new or changed sputum** **•Decreased breath sounds** **•Worsening of gas exchange**
Pleural effusion	**•Evidence of new hazy opacity of one hemithorax with preserved vascular shadows on the supine radiograph** **•Tachypnea** **•Pleuritic chest pain** **•Blunting of costophrenic angle** **•Diminished or absent breath sounds**
Pneumothorax	**Presence of air within the pleural space detected with chest radiograph**
Respiratory insufficiency	**At <u>two</u> of the following criteria:** **• SpO_2 < 90%** **• PaO_2/FiO_2 < 300** **• $PaCO_2$ > 45 mmHg** **• Dyspnea with respiratory distress or use of accessory muscles**

Appendices (4)
IRB Acceptance letter

An-Najah
National University
Health Faculty of medicine&
Sciences
IRB

جامعة النجاح
الوطنية
كلية الطب وعلوم الصحة
لجنة اخلاقيات البحث العلمي

Approval Letter

Study Title:

Preoperative Incentive spirometry for preventing postoperative pulmonary complications in patient undergoing coronary artery bypass graft surgery

Submitted by:
Essa Sweity

Supervisor:
Dr. Aidah Alkaissi
Dr. Wafiq Othman

Date Reviewed:
27th May 2019

Date Approved:
29th May 2019

Your Study titled "**Preoperative Incentive spirometry for preventing postoperative pulmonary complications in patient undergoing coronary artery bypass graft surgery**" with archived number (14) May was reviewed by An-Najah National University IRB committee and was approved on 29th May 2019.

Hasan Fitian, MD

IRB Committee Chairman
An-Najah National University

IRB

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Appendices 5

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16 July 2020

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Author(s): **Essa Sweity**

Format: **American English**

Style guide: **APA style.**

جـامــعة الــنجاح الــوطــنية

كليـــة الدراســات العليـا

استخدام جهاز قياس التنفس الحافز(جهاز النفخ بالكرات) قبل الجراحة للوقاية من المضاعفات الرئوية بعد العملية الجراحية في المرضى الذين يخضعون لجراحة ترقيع الشريان التاجي(القلب المفتوح).

إعداد

عيسى محمد سويطي

إشراف

د. عايدة القيسي

د. وفيق عثمان

قدمت هذه الرسالة استكمالاً لمتطلبات الحصول على درجة الماجستير في تمريض العناية المكثفة، بكلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس– فلسطين.

2020

استخدام جهاز قياس التنفس الحافز(جهاز النفخ بالكرات) قبل الجراحة للوقاية من المضاعفات الرئوية بعد العملية الجراحية في المرضى الذين يخضعون لجراحة ترقيع الشريان التاجي (القلب المفتوح).

إعداد

عيسى محمد سويطي

إشراف

د. عايدة القيسي

د. وفيق عثمان

الملخص

الخلفية: المضاعفات الرئوية بعد العملية الجراحية هي حادثة متكررة بعد العمليات الجراحية القلبية والصدرية والبطنية الرئيسية، وهي سبب رئيسي للمراضة والوفيات وإعاقة الأكسجين، وزيادة مدة الإقامة في المستشفى، على الرغم من حقيقة الأدلة السريرية المتعلقة بالوقاية من هذه المضاعفات هي غالبًا غير واضحة، حيث يتم اتخاذ تدابير حاسمة لتقليلها، أحد الأجهزة الشائعة الاستخدام لهذا الغرض هو قياس التنفس الحافز (جهاز النفخ بالكرات). الهدف من الدراسة هو تقييم تأثير استخدام جهاز قياس التنفس الحافز قبل الجراحة لمنع المضاعفات الرئوية بعد الجراحة، وتحسين الأوكسجين بعد العملية الجراحية وتقليل مدة الإقامة في المستشفى في المرضى الذين يخضعون لجراحة ترقيع الشريان التاجي (القلب المفتوح).

الطريقة: كانت هذه دراسة مستقبلية عشوائية سريرية. تم اختيار إجمالي 80 مريضاً من المرشحين لعملية ترقيع الشريان التاجي في مستشفى النجاح الوطني الجامعي، نابلس – فلسطين. تم تخصيص المرضى لمجموعتين عشوائيتين : مجموعة الدراسة ومجموعة التحكم. كان هناك مرضى تم إجراء قياس التنفس التحفيزي قبل الجراحة (مجموعة الدراسة). بينما في المجموعة الثانية لم يتم إجراء قياس التنفس قبل الجراحة (مجموعة التحكم). كان هناك 40 مريضا في كل مجموعة. تلقى جميع المرضى نفس التخدير والتهوية في غرفة العمليات.

النتيجة: أظهرت نتائج الدراسة أنه كان هناك فرق كبير بين مجموعة التحكم ومجموعة الدراسة في حدوث انكماش الرئتين ما بعد الجراحة، حيث كان 8 مرضى (20.0٪) في مجموعة الدراسة و17 مريض (42.5٪) في مجموعة التحكم (القيمة الاحتمالية اقل من 0.03). كان وقت التهوية أقل بكثير في مجموعة الدراسة، وكان المتوسط 4 ساعات مقابل 6 ساعات في مجموعة التحكم (القيمة الاحتمالية <0.001). كانت مدة الإقامة في المستشفى أقل بكثير في مجموعة الدراسة، وكان المتوسط 6 أيام مقابل 7 أيام في مجموعة التحكم (القيمة الاحتمالية <0.001). كان متوسط كمية الأكسجين في الدم الشرياني وتشبع الأكسجين تحسناً فعالاً بشكل ملحوظ في مجموعة الدراسة مع (القيمة الاحتمالية <0.005). لذلك وجدنا أن قياس التنفس الحافز قبل العملية يؤدي إلى انخفاض كبير في حدوث انكماش الرئتين اللاحق للعمليات الجراحية، ويمكنه أيضًا تقليل وقت التهوية وكذلك كمية التحسين الفعال لأكسجين الدم الشرياني وتشبع الأكسجين.

الخلاصة: استخدام جهاز قياس التنفس الحافز قبل العملية يساعد على تقليل حدوث انكماش الرئتين، وتحسين الأكسجين بعد الجراحة، تقليل ايام المكوث بالمستشفى ويمكنه أيضًا تقليل وقت التهوية في المرضى الذين يخضعون لعملية ترقيع الشريان التاجي.

الكلمات المفتاحية: جهاز قياس التنفس الحافز، مضاعفات رئوية بعد الجراحة، انكماش الرئتين، الاكسجة، وقت التهوية، ترقيع الشريان التاجي، مدة الإقامة.