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Impact Of Preoperative Respiratory Status On Postoperative Complications And Recovery In Open Heart Surgical Patients During Hajj

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Abstract

Objectives: To investigate how preoperative respiratory status affects postoperative complications and recovery time in open-heart surgical patients during Hajj, Evaluate the effectiveness of preoperative interventions aimed at optimizing respiratory function.

Methods: This study is a retrospective study design in a tertiary-care hospital (KAMC) in Makkah, Saudi Arabia. Data related to open-heart surgery during Hajj season in 2024

Results: Overall, the results of the study showed that the impact of Preoperative Respiratory Status on Postoperative Complications and Recovery in open heart Surgical Patients and the effectiveness of preoperative interventions aimed at optimizing respiratory function. Patients in the intervention group spent less time in the intensive care unit (ICU) and in the hospital overall after receiving training with a preoperative incentive spirometer than patients in the control group.

Conclusion: Postoperative pulmonary problems arise from anesthesia and surgical stress, significantly affecting morbidity and mortality. To accurately predict risk, optimize respiratory conditions, and develop treatment plans, a multidisciplinary team may be needed in the preoperative pulmonary examination process, alongside patient-related risk factors.

Keywords: Impact, Preoperative, Respiratory Status, Postoperative Complications, Open heart Surgery, Hajj.

Introduction

The evaluation of preoperative pulmonary function, including complications and postoperative outcomes of open-heart surgery, is crucial during the pilgrimage season. Thus, knowing the preoperative respiratory status affects the postoperative outcome. It is essential since it would be difficult not to perform an open-heart surgery at a time as active as a sporting event. Particularly, the respiratory system is vital in maintaining homeostasis and responding to the need for oxygenation in physically stressed conditions, such as surgery (1).

Many medical specialties have begun to recognize the preoperative period as a pivotal opportunity to improve patient recovery and outcomes. As more and more health care specialties recognize the significance of the preoperative period, and optimizing patient comorbidities preoperatively, the respiratory therapy team will inevitably find a growing role to participate (2).

Particularly during operations such as those involving the heart and the lungs, since the surgical process affects the heart-lung relationship, any compromise in respiratory function will necessarily affect the body's ability to cope with other burdens associated with the surgical procedure and the postoperative period (3). Fixing earlier poor respiratory status, which includes COPD, asthma, or smoking, practitioners, can state that the risk of some of the complications following open-heart surgery will increase significantly, including pneumonia, atelectasis, and respiratory failure (4). However, there is evidence that poor lung capacity correlates with worse outcomes, extended hospital stays, and elevated medical expenses (5). Therefore, knowledge of the relationship between preoperative lung capacity and postoperative outcome is helpful for improving patients' recovery and reducing the risk of complications during the Hajj.

It has long been known that postoperative pulmonary complications (PPCs) play a significant role in perioperative morbidity and death in surgical patients undergoing both thoracic and non-thoracic procedures. PPCs are defined differently in different literature sources, but they usually involve atelectasis, respiratory infections, hypoxemia, worsening of underlying lung disease, and the requirement for either non-invasive or invasive mechanical ventilation. Although the incidence is commonly considered to be between 3 and 6%, it also relies on the population under study and the perioperative and surgical practices. Studies have found occurrences that are comparable to or greater than cardiac problems, and they have a strong correlation with death over the long term (6).

Significantly, this study might be related to the possible improvement of the targeted practice in the healthcare system, namely, the practice of the designers for open-heart surgical patients who are performing the Hajj pilgrimage. In this way, to recognize those postoperative patients at increased risk due to their preoperative respiratory comorbidity, healthcare providers can develop measures to alleviate some of the said challenges and enhance patients' recovery rates (7). Especially, this not only has the advantage for an individual patient but also solves the problem of appropriate utilization of resources in severe health care centers during such a busy period.

Literature review

Existing literature has explored similar studies conducted in different settings outside of the Hajj pilgrimage situation, highlighting the consistent association between preoperative respiratory status and postoperative complications. However, there is limited research focusing on this specific population undergoing open-heart surgery during Hajj. Conducting this study within the unique environmental and logistical challenges posed by the Hajj pilgrimage will provide valuable insights into how factors such as crowd density and, extreme weather conditions, may interact with preexisting respiratory conditions to influence postoperative outcomes (14).

Aldossari et al have also mentioned the health risks and services in the context of the Hajj in Mecca. It combined electronic and manual search functions, enabling them to retrieve 60 studies from the literature published in 2005–2014. The study employed a narrative review method, which was conducted based on

communicable diseases, NCDs, and the health service. The conclusions pointed out that the number of continued public health issues during each subsequent hajj season has shown improvement over time. The recommendations outlined in the research focused on increasing cooperation with other countries and strengthening health care to prevent these risks and improve health care during the holy pilgrimage of Hajj (14).

Wang et al.'s meta-analysis analyzed six trials concerning preoperative IMT and its effect on postoperative outcomes in cardiac surgery patients, including 925 participants. The study did not identify any change in mechanical ventilation time or ICU length of stay when comparing IMT with the control group. However, it found that IMT reduced postoperative hospital days by one. The transit time is 77 days, which may mean companies could reduce expenses. Subsequently, more studies with higher quality and the following optimized IMT protocols are required (9).

Li et al. observed that physical performance prior to the surgery, such as grip strength, gait speed, and the timed up and go (TUG) test, correlates statistically with postoperative pulmonary complications in coronary artery bypass grafting patients. Of the 438 patients, decreased grip/weight, walking speed, and TUG time indicate a higher risk of PPC. These individual ERs indicated a better prediction accuracy (AUC 0.792) if a model integrating all the indicators rather than individual indicators was used to improve the identification of high-risk patients before surgery (10).

Moreover, Nardi et al. observed the positive impact of preoperative respiratory and motor physiotherapy on the pulmonary and musculoskeletal outcomes of patients who were to undergo elective cardiac surgery. The study involved 59 patients divided into three groups: respiratory physiotherapy (group A), respiratory and motor physiotherapy (group B), and control (group C). There was an increase in the 6-minute walking test distances of Groups A and B compared to the control group and a significant improvement in the peak expiratory flow and blood gas analysis. Group B also had fewer days of postoperative hospital stay, stressing the advantage of employing both physiotherapy protocols (11). On the other hand, Sweity et al. examined the effects of incentive spirometry in a prospective, randomized, controlled trial in patients undergoing CABG about PPCs. The study, including 80 patients, showed that preoperative IS decreases the risk of atelectasis appearance, mechanical ventilation time, and hospital stay. In addition, IS enhanced postoperative oxygenation; these targeting CDC measures were clinically practical to prevent PPCs and improve recovery for CABG patients (8).

Also, Su et al. compared the outcomes of pre and postoperative nurse-administered IS with a control group of physiotherapist-organized breathing exercises in patients undergoing cardiac surgery. The study included 321 patients divided into three cohorts: Preoperative and postoperative IS labeled as PPN, pre and postoperative breathing exercises labeled as PPP, and breathing exercises only in the postoperative period labeled as PPB. Results also indicated a comparatively lower incidence of atelectasis, dyspnea, and sweating in the PPN group compared to the PPP and PPB groups, shorter duration of ventilation, and shorter hospital stay in the PPN group, all pointing towards the fact that nurse-guided (IS) is more advantageous (12).

Lastly, Kotta and Ali synthesized the literature on incentive spirometry (IS) in the prevention of postoperative pulmonary complications (PPCs) among thoracic surgery patients. However, investigating the effectiveness of IS in practice, they observed scarce effectiveness in reducing PPCs or the duration of a hospital stay. Nevertheless, some studies recently provided suggestive data that could favor high-risk patients, for example, patients with COPD. The authors pointed out some issues related to patient compliance and some concerns as limitations of the studies. Overall, they opined that while IS may encourage patients to do breathing exercises, it has no adequate backing for all thoracic surgery patients (13).

There is vast knowledge on the topic from the existing literature. However, it has been noted that there is a need to research the impact of preoperative respiratory status on postoperative complications and recovery

in open-heart surgical patients during Hajj due to insufficient research on the topic. The proposed research aims to address this topic and present evidence-based insights to medical practitioners worldwide.

Objectives:
Primary Objective:
The objective of this research is to investigate how preoperative respiratory status affects postoperative complications and recovery time in open-heart surgical patients during Hajj.

Methodology

Study design:
This study is a cohort retrospective study design in a tertiary-care hospital (KAMC) in Makkah, Saudi Arabia. Data related to open-heart surgery during Hajj season in 2024 collected through the electronic health system of Hajj medical facilities. Each patient's demographic information, medical history, timing of intubation post-diagnosis, and outcome (discharge, prolonged hospitalization, or mortality) recorded in a structured Excel spreadsheet.

Study Population:
The inclusion criteria for these study selections are:

- Patient age ≥ 18 years
- All open-heart surgery patients

Exclusion criteria:
Patient age < 18 years
Pregnant patients
Electronic patients file reviewed and data collected in an Excel sheet of the following

Participant Information

1. Age
2. Gender
3. Weight
4. Height
5. BMI (Body Mass Index)
6. Smoking History

Admission and Surgery Details

1. Preoperative Diagnosis
2. Type of Surgery
3. Surgery Duration

Preoperative and Postoperative incentive spirometer (IS):

- Preoperative IS: Preoperative incentive spirometer received before surgery.
- Postoperative IS (D1-D4): Postoperative incentive spirometer received on days 1 to 4 after surgery.

Postoperative Outcomes and Complications

- Duration of hospital stay
- Length of ventilator stay
- Mortality status (survived or deceased)

Results

Table (1): Participant Information

Sociodemographic variables	Cases (n=71)	
	No.	%
Age category (years)		

Less than 25 years	12	16.9%
From 26 to 50 years	16	22.5%
More than 50 years	43	60.56%
Gander		
Male	45	63.38%
Female	26	36.61%
Weight		
Less 100 kg	31	43.66%
More than or equal 100 kg	40	56.33%
Height		
Less than 170 cm	30	42.25%
More than or equal 170 cm	41	57.74%
BMI		
Less than 25	19	26.76%
More than or equal 25	52	73.23%
Smoking History		
Yes	30	42.25%
No	41	57.74%

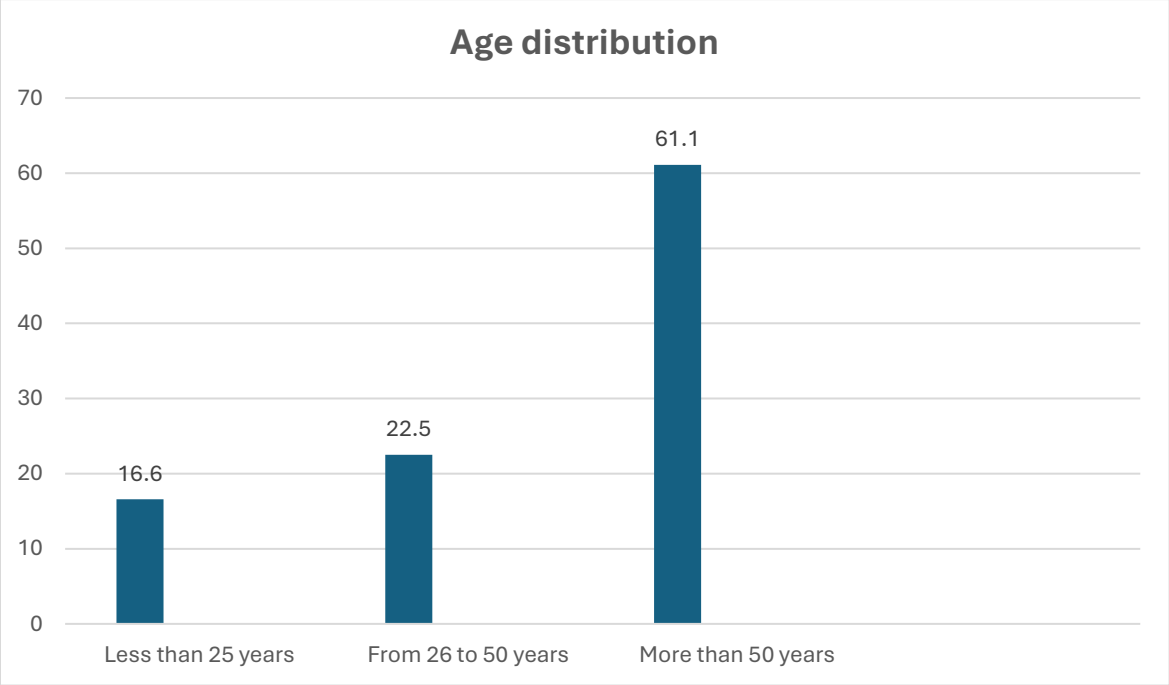

Fig (1): Age distribution among the studied participants

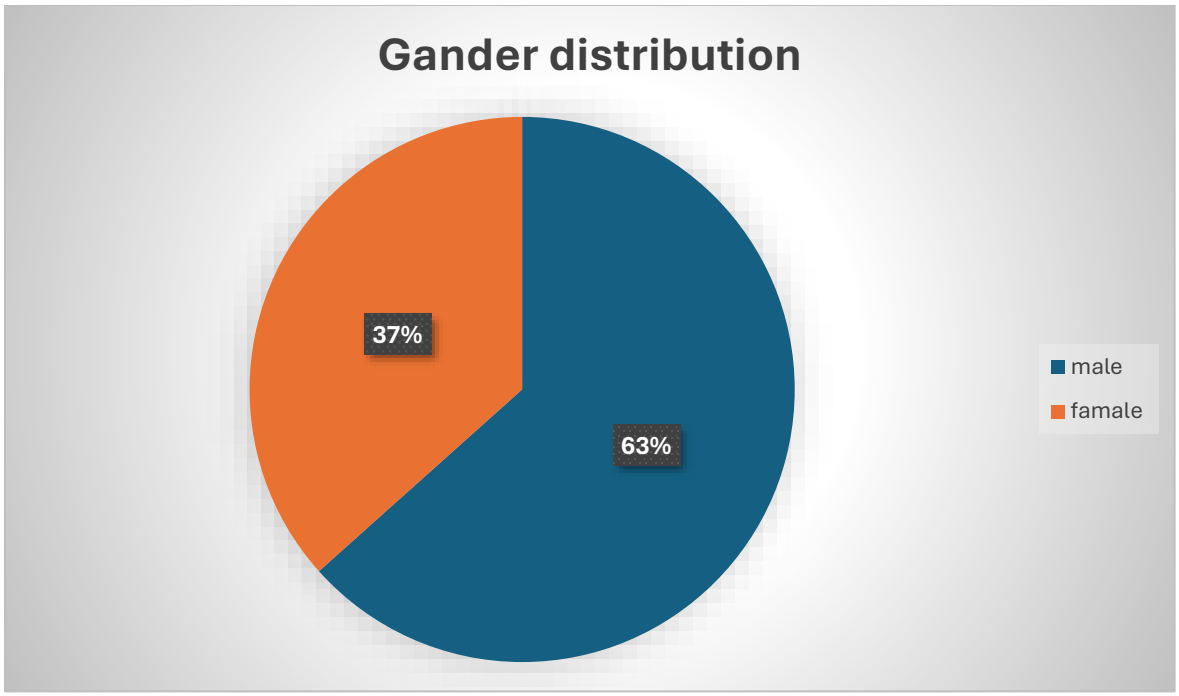

Fig (2): gander distribution among the studied participants

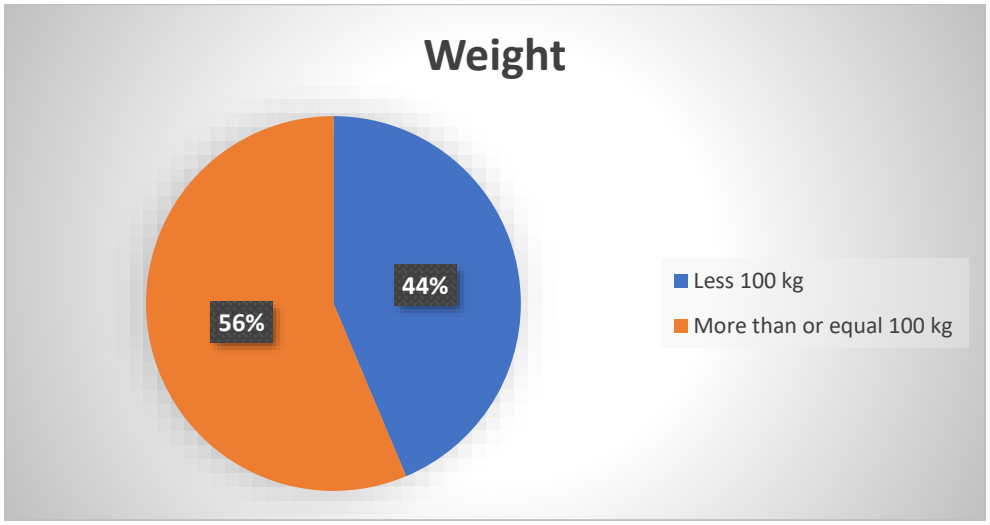

Fig (3): Weight distribution among the studied participants

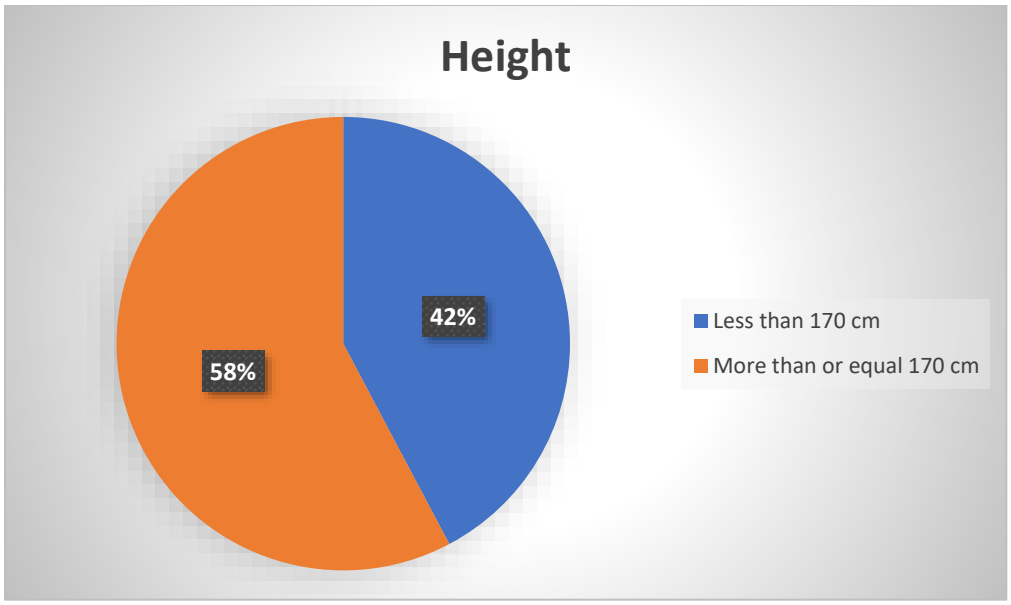

Fig (4): Height distribution among the studied participants

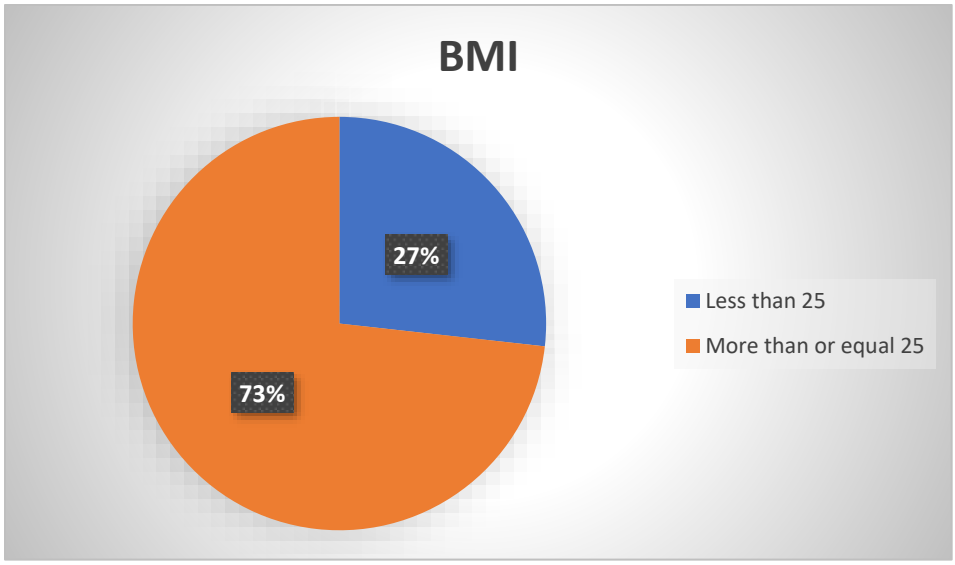

Fig (5): BMI distribution among the studied participants

Table (1) & Figure (1-2) showed that 16.6% and 61.1% of the studied participants were aged less than 25 years and more than 50 years respectively. Regarding to the gander, more than half (63%) were males and 37% were females. 56.94% of the studied participants were nonsmoker. As regard to BMI, 73.23% of the studied participants were more than 25.

Secondly: Results Related to Admission and Surgery Details:

Table (2): Admission and Surgery Details

	No.	%
Preoperative Diagnosis		

Smoking-related lung disease	16	22.5
COPD	25	35.2
No Respiratory Issues	20	28.16
Asthma	10	14.08
Type of Surgery		
CABG (Coronary artery bypass grafting)	44	61.97
Aneurysm Repair	3	4.2
Valve Replacement	24	33.8
Surgery Duration		
Less than 5 hours	29	40.84
More than or equal 5 hours	42	59.15

According to "Preoperative Diagnosis "There are (22.5%) of the respondents diagnosed as (Smoking-related lung disease), which is the highest percentage, (35.2%) of the respondents diagnosed as (COPD), which is the highest percentage, (28.16%) of the respondents diagnosed as (No Respiratory Issues), (14.08%) of the respondents diagnosed as (Asthma). Regarding to the type of surgery, more than half (61.97%) were undergoing CABG (Coronary artery bypass grafting), 4.2% were undergoing aneurysm repair surgery and 33.8% were undergoing Valve Replacement surgery. Regarding to the surgery duration, 40.84% and 59.15% of the studied surgeries were less than5 hours and more than or equal 5 hours respectively.

Thirdly: Results Related to Preoperative and Postoperative incentive spirometer (IS):

Table (3): Preoperative and Postoperative incentive spirometer (IS)

	No.	**%**
Preoperative IS		
Yes	45	63.38
No	26	36.61
Postoperative IS (D1-D4)		
Yes	33	46.47
No	38	53.52

According to Preoperative incentive spirometer, there are (63.38%) of the respondents, chose (yes) and (36.61%) chose (no). Regarding to the Postoperative incentive spirometer, there are (46.47%) of the respondents chose (yes) and (53.52%) chose (no).

Fourthly: Results Related to Postoperative Outcomes and Complications

Table (4): Postoperative Outcomes and Complications

	No.	**%**
Duration of hospital stay		
Less than 20 days	38	53.52
More than or equal 20 days	33	46.47
Length of ventilator stay (hours)		
Less than 10 hours	49	69.01
More than or equal 10 hours	22	30.98
Mortality status		
Survived	58	81.70

Deceased	13	18.30

Regarding to the duration of hospital stay, 53.52% and 46.47% of the studied respondents were less than 20 days and more than or equal 20 days respectively. According to the length of ventilator stay (hours), 69.01% and 30.98% of the studied respondents were less than10 hours and more than or equal 10 hours respectively. Regarding to the mortality status, (50.70%) are survived and 49.29% were deceased.

Fifthly: Results Related to Comparison between Doing Preoperative IS or Not and its Outcomes

Table (5): Comparison between Decision of Doing Preoperative IS or Not

	Cases (n=71)	
	No.	%
Preoperative IS		
Yes	40	56.3
No	31	43.7

According to decision of doing preoperative IS, there are (56.3%) of the patients chose to do the operation.

Table (6): Comparison between patients who did pre-operative IS and patients who did not

Outcomes	Preoperative IS		No preoperative IS	
	No.	%	No.	%
Duration of hospital stay				
Less than 20 days	35	87.5	11	35.5
More than or equal 20 days	5	12.5	20	64.5
Length of ventilator stay (hours)				
Less than 10 hours	33	82.5	5	16.1
More than or equal 10 hours	7	17.5	26	83.9
Mortality status				
Survived	36	90	2	6.4
Deceased	4	10	29	93.5

Regarding to the duration of hospital stay, 87.5% and 12.5% of the studied respondents were less than 20 days and more than or equal 20 days respectively who did the operation. Although, 35.5% and 64.5% of the studied respondents were less than 20 days and more than or equal 20 days respectively who didn't do the operation. According to the length of ventilator stay (hours), 82.5% and 17.5% of the studied respondents were less than10 hours and more than or equal 10 hours respectively who did the operation. Although, 16.1% and 83.9% of the studied respondents were less than10 hours and more than or equal 10 hours respectively who didn't do the operation. Regarding to the mortality status, (90%) are survived from whom did the operation but 6.4% were survived from whom didn't do the operation.

Discussion

In this study, according to socio demographic characteristics of the studied participants there are many variations. Regarding to the age, the results showed that 16.9%, 22.5% and 60.56% of the studied participants were aged less than 25 years, 26-50 years and more than 50 years respectively. Regarding to the gander, more than half (63.38%) were males and 36.61% were females. Regarding to the weight, less than half (43.66%) were less 100 kg and 56.33% were more than or equal 100 kg.

In previous studies, female patients have a higher risk of post-operative mortality. Lung disease was the only pre-operative disease that was more frequent in females compared with males. Female patients' odds of longer sick leave seem unrelated to their degree of illness on admission to the hospital (15).

Regarding to the height, less than half (42.25%) were less 170 cm and 57.74% were more than or equal 170 cm. According to the body mass index, less than half (26.76%) were less 25 and 73.23% were more than or equal 25. Regarding to smoking history, less than half (42.25%) were smoker and 57.47% were nonsmoker.

Similar to the findings of the study by Alam et al. and other studies' findings indicated that half of the study population was overweight, with a BMI of ≥25 to 29.9 kg/m2. These findings are not unexpected because there is a strong correlation between being overweight or obese and established as well as new cardiovascular disease risk factors. In terms of smoking status, heavy smokers and light smokers made up the largest percentages in the study group (31.3%) and control group (34.3%), respectively. This finding is in line with the findings of Sharif-Kashani et al. (17), who found that 43.7% of patients had a cumulative tobacco exposure of >40 pack years. These results confirm that smoking increases low-density lipoprotein (LDL) oxidation and decreases coronary endothelial vasodilation, which both contribute significantly to early coronary atherosclerosis and the acceleration of atherosclerosis (16).

According to “Preoperative Diagnosis “There are (22.5%) of the respondents diagnosed as (Smoking-related lung disease), which is the highest percentage, (35.2%) of the respondents diagnosed as (COPD), which is the highest percentage, (28.16%) of the respondents diagnosed as (No Respiratory Issues), (14.08%) of the respondents diagnosed as (Asthma). Regarding to the type of surgery, more than half (61.97%) were undergoing CABG (Coronary artery bypass grafting), 4.2% were undergoing aneurysm repair surgery and 33.8% were undergoing Valve Replacement surgery.

Patients with asthma had a low perioperative risk of postoperative pulmonary complications (PPCs), according to the majority of research. The confounding effect of the patient population's younger age and lower comorbidities may contribute to this observation in part. However, especially during airway manipulation and endotracheal intubation, the peri-anesthetic phase can be linked to potentially fatal bronchospasm and status asthmaticus. In order to provide enough time for medical optimization, preoperative examination is crucial and should ideally be planned a few weeks before elective surgery (6).

According to Preoperative incentive spirometer, there are (63.38%) of the respondents chose (yes) and (36.61%) chose (no). Regarding to the Postoperative incentive spirometer, there are (46.47%) of the respondents chose (yes) and (53.52%) chose (no). Regarding to the duration of hospital stay, 53.52% and 46.47% of the studied respondents were less than 20 days and more than or equal 20 days respectively. According to the length of ventilator stay (hours), 69.01% and 30.98% of the studied respondents were less than10 hours and more than or equal 10 hours respectively. Regarding to the mortality status, (50.70%) are survived and 49.29% were deceased.

The results of other studies show how the study group and control group differed in the number of days they spent in the intensive care unit (ICU), indicating that the study group's use of preoperative IS reduced their ICU stay relative to the control group (Figure 3). These findings were corroborated by a previous Turkish study that found preoperative Inspiratory Muscle Training decreased the ICU stay (16). Patients in the intervention group spent less time in the intensive care unit (ICU) and in the hospital overall after receiving training with a preoperative incentive spirometer than patients in the control group. This reinforces the well-established idea of "meaningful use" of healthcare resources by leading to the effective use of the limited resources and a decrease in health-care expenses.

According to Renault et al.'s findings, an early incentive to cough reduces pain and improves control. Pain and postoperative fear are linked to changes in lung mechanics that affect the performance of periodic deep inspiration and an effective cough with effective spirometry. These changes allow for the accumulation of secretion, alveolar collapse, and changes in gas exchange (17).

Recommendations

Because incentive spirometers tend to have a preventive impact against PPCs, patients undergoing open-heart surgery should have free access to these devices in the surgical units, along with sufficient training

and encouragement. These results need to be confirmed by bigger sample size studies that explicitly target patients with preexisting respiratory conditions including asthma and Chronic Obstructive Pulmonary Disease (COPD). Double blinding in the recruitment and outcome evaluation processes should be taken into consideration in future clinical studies. Future clinical studies need to consider patients' adherence concerns in order to build a stronger database and make pertinent findings.

Conclusion

Together with patient-related risk factors, postoperative pulmonary problems result from anticipated pathophysiologic changes brought on by anesthesia and surgical stress. They significantly influence both perioperative morbidity and mortality. To accurately predict perioperative risk, optimize underlying respiratory condition, and create a treatment plan to reduce postoperative complications, a multidisciplinary team may need to be included in the complex preoperative pulmonary examination process.

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