COLLEGE OF HEALTH SCIENCE

SCHOOL OF MEDICINE

DEPARTMENT OF ANESTHESIA

INCIDENCE AND ASSOCIATED FACTORS OF POSTOPERATIVE PULMONARY COMPLICATIONS IN PATIENTS UNDERWENT ABDOMINAL SURGERY AT PUBLIC HOSPITAL, ADDIS ABABA ETHIOPIA. CROSSSECTIONAL STUDY

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A RESEARCH THESIS TO BE SUBMITTED TO DEPARTMENT OF ANESTHESIA, COLLEGE OF MEDICINE AND HEAITH SCIENCES, ADDISS ABABA UNIVERSITY IN PARTIAL FULLFILMENT OF THE REQUIREMENTS FOR MSC DEGREE IN CLINICAL ANESTHESIA

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COLLEGE OF HEALTH SCIENCE

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Title of research	Incidence and associated factors of postoperative pulmonary complications in patients underwent abdominal surgery in multiple public hospitals, Addis Ababa Ethiopia. Cross-sectional study
Duration of project	From February 1 to April 30, 2020/21
Study area	Addis Ababa, Ethiopia
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Declaration

I, the undersigned, declare that this thesis is my original work in partial fulfillment of the requirements for the Master of Science degree in Anesthesia. I understand that plagiarism will not be tolerated and all directly quoted material has been appropriately referenced

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Assurance of investigators

The undersigned agrees to accept responsibility for the scientific, ethical and technical conduct of the research project and for provision of required progress reports as pre terms and conditions of the research and publications office of Addis Ababa University

Approval of the advisor(s)

Name

1._____signature_____Date_____

*2.*_____*signature*_____*Date*_____

Advisor agreement

Full title of research project: *Incidence and associated factors of postoperative pulmonary complications in patients underwent abdominal surgery at public hospital, Addis Ababa, Ethiopia. Cross-sectional study*

This thesis work has been submitted for examination with my/our approval as Advisors and Tutors on the Master of Science degree in Anesthesia

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ACRONYMS

ASA	American Society of Anesthesiologist
BMI	Body Mass Index
EPCO	European Perioperative Clinical Outcome
ICU	Intensive Care Unit
LOS	Length of Hospital Stay
NMBA	Neuromuscular Blockade Agent
NRS	Numerical Rating Scale
PACU	Post Anesthesia Care Unit
POD	Postoperative Day
PPCs	Postoperative Pulmonary Complications
SpO2	Arterial Ox Hemoglobin Saturation
SPSS	Statistical Package of the Social Sciences
TASH	Tikur Anbesa Specialized hospital
UAS	Upper Abdominal Surgery

Abstract

Background: Postoperative pulmonary complication is a general term of affecting the respiratory system that can alter the clinical course of patients. Its incidence in the world is wide (5-60%) and it leads to morbidity, mortality, and long hospital stay. Managing patients who develop postoperative pulmonary complications requires an understanding of respiratory physiology occurring after surgery and anesthesia as well as a knowledge of factors associated with the development of postoperative pulmonary complications.

Objectives: To assess the incidence and associated factors of postoperative pulmonary complications among adult surgical patients who underwent abdominal surgery in multiple public hospitals, Addis Ababa, Ethiopia

Methods: Institutional based cross-sectional study design was conducted at Minilik II, Tikur Anbessa, Zewuditu and Yekatit Hospital and selected purposely. A systematic random sampling method was employed. Data collection included Socio-demographic and Perioperative factors employed by using short interview, chart review and medical record. The data was entered and analyzed using SPSS version 26 and logistic regression also employed. A p-value of <0.05 was considered as a cutoff point to test for statistical significance.

Result: Among 287 patients who underwent abdominal surgery, 33 % developed postoperative pulmonary complications. Pneumonia (50%) was the most common complications followed by atelectasis (24%). Age ≥64 years (AOR=12.091, 95% CI=3.310-44.169), duration of surgery >3 hours (AOR=11.737, 95% CI=3.621-38.039), preoperative oxygen saturation <94% AOR=10.671, 95%CI=3.794-30.016), postoperative serum albumin level <3.5 g/dl (p-value<0.001) were significantly associated with postoperative pulmonary complications.

Conclusion: The incidence of postoperative pulmonary complications was high (33%). Pneumonia (50%) was the most common. Age ≥65 years, duration of surgery >3 hours, SpO2% < 94%, and serum albumin level <3.5g/dl were strongly associated with postoperative pulmonary complications. Therefore health professionals should be care given for elderly patients, minimize operative time < 3 hours, treat the underlying cause of low SpO2% and correct serum albumin and should be known all possible factors and develop a strategy for the resource-limited area

Key word: Pneumonia, upper abdominal, lowers abdominal, risk factors, perioperative

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1. Introduction

1.1. Background

A postoperative pulmonary complication is an umbrella term used to describe any adverse changes to the respiratory tract occurring immediately after surgery and affecting the clinical course of the patients(1). The European Society of Anesthesiology and the European Society of Intensive Care Medicine have developed standard definition for postoperative pulmonary complications(2). The incidence of postoperative pulmonary complications in the world is between 5 and 80% (3). This variation is mainly associated with the unavailability of clear definitions, hospital set-up, and perioperative risk factors. Postoperative pulmonary complications need emphasis as postoperative cardiac complications and it does contribute to increased length of hospital stay and financial expenses. Almost 25% of postoperative mortality occurring in the first week after surgery is related to postoperative pulmonary complications (3,4).

Surgical patients in Africa are younger, with a lower risk profile and low complication rates, but twice as likely to die when compared with the global average(6). A prospective observational study was conducted in 2019 at Nnamdi Azikiwe University Teaching Hospital in Nigeria revealed that among 50 patients who underwent elective abdominal surgery the rate of postoperative pulmonary complications was 52% and another retrospective observational study carried out at a government hospital in Harare, Zimbabwe showed among 92 patients 42.4% of them developed postoperative pulmonary complications and An observational study conducted in 2015 at university of Gondar comprehensive specialized hospital found that among 405 surgical patients 21.7% were developed postoperative pulmonary complications(6,7,8).

Various factors have been shown in literatures to cause postoperative pulmonary complication. In Nigeria observational study found that preoperative cough, shortness of breath and consolidation, postoperative respiratory rate, and pulse rate were risk factors for developing postoperative pulmonary complication(7). A Study in Zimbabwe revealed that a history of alcohol consumption, prolonged surgery, prolonged stay in the hospital, incision type, and the presence of comorbidities were recorded as risk factors for pulmonary complications(8). A Study at the University of Gondar Hospital showed that the use of general anesthesia, intraoperative

blood loss, poor postoperative pain control, and prolonged surgery were independently associated with postoperative pulmonary complications(10).

All of these are used to improve respiratory function postoperatively by increasing ventilation and functional residual capacity in order to improve gas exchange and make breathing easier. Appropriate diagnostics, and risk reduction strategies will help improve surgical outcomes and decrease the economic crisis of postoperative pulmonary complications(1,3). Most deaths occur after surgery, suggesting a need to improve the quality of care through postoperative surveillance for deteriorating patients on the ward and ICU(6).

1.2. Statement of the problem

The incidence and risks factors for postoperative pulmonary complications after abdominal surgery are not completely understood. Several literatures showed a wide range of postoperative pulmonary complications ranging from 5%-60%(8-30). Variation of definitions, preoperative tests to identify the associated risk, criteria used to diagnose, and diverse populations in different countries was the major contributory factors to develop postoperative pulmonary complications in a wide range. Postoperative pulmonary complications were frequent associated with higher morbidity and mortality and many scoring systems exist to quantify the risk but there was no standard scoring system exists to use clinically to determine postoperative pulmonary complications.(11). It affects the respiratory drive, muscle function, and lung volumes. After major abdominal surgery following general surgery it might take 6 weeks to return to its preoperative state(1).

Different literatures in different country state which postoperative pulmonary complication was the most common. Research done in Ethiopia, University of Gondar Hospital, and in Zimbabwe showed pneumonia was a most common complication (8,9). As one of third world country the possible cause were shortage of respiratory-therapy devices due to re-use of several times, cross-contamination via hands of personnel due to lack of hygiene, long duration of hospital stay and presence of comorbidities. Other study conducted in Pakistan showed atelectasis was a most common complication(15). Research done in developed country in china found respiratory infection was a most common complication(16). Study conducted in Turkey by and in Brazil revealed that respiratory failure was a most common complication(17,18).

The studies showed perioperative risk factors are liable for postoperative pulmonary complications. Some are ASA>III, age≥65 years, history of upper respiratory tract infection, use of general anesthesia, incision type, the presence of the comorbidities, the habit of smoking, history of alcohol consumption, low socioeconomic status, decreased oxygen hemoglobin saturation less than 94%, positive sputum culture, serum albumin of less than 3.5gm/dl, intraoperative blood loss, hemoglobin of less than 10 gram/dl, blood transfusion, prolonged surgery, postoperative mechanical ventilation, prolonged stay in the hospital, cardiac surgery, history of previous respiratory diseases, poor postoperative pain control, use of neuromuscular blocking drugs, early mobilization and appropriate anesthetic technique (8,13-16,23-26,31,38,48).

Postoperative pulmonary complications after abdominal surgery are still a major problem. Limited data available in Ethiopia indicating the incidence and associated factors of postoperative pulmonary complications. So, the result of this research will help us to assess the incidence and associated factors of postoperative pulmonary complications. It can lead to a long hospital stay, high economic burden, and death in selected Addis Ababa governmental hospitals. A systematic review was done at the University of Gondar in Ethiopia in 2021 showed perioperative risk stratification and screening were vital during the preoperative period to reduce the post-operative pulmonary complications in the resource-limited area(3).

The future development and adaption of innovative strategies are required to reduce their impact on the elderly and co-morbid population. Risk stratification is essential to identify patients at risk and to predict for developing PPCs. It helps to develop preventative strategies to reduce the occurrence of postoperative pulmonary complications.

1.3. Justification of the study

In this study, we have used a definition of PPCs that is clinically relevant in terms of affecting key outcomes including morbidity, mortality, and length of stay. Moreover, the risk factors associated with PPCs after abdominal surgery can be identified and the necessary precaution can be used by responsible bodies. Identifying risk factors predisposing to this outcome may help in the elaboration of prevention strategies. Plans to reduce the rate of complications have to be implemented by the health professionals as a team to reduce the burden of disease on the patients as well as on hospital setup. The ability to predict and prevent modifiable adverse clinical events such as postoperative pulmonary complications has become vital for quality and safety of hospital care.

Knowledge about postoperative pulmonary complications and predicting factors in our study area setup is lacking. Limited data available in Ethiopia indicating the incidence and associated factors of postoperative pulmonary complications. Awareness about postoperative pulmonary complications is not clearly known following abdominal surgery.

We undertook this issue to see the incidence and predictors of PPC and to recommend the strategies for their prevention and to reduce the financial health care burden. This is very vital for a poorly funded health care system like the one in a developing country like Ethiopia. So that appropriate measures can be taken during preoperative, intraoperative, and postoperative periods for better patient handling to improving quality of care in surgical patients and health care facilities. So emphasis should be given to diagnose postoperative pulmonary complications.

So this paper is important as a baseline for future study about postoperative pulmonary complications in Ethiopia. The main goals of this study are to answer which factors are more associated with postoperatively pulmonary complications and to find out the incidence of postoperative pulmonary complications following abdominal surgery.

2. Literature review

2.1. Incidence of postoperative pulmonary complication

In 2015, an observational prospective study was conducted by denu za, et al. in University of Gondar Hospital in Ethiopia found that among 405 surgical patients 21.7% were developed PPCs and included postoperative pneumonia (85.2%) followed by Bronchitis(11.4%) and respiratory failure(1.1%)(9). In 2017, a retrospective observational study carried out in Zimbabwe by Tadyanemhandu et al. showed among 92 patients 42.4% developed PPCs and the most common complications were nosocomial pneumonia (22.8%), ventilator associated pneumonia(12.0%), and atelectasis (6.5%)(8). In 2019, Ufoaroh et al. a prospective observational study was conducted in Nigeria, among 50 patients who underwent elective abdominal surgery 52% were developed PPCs(7). Prospective observational study was conducted in India, Kailash et al.(2020) among 35 patients who underwent emergency abdominal surgery, Sinouvassan V et al et al.(2019) among 100 patients who underwent gastrointestinal surgeries were 51.4%, and 34% respectively developing PPCs (26) (27).

A prospective observational study conducted in Pakistan in 2012 by Toori et al among 404 surgical patients 8% had developed PPC's and most common complications were atelectasis (48%) followed by bronchospasm(25%) and pneumonia (16%)(15). In 2015, Yue Jin et al. a prospective, multicenter, and observational study in China among 1673 participants who underwent non-cardiac surgical procedures 9.7% were developed PPCs and most common complications were respiratory infection (7.8%), bronchospasm (2.9%) and respiratory failure(1.8%)(16). In 2005, Jiang et al. among 1002 patients who underwent gastrointestinal surgery were retrospectively studied the incidence of PPC was 22.8 %(20). In 2016, A prospective cohort study by Martos-Benítez et al. in Cuba was conducted on 179 patients found 30.2% were developed PPCs(28). In 2016, Nertila Kodra et al. a prospective cohort study was conducted in Albania showed among 450 patients the incidence of PPC was 27.3 %(29). In 2010, p.agostini et al. A prospective observational study in the UK showed among 234 participants 14.5% were developed PPCs(30). In 2016, Patel et al. a prospective, multi-center cohort study in the UK found among 268 participants 11.9% were developed PPCs(31). Smith et al.'s Prospective observational study was conducted in 2010 New York showed among 200 patients 4.5% were developed PPCs(32). In 2017, Avila et al. a prospective, observational and

analytical study underwent thoracic and abdominal surgeries in Brazil among 314 participants 11.5% were developed PPCs and the most common complications were respiratory failure (9.2%), pleural effusion (1.3%) and pneumonia (1.3%)(17). In Turkey, observational study was conducted, by Büyük ve ark et al. (2020) among 683 participants who underwent non-cardiothoracic surgery, by kanat et al. (2007) 60 consecutive patients who underwent elective UAS, by Diken et al. (2019) among 307 participants were 10.3 %, 58.3%, and 32.6% respectively developing PPCs (22,33,34). A prospective observational cohort study conducted in Australia, K.J. Haines et al. (2013) among 72 patients who underwent high-risk abdominal surgery, Scholes et al. (2009) among 268 consecutive patients who underwent elective UAS, S. Parry et al. (2014) among 50 participants who underwent UAS surgery were 39%, 13%, and 42% respectively(35,36,37). In Spain, a prospective observational cohort study was conducted, canet et al. (2010) among 2,464 patients, Garutt et al. (2020) the rate of PPCs were 64.6% and 5% respectively (38,39). In Portugal, a retrospective, observational study conducted in 2019 by Fernandes et al. showed among 60 patients who underwent abdominal surgery within 48 and 24hr 60% were developed PPCs after 48 h(19).

2.2. Associated factors for Post-operative pulmonary complications

Most literatures showed older age significantly associated with developing of postoperative pulmonary complications (20,29,30,33,40-45). Research done by different researchers in different country showed when the ASA class above > II, the incidence rate of postoperative pulmonary complications also increased (29,30,33,45). In 2015, an observational prospective study was conducted by denu za, et al. in University of Gondar Hospital found intraoperative blood loss > 500ml twice increased rate of PPC than ≤ 500 (9). In 2015, Yue Jin et al. a prospective, multicenter, and observational study in China showed intraoperative blood loss ≥100ml associated with developing PPC (16). In 2017, Avila et al. a prospective, observational and analytical study who underwent thoracic and abdominal surgeries in Brazil found diabetic patients associated with developing PPCs (17). Study done by different researchers showed emergency surgery increased rate of PPC when compared to elective surgery (15,19,42-45). A retrospective observational study carried out in 2017 at Zimbabwe by Tadyanemhandu et al revealed a history of alcohol consumption increased the rate of PPC (8). In 2015, an observational prospective study was conducted by denu za, et al. in University of Gondar

Hospital found poor postoperative pain control increase the incidence of PPC and use of general anesthesia more likely associated with PPCs than regional anesthesia independently (9). Research done by different researchers showed cigarettes smoking associated with developing of PPC (16,26,36,40,41). Different researches showed low level of serum albumin (<3.5 g/dl) significantly associated with developing of PPC (16,19,20,33,40,45,46,47). Showed a serum albumin < 35 g/dl was one of the most powerful patient-related and predictors of risk factors. Literatures regarding on duration of surgery studied by different authors showed duration of surgery > 3 hours significantly associated with developing of PPC (8,9,15,29,31,41,44,45). Different researches showed low level of albumin significantly associated with developing of PPC (20,33,40,45,46).

A retrospective observational study carried out in Zimbabwe by Tadyanemhandu et al revealed upper incision type associated with developing PPC (8). Prospective, observational cohort study in 2013 conducted in Australia by K.J. Haines et al. showed midline incision type increased the rate of PPC (35). In 2015, Yue Jin et al. a prospective, multicenter, and observational study in China showed SpO2 <96% was strongly associated with developing of PPCs (16). Other, in Spain, a prospective observational cohort study was conducted by canet et al. in 2010 low preoperative arterial oxygen saturation (SpO2 <94%) (44). Prospective, multicenter, and observational study in China in 2015 by Yue Jin et al. showed abdominal surgical site (23%) and intra thoracic procedure (51.3%) associated with developing PPCs(16). In 2009, a prospective observational cohort study was conducted by Scholes et al. in Australia among 268 consecutive patients who underwent elective abdominal surgery found upper gastrointestinal surgery associated with developing of PPCs (36). In 2005, Jiang et al. among 1002 patients who underwent gastrointestinal surgery were retrospectively studied in china strongly associated with blood transfusion which increased the risk for postoperative infection and respiratory complication(20).

A prospective observational study in the UK in 2010 by p. agostini et al. showed among 234 participants found increased BMI was highly associated with developing of PPC (30). In 2016, Patel et al. a prospective, multi-center cohort study in the UK showed a history of malignancy strongly related with PPCs (31). In 2019, Sinouvassan V et al et al. a prospective observational descriptive-analytic study in India among 100 patients who underwent gastrointestinal surgeries

showed the hemoglobin of less than 8 g/dl. were associated with developing PPC (40). Other, prospective observational cohort study in Spain conducted by canet et al. in 2010 showed preoperative anemia (hemoglobin of less than 10 g/dl was associated with PPC (44). In Europe, a multicenter, prospective observational cohort study was conducted by Kirmeier et al. in 2019 among 22,803 surgical patients with PPCs associated with the use of neuromuscular blocking drugs in general anesthesia (48).

In 2019, a retrospective, observational study conducted in the US by Attaallah et al. found hypertension was independent risk factors for developing PPCs (45). In 2018, a retrospective cohort study was conducted in Japan by M. Hanada et al. showed a total of 118 patients who underwent Video-assisted thoracoscopic surgery revealed that early mobilization reduces the incidence of PPCs (49). Other, prospective, observational cohort study in 2013 conducted in Australia by K.J. Haines et al. showed time to mobilize away from the bed independently associated with postoperative pulmonary complications (35).

Conceptual framework

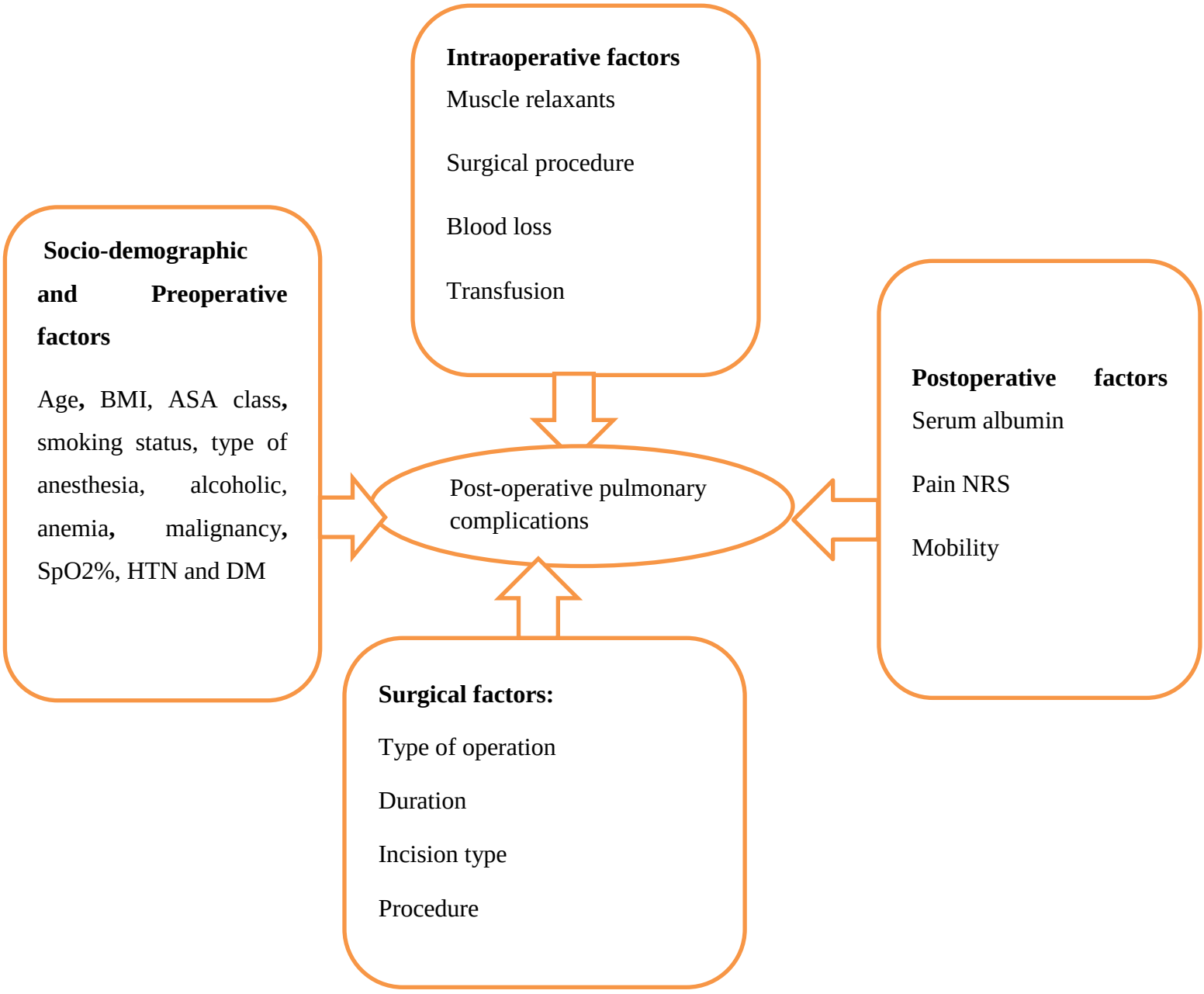

Figure 1 conceptual framework of perioperative risk factors for postoperative pulmonary complications

3. Objectives

3.1. General objective

- To assess the incidence and associated factors of postoperative pulmonary complications among adult abdominal surgical patients in selected Governmental Hospitals in Addis Ababa Ethiopia.2020/2021

3.2. Specific objective

- To determine the incidence of postoperative pulmonary complications among adult abdominal surgical patients in selected Governmental Hospitals in Addis Ababa Ethiopia.2020/2021.
- To identify the associated factors of postoperative pulmonary complications among adult abdominal surgical patients in selected Governmental Hospitals in Addis Ababa Ethiopia.2020/2021

4. Method and Materials

4.1. Study Area

Addis Ababa is the capital city of Ethiopia. In Addis Ababa city administration total of 13 hospitals are found. Four governmental hospitals were used for this study. They are TASH, Zewuditu memorial hospital, Minilik II Hospital and Yekatit 12 Hospital. The four hospitals were chosen purposely for this study. Tikur Anbessa Specialized Hospital is the largest and the main teaching hospital in the country. It offers diagnosis and treatment for approximately 370,000- 400,000 patients a year with nearly 8000 surgeries are performed annually with 15 operation rooms. Zewuditu memorial hospital is named after Empress Zawuditu, the cousin and predecessor on the throne of Emperor Haile Selassie. Today the Zewuditu Hospital is operated by the Ministry of Health 128 bed 7 operation rooms. Minilik II Hospital, one of the well-known and oldest public hospitals in Addis Ababa. Today the hospital is operated by the Ethiopian Ministry of Health. The hospital surgery department provides all general, thoracic, urological, gynecological, orthopedics, and ophthalmic surgeries, and now 135 bed 8 operation rooms are available and one PACU. Yekatit 12 Hospital Medical College is giving routine health services for Addis Ababa and other referral cases from different regional states of Ethiopia. The hospital provides services for a population of approximately 4 million people. It has 9 departments and 6 units and has 265 beds.

4.2. Study design

An Institutional-based cross-sectional study was conducted in a selected Governmental Hospital, Addis Ababa, Ethiopia from February 1 to April 30, 2020/21

4.3. Study period

From February 1 to April 30, 2020/21 and total follow-up period was 7 days starting from day one postoperatively

4.4. Population

4.4.1. Source of population

All patients who underwent elective and emergency abdominal surgery in Governmental Hospital, Addis Ababa, Ethiopia

4.4.2. Study population

All surgical patients undergoing for abdominal surgery during the study period and fulfilling inclusion criteria

4.5. Inclusion and exclusion criteria

4.5.1. Inclusion criteria

All surgical patients undergoing abdominal surgery aged ≥ 15 years

4.5.2. Exclusion criteria

Pregnancy

ASA Class >II

Preoperatively intubated trachea

Procedures performed under local anesthetic infiltration

Reoperation

Patients with preexisting respiratory diseases

4.6. Study variables

4.6.1. Dependent variable

Post-operative pulmonary complications Yes/No

4.6.2. Independent variables

Socio-demographic and Preoperative factors: Age, BMI, ASA class, type of anesthesia, smoking status, alcoholic, preoperative anemia, malignancy, SpO2%, HTN and DM

Intraoperative and Surgical factors: Type of operation, duration of surgery, surgical incision, surgical procedure, type of anesthesia, muscle relaxants, blood loss, transfusion

Postoperative factors: serum albumin, pain score, and mobilization

4.7. Sample size determination and sampling technique

4.7.1. Sample size determination

The sample size was determined using single population formula. The incidence of postoperative pulmonary complications was 21.7% based on previous research done in University of Gondar Hospital in Ethiopia (10). So we used p=0.217, q= 1-p= 1-0.217=0.783

n = (Za/2)2×p*q/d2 = (1.96)2× (0.217) (0.783)/ (0.05)2 = 261

Where: n= number of sample size, Z =desired 95% confidence, Z= 1.96, d= is the margin of sampling error tolerated = 5 %. Non-response (contingency 10%), the final sample size was 287.

4.7.2. Sampling technique

Systematic random sampling was used to select study participants by using skip interval of K=N/n 500/287= 2 where, N- Total study population, n- Total sample size, K- Skip interval

Therefore, the sampling interval was two and the first study participant (random start) was selected using lottery method from the daily abdominal surgical patients. Then, every second cases from the daily abdominal surgical patient were included in the study during the study period. A review of situational analysis of the previous surgery per three months on the logbook 500 patients underwent abdominal surgery at selected Addis Ababa governmental hospitals. Then Adult patients who underwent abdominal surgery during the study period proportionally allocated for each selected Addis Ababa governmental hospital. The study unit were determined from 500 patients estimated to undergo abdominal surgery in four hospitals during study period, 287 participants were recruited with the probability of about 57% by considering the consecutive emergency or elective abdominal surgery. To calculate sample size for each hospital using

$\boldsymbol{n\,j} = \left(\frac{Nj}{N}\right)\boldsymbol{n}$ j=1, 2, k where k is the number of strata, n j=is the sample size of each hospital allocation and NJ=is the source population size of each hospital

n=n1+n2+n3+n4=is the total sample size

N=N1+N2+N3+N4=the total population size of each hospital

TASH (N= 130, n=74), Zewuditu (N= 145, n=83), Yekatit (N= 100, n=58), and Menelik (N= 125, n=72)

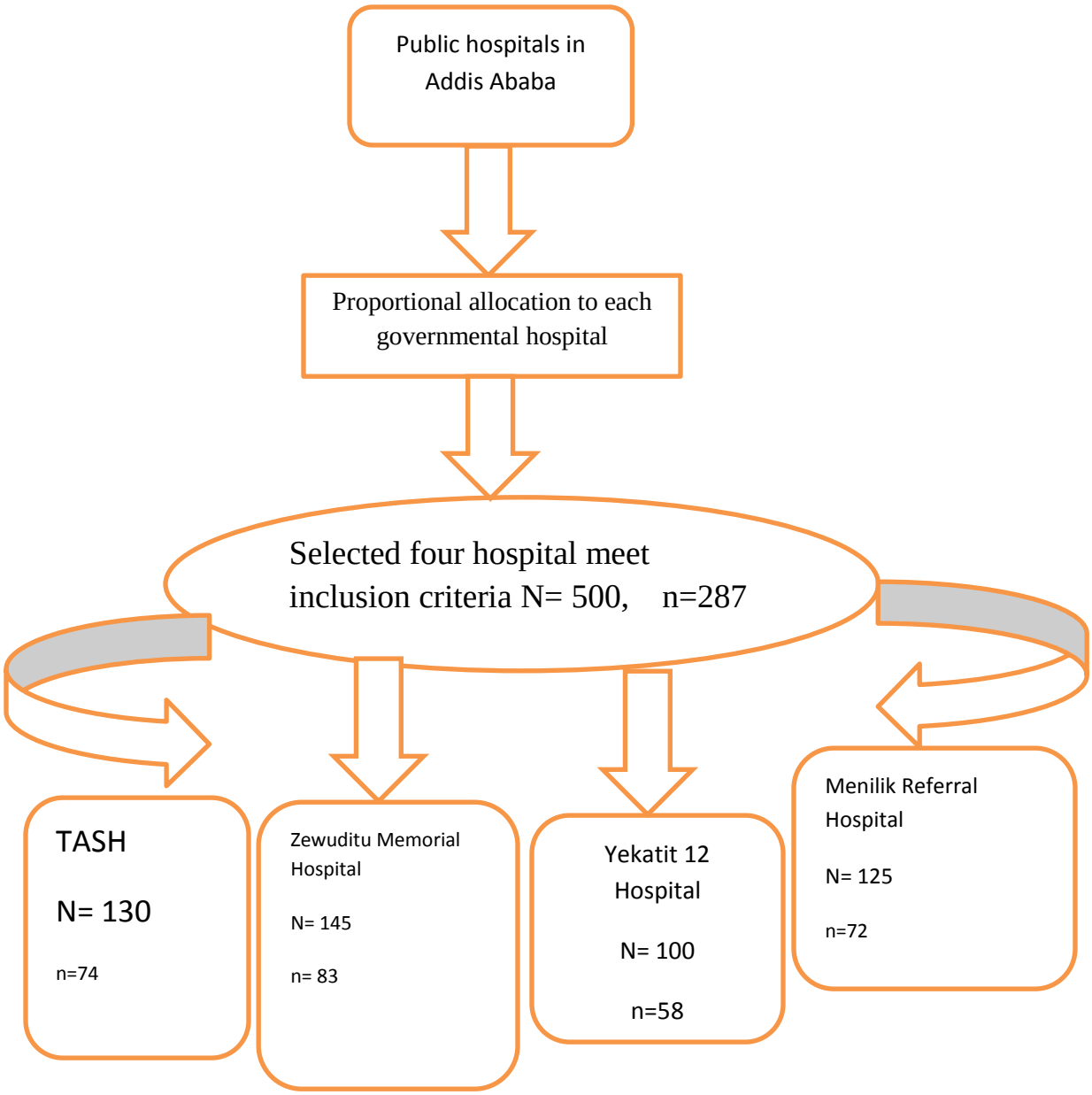

Figure 2 proportional allocation and enrollment chart for patients underwent elective and emergency abdominal surgery for each selected Addis Ababa governmental hospitals, Ethiopia from February 1- April 30 2021.

4.8. Data collection technique

Data were collected using a pretested questionnaire in the selected Governmental Hospital, Addis Ababa, Ethiopia. Data collection carried out by four trained BSc anesthetist assigned at each center. Postoperatively physicians diagnosed pulmonary complications by using European Perioperative Clinical Outcome (EPCO) definitions(2). On postoperative days 1 through 7, the subjects were seen and reviewed of medical record daily. A pre-tested questionnaire consisting of socio-demographic and preoperative variables, surgical-related factors, intraoperative-related factors, and postoperative-related factors were extracted from medical record. English version questionnaire was used and the data were collected consecutively after ethical clearance obtained from the AAU. The data collection started from day one postoperatively and the follow-up ends within 7 days post-operatively.

4.9. Operational definition

European Perioperative Clinical Outcome (EPCO) definitions(2).

Aspiration pneumonitis: Acute lung injury after the inhalation of regurgitated gastric contents

Atelectasis: Lung opacification with a shift of the mediastinum, hilum or hemi diaphragm toward the affected area, and compensatory over-inflation in the adjacent non-atelectatic lung

Bronchospasm: Newly detected expiratory wheezing treated with bronchodilators

Pleural effusion: Chest radiograph demonstrating blunting of the cost phrenic angle, loss of sharp silhouette of the ipsilateral hemi diaphragm in upright position, evidence of displacement of adjacent anatomical structures or (in supine position) a hazy opacity in one hemi thorax with Preserved vascular shadows

Pneumonia: Clinician decision to commence antibiotics for suspected pneumonia based on two or more of: chest radiograph evidence of infiltration; fever > 38 °C; leukocytosis > 12×10'9 and purulent sputum

Pneumothorax: Air in the pleural space with no vascular bed surrounding the visceral pleura

Respiratory failure: Postoperative PaO2 < 8 kPa (60 mmHg) on room air, a PaO2:FI02 ratio <40 kPa (300 mmHg) or arterial oxyhaemoglobin saturation measured with pulse oximetry < 90% and requiring oxygen therapy

Respiratory infection: Patient has received antibiotics for a suspected respiratory infection and met one or more of the following criteria: new or changed sputum, new or changed lung opacities, fever, white blood cell count > 12×10'9

Never smoker: has never smoked cigarettes in a life time

Former smoker: smoked regularly 1 cigarette/day or more, and quit at least 15 days before the operation

Current smoker: regularly smokes at least 1 cigarette/day as of at least 15 days before the operation

Abdominal surgery: broadly covers surgical procedures that involve opening the abdomen

Hypoalbuminemia: defined as a serum albumin level less than 3.5 grams per deciliter (g/dl)(50).

4.10. Data processing and analysis

Data were checked for completeness, and then coded, entered. Then the data were analyzed using SPSS version 26. Descriptive statistics were computed to determine frequencies and summary statistics (mean and percentage). Data were presented using tables and graphs. A p-value ≤ of 0.2 from bi-variable was transferred to multivariable to see the strength of association. Adjusted odds ratio with 95% CI was estimated to identify the factors associated with adherence status using multivariable logistic regression analysis. The level of statistical significance was declared at a p-value <0.05.

4.11. Data quality assurance

To assure the quality of data, training on the objectives and relevance of the study and brief Orientations on the assessment tools were provided for data collectors. During data collection, all data were collected and properly filled in the prepared format. The supervisor controlled the data collector and checked for completeness daily after data collection.

4.12. Ethical Considerations

Ethical clearance and approval were obtained from the ethical review committee, Anesthesia Department, Addis Ababa University. An official support letter was written to each selected Addis Ababa governmental hospital and permission for data collection was sought from the responsible authorities. The purposes and the relevance of the study were explained and verbal as well as written informed consent was obtained from each participant. Confidentiality was ensured by avoiding personal identification on the questionnaire.

4.13. Result dissemination plan

The result of the study will be submitted to the college of health science and school of medicine of Addis Ababa University, Minilik II Hospital, TASH, Zewditu Memorial Hospital, Yekatit 12 Hospital, and Ethiopian Anesthetist Association. The findings will be presented in different seminars, meetings, conferences, and workshops. Moreover, efforts will be done to publish the result of the study and disseminated them through different journals and scientific publications.

5. Result

5.1. Basic characteristics of respondents

In this study, 287 participants were analyzed with the response rate of 100%. The mean age of the participant was 39.42 ± 15.13. Almost both sexes were equally participated. Majority of participants were normal BMI (76.7%) in the range of 18.5-24.9. Of the study population, 209(72.8%), 22(7.7%) and 56(19.5%) were never, former and current smoker respectively.

Table 1: Basic characteristics of respondents among 287 patients underwent emergency and elective abdominal surgery at selected Addis Ababa governmental hospitals, Ethiopia from February 1-April 30, 2021.

Variables		Frequency(n)	Percentage (%)
Age	15-47	166	57.8
	48-63	55	19.2
	≥64	66	23
Gender	Female	143	49.8
	Male	144	50.2
BMI	<18.5	36	12.5
	18.5-24.9	220	76.7
	25-34.9	30	10.5
	>35	1	0.3
ASA status	ASA I	154	53.7
	ASA II	133	46.3
Type of anesthesia	General	249	86.8
	Regional	38	13.2
Type of operation	Elective	117	40.8
	Emergency	170	59.2
Alcoholic	Yes	46	16
	No	241	84
Preoperative anemia	Yes	33	11.5
	No	254	88.5
Preoperative saturation	<94%	99	34.5
	≥94%	188	65.5
Malignancy	Yes	34	11.8
	No	253	88.2
Hypertension	Yes	29	10.1
	No	258	89.9
Diabetes mellitus	Yes	21	7.3
	No	266	92.7

5.2. Intra operative anesthesia and surgery related factor

Another finding was that most of the surgical procedure that underwent in the study period was upper abdominal (58.9%) and 76% the patient loss less than 500ml of blood intraoperative.

Table 2: Intraoperative anesthesia and surgical factors among 287 study participants underwent emergency and elective abdominal surgery at selected Addis Ababa governmental hospitals, Ethiopia from February 1-April 30, 2021.

Variables		Frequency(n)	Percentages (%)
Surgical procedure	Upper abdominal	169	58.9
	Lower abdominal	46	16
	Both	72	25.1
Incision type	Vertical	146	50.9
	Horizontal	30	10.5
	Transverse	70	24.4
	Subcostal	41	14.3
Muscle relaxant	Short acting	17	5.9
	Intermediate	216	75.3
	Long acting	8	2.8
	None	46	16
Surgical position	Supine	268	93.4
	Lateral	5	1.7
	Lithotomy	14	4.9
Transfusion	Yes	36	12.5
	No	251	87.5
Intraoperative blood loss	≤500ml	218	76
	>500ml	69	24

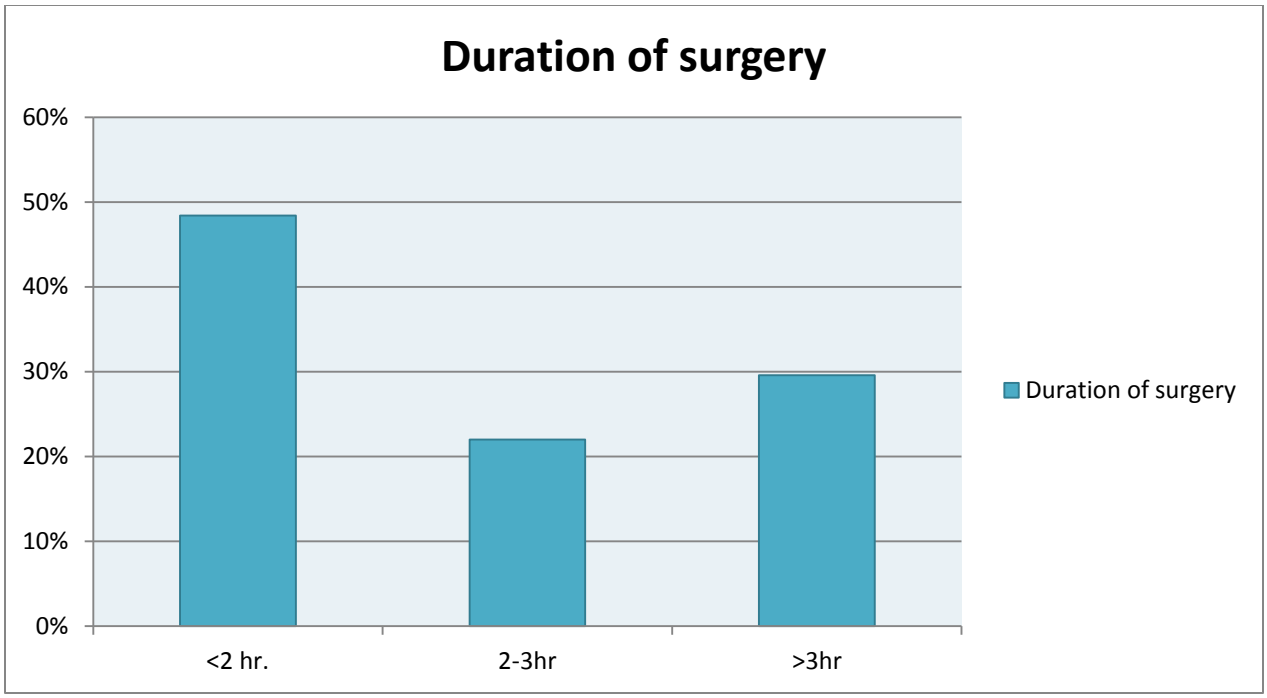

Figure 3: Duration of surgery distribution among 287 participants who underwent abdominal surgery at selected Addis Ababa governmental hospitals, Ethiopia from February 1-April 30, 2021.

5.3. Postoperative factors

Table 3: postoperative factors among 287 patients underwent abdominal surgery at selected Addis Ababa governmental hospitals, Ethiopia from February 1-April 30, 2021.

Variables		Frequency (n)	Percentage (%)
Postoperative albumin	<3.5	100	34.8
	≥3.5	187	65.2
NRS pain score	None	24	8.4
	Mild	138	48.1
	Moderate	98	34.1
	Severe	27	9.4
Postoperative mobility	≤24 hour	152	53
	>24 hour	135	47

Over all incidence of postoperative pulmonary complication

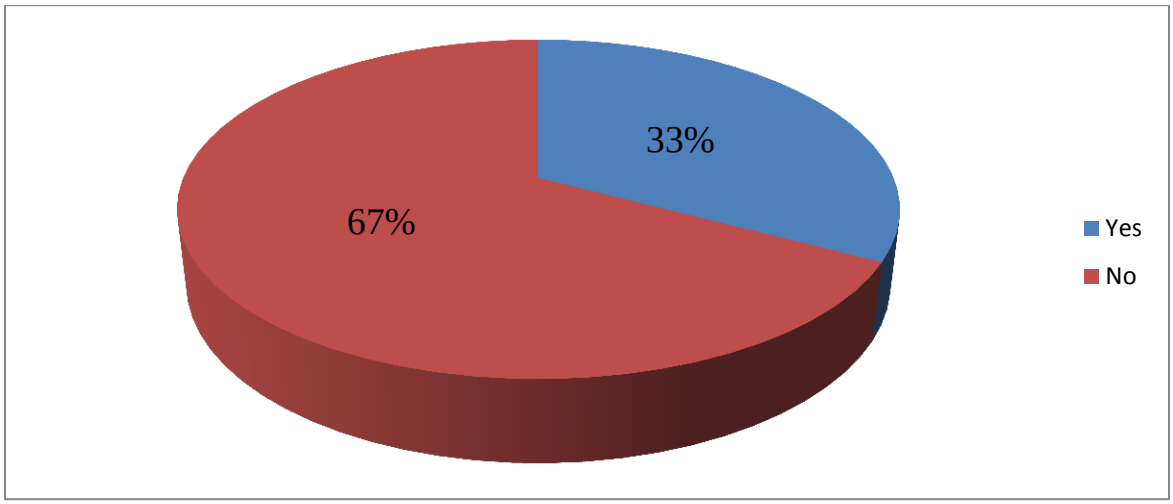

Figure 4: Incidence of postoperative pulmonary complications among 287 patients who underwent abdominal surgery at selected Addis Ababa governmental hospitals, Ethiopia from February 1-April 30, 2021.

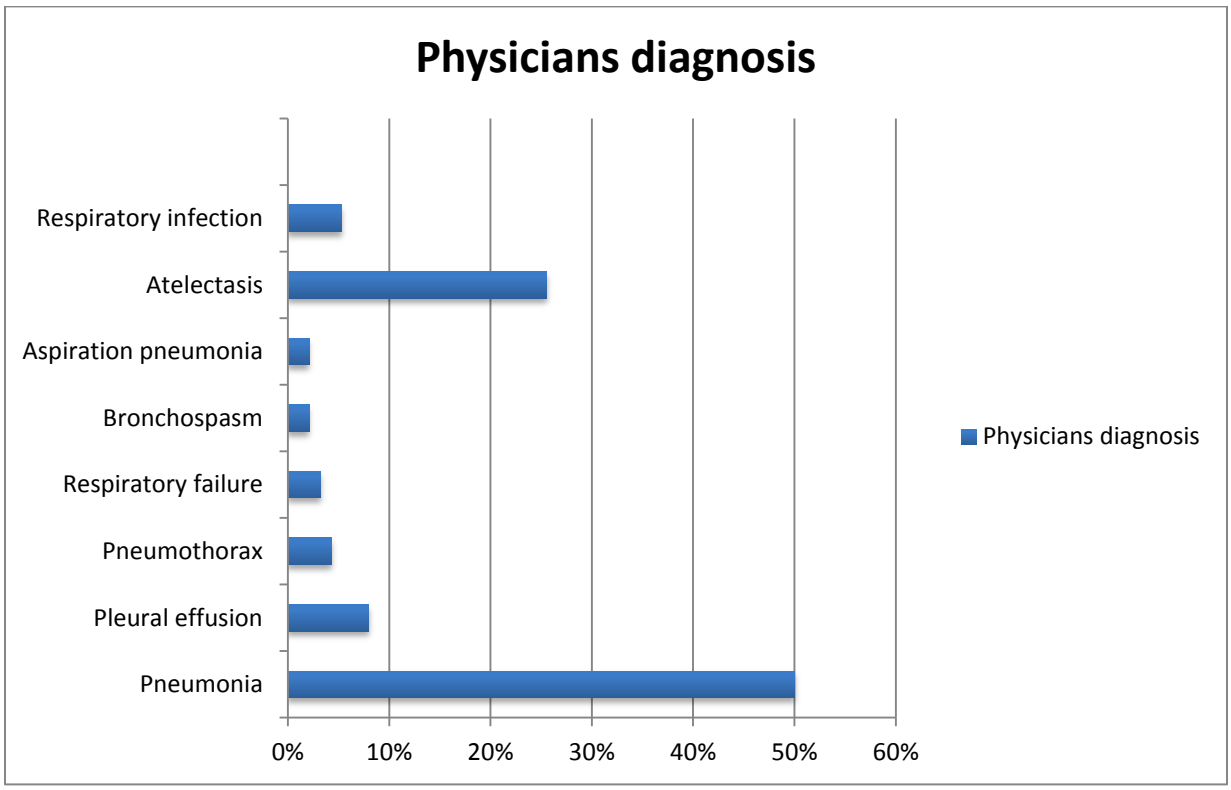

Figure 5: Distribution of complications among 94 patients who developed postoperative pulmonary complications that underwent abdominal surgery at selected Addis Ababa governmental hospitals, Ethiopia from February 1-April 30, 2021.

5.4. Factors associated with postoperative pulmonary complication after abdominal surgery

Binary logistic regression analysis was conducted to identify association of outcome variable with each explanatory variable. Nine independent variables were included in the bivariate analysis. After excluding variables which doesn't fit for the final model using P-value >0.2 when multivariate analysis was performed. Four variables were selected for multivariable model and all of variables were significant by using P-value <0.05.

Table 4: Bivariate analysis of postoperative pulmonary complication in abdominal surgical patients at selected Addis Ababa governmental hospitals, Ethiopia from February 1-April 30, 2021.

		Postoperative pulmonary complications			
Variables	Category	Yes (%)	No (%)	COR 95%CI	P-value
Age	15-47	25(26.6%)	141(73.1%)	1	
	48-63	15(16%)	40(20.7%)	0.735(0.136-3.971)	0.720
	≥64	54(57.4%)	12(6.2%)	0.078(0.011-0.552)	**0.011***
Surgical procedure	Upper abdominal	51(54.3%)	118(61.1%)	4.033(0.119-137.217)	0.438
	Lower abdominal	12(12.8%)	34(17.6%)	1	
	Both	31(33%)	41(21.2%)	6.463(0.125-334.303)	0.354
Type of anesthesia	General	83(88.3%)	166(86%)	0.177(0.005-6.167)	0.339
	Regional	11(11.7%)	27(14%)	1	
Duration of surgery	<2 hrs.	13(13.8%)	126(65.3%)	1	
	2-3 hrs.	12(12.8%)	51(26.4%)	2.003(0.286-14.026)	0.484
	>3 hrs.	69(73.4%)	16(8.3%)	0.064(0.011-0.381)	**0.003***
Type of operation	Elective	40(42.6%)	77(39.9%)	1	
	Emergency	54(57.4%)	116(60.1%)	0.574(0.117-2.809)	0.493
Smoking status	Never smoker	42(44.7%)	167(86.5%)	1	
	Former smoker	9(9.6%)	13(6.7%)	1.005(0.097-10.354)	0.997
	Current smoker	43(45.7%)	13(6.7%)	0.453(0.069-2.992)	0.411
Preoperative saturation	<94%	77(81.9%)	22(11.4%)	0.257(0.057-1.164)	**0.078***
	≥94%	17(18.1%)	171(88.6%)	1	
Albumin	<3.5	79(84%)	21(10.9%)	0.067(0.014-0.322)	**0.067***
	≥3.5	15(16%)	172(89.1%)	1	
Pain score	None	0	24(12.4%)	1	
	Mild	4(4.3%)	134(69.4%)	0.000	
	Moderate	63(67%)	35(18.1%)	0.000	
	Severe	27(28.7%)	0	0.000	

The present study confirmed that age ≥64 years patients underwent abdominal surgery were 12 times more risky to postoperative pulmonary complication when compared to those young adults patients who had age 15-47 years (AOR=12.091, 95% CI=3.310-44.169).

This study found that duration of surgery >3 hours increased the incidence of postoperative pulmonary complication 11 times as compared to those duration of surgery <2 hours (AOR=11.737, 95% CI=3.621-38.039).

Of the variables, those study participants who had preoperative oxygen saturation <94% were 10 times more risky for postoperative pulmonary complication after abdominal surgery as compared to those who were preoperative oxygen saturation ≥94%(AOR=10.671, 95%CI=3.794-30.016).

The participant, who had albumin level <3.5 g/dl postoperatively following abdominal surgery were 23 times risky for postoperative pulmonary complication when compared to those who had albumin level ≥3.5 g/dl (p-value<0.001).

Table 5: Factors associated with postoperative pulmonary complication in abdominal surgical patients at selected Addis Ababa governmental hospitals, Ethiopia from February 1-April 30, 2021.

Variable		PPCs		COR(95%CI)	AOR (95%)	p-value
		Yes	No			
Age	15-47	25(26.6%)	141(73.1%)	1	1	
	48-63	15(16%)	40(20.7%)	0.735(0.136-3.971)	1.399(0.409-4.783)	0. 593
	≥64	54(57.4%)	12(6.2%)	0.078(0.011-0.552)	12.091(3.310-44.169)	**0.000****
Duration of surgery	<2 hrs.	13(13.8%)	126(65.3%)	1	1	
	2-3 hrs.	12(12.8%)	51(26.4%)	2.003(0.286-14.026)	1.039(0.267-4.045)	0.956
	>3 hrs.	69(73.4%)	16(8.3%)	0.064(0.011-0.381)	11.737(3.621-38.039)	**0.000****
Preoperative saturation	<94%	77(81.9%)	22(11.4%)	0.257(0.057-1.164)	10.671(3.794-30.016)	**0.000****
	≥94%	17(18.1%)	171(88.6%)	1	1	
Albumin	<3.5	79(84%)	21(10.9%)	0.067(0.014-0.322)	23.407(7.956-68.865)	**0.000****
	≥3.5	15(16%)	172(89.1%)	1	1	

Key 1=reference, **=statistically significant, COR= crude odd ratio, AOR= adjusted odd ratio

6. Discussion

Our study was shown a postoperative pulmonary complication rate of incidence 33% following abdominal surgery which means that PPC is common in our study area setup. The incidence rate for development of PPCs in our study falls in the range of 5-60 % (8-30). This wide variation is mainly related to the unavailability of standard definitions, clinical set-up, perioperative risk factors, criteria used to diagnose and diverse populations in different countries (1,2). The reason why our incidence rate was relatively higher than the reported rates in Gondar University Hospital (denu za, et al. 2015) (9). The possible justification could be surgical procedure (Yue Jin et al. 2015, Scholes et al. 2009) surgery around the diaphragm lead to fear of adequate breathing due to pain that end up with PPC (16,36), duration of postoperative follow-up and criteria of diagnosis. Our study incidence of PPC was high when we compared with different authors reported incidence of postoperative pulmonary complication between 5 and 24 %(15-17,20,30-33). Possible justification for this variation which may be explained by differences in patients' risk factors (e.g., smoking status, co-morbid illness), socioeconomic status, sampling technique, and the criteria to diagnose postoperative pulmonary complication, site and urgency of procedure.

Our study was comparable to the study done by Sinouvassan V et al et al.(2019), Martos-Benítez et al (2016) and Diken et al. (2019) incidence of PPCs were 34%, 30.2%, and 32.6% respectively (22,27,28). These literatures supported our result. This might be due to criteria used to diagnose postoperative pulmonary complication or similar postoperative follow up period. In the present study the rate of postoperative pulmonary complication following abdominal surgery rate is lower than the reported rates Tadyanemhandu et al. in Zimbabwe, (K.J. Haines et al, S. Parry et al) in Australia were 42.4%, 39%, and 42% respectively(8,35,37). Additionally, research done by different authors in different country had higher incidence of PPCs 51.4%,52%,58.3%, and 60% respectively (7,19,26,34). Possible justification for higher rate of PPCs could be the site of surgery which was common in upper abdominal, emergency patients only involved, differences in patient populations and criteria used to define the postoperative pulmonary complication.

Pneumonia (50%) was the most common PPC identified in our study. Similarly with research done in Ethiopia, University of Gondar Hospital and in Zimbabwe (8,9). As one of third world

country the possible cause were shortage of respiratory-therapy devices due to re-use of several times, cross-contamination via hands of personnel due to lack of hygiene, long duration of hospital stay and presence of comorbidities. Our second common complication was atelectasis (24%). Unlikely, in Pakistan showed atelectasis was a most common complication(15). Possible justification could be the closer the incision to the diaphragm, the greater the risks of developing atelectasis. These might result from disruption of respiratory muscle movement and Pain also limits the movement of the chest. Research done in developed country in china found respiratory infection was a most common complication(16). Study conducted in Turkey and in Brazil revealed that respiratory failure was a most common complication(17,18).

This study demonstrates four significant independent perioperative risk factors Age ≥65 years, duration of surgery >3 hours, preoperative oxygen saturation <94%, and serum albumin level <3.5g/dl were strongly associated with postoperative pulmonary complication following elective and emergency abdominal surgery.

The participant, who had albumin level <3.5 g/dl postoperatively following abdominal surgery were 23 times risky for postoperative pulmonary complication when compared to those who had albumin level ≥3.5 g/dl (p-value<0.001). A serum albumin < 35 g/dl was one of the most powerful patient-related and predictors of risk factors. Different researches showed low level of albumin significantly associated with developing of PPC (16,19,20,33,40,45,47). Early postoperative decrease of serum albumin associated with metabolic response, length of stay and the duration of surgery / our study proved the duration of surgery as a risk factors for PPC (46). The serum albumin level indicating the nutrition status and associated with weakness of the expiratory muscles, decreased chest wall expansion and an increased incidence of pulmonary complications in patients undergoing elective upper abdominal surgery(52). The decrease in serum albumin postoperatively cause hemodilution during fluid transfusion and capillary permeability into the interstitial space that lead to PPC(50).

The present study confirmed that age ≥64 years patients underwent abdominal surgery were 12 times more risky to postoperative pulmonary complication when compared to those young adults' patients who had age 15-47 years. Most literatures consistent with our result so that older age independently a powerful predictive risk factor. It lead to a higher incidence of coexisting comorbid conditions(20,29,30,33,40-45). Physiologic aging leads to lowered PaO2, increased

work of breathing, mismatch of ventilation and perfusion, decline in central hypoxic drive and with aging, there is stiffening of the ribcage, decreased elasticity of the lungs, and reduced number and function of the cilia along the respiratory tract(53).

This study found that duration of surgery >3 hours increased the incidence of postoperative pulmonary complication 11 times as compared to those duration of surgery <2 hours. This finding in line with different literatures studied by different researchers (8,9,15,29,31,41,44,45). The possible reasons might be prolonged operative time associated with postoperative wound dehiscence, infection and alters the normal physiological response of metabolic activities(51). Of the variables, those study participants who had preoperative oxygen saturation <94% were 10 times more risky for postoperative pulmonary complication after abdominal surgery as compared to those who were preoperative oxygen saturation ≥94%. SpO2% is an easily recorded objective measure, which reflects the function of respiratory as well as cardiovascular status. Our result in line with research done in China (Yue Jin et al. 2015) and in Spain (canet et al. 2010) (16,44).

Our study excluded Higher ASA class patients because of systemic comorbidity affects the respiratory physiology and prolongs the length of hospital stay. Most literature confirmed that ASA classes I and II have no strongly association with PPCs, usually it has a low risk of developing of pulmonary complications (29) (30) (33) (45). Another factor that was also expected to relate with PPC but was not significantly related with this type of complication in this study was pain. Pain limits the movement of the chest. Unlike research done by denu za, et al. (2015) (9). This study did not show association of type of anesthesia with PPCs, though we expected this association. Type of anesthesia/ most general anesthesia alters lung volumes, impairs respiratory muscles and mucociliary functions due to bypass of endotracheal tube. Similarly, this study did not show association of muscle relaxants with PPCs. However, In Europe, Kirmeier et al. (2019) use of neuromuscular blocking drugs in general anesthesia is related with postoperative pulmonary complications by the increase the length of residual neuromuscular blockade which plays a important role in the immediate postoperative period(48).

Limitation of the study

- We did not categorize the type of surgery on the basis of different surgical specialties because we involved abdominal surgery only. If we categorized the type of surgeries included in the study inclusion of different surgical specialties such as thoracic and orthopedic surgeries would have changed the results percentage of complications.
- The patients' postoperative analgesia methods not being standardized were another limitation to determine the association of pain with postoperative pulmonary complications. The reason for this was the protocol they follow to manage pain was different for each setup in our study area and other reason also we evaluated major with minor surgeries and open or laparoscopic surgeries together.

7. Conclusion

The incidence of postoperative pulmonary complications was (33 %) which means it is common in our study area setup. Pneumonia (50%) was the most common postoperative pulmonary complication followed by atelectasis (24%). Age ≥65 years, duration of surgery >3 hours, preoperative oxygen saturation <94%, and serum albumin level <3.5g/dl were strongly associated with postoperative pulmonary complications following elective and emergency abdominal surgery. Therefore health professionals should be care given for elderly patients, minimize operative time < 3 hours, treat the underlying cause of low preoperative oxygen saturation and correct serum albumin postoperatively and should be known all possible factors and develop a strategy for the resource-limited area.

8. Recommendations

For anesthetist

- Preoperative assessment should be mandatory in order to alleviate the important risk factor for postoperative pulmonary complications
- Anesthetist at Addis Ababa governmental hospital should know all possible factors associated with postoperative pulmonary complications when we plan to give anesthesia for the patients who have abdominal surgery.

For stakeholders

- When we plan to give treatment for the patients who have postoperative pulmonary complications it should be based on standard treatment guideline and protocol.
- Should be checking the change of serum albumin after abdominal surgery to detect potential pulmonary complications because albumin decrease occurs rapidly after surgery and it is easy to measure.

For further researchers

- Further study with cohort study needs to be conducted

9. References

1. Miskovic A, Lumb AB. Postoperative pulmonary complications. Br J Anaesth. 2017 Mar;118(3):317–34.

2. Jammer I, Wickboldt N, Sander M, Smith A, Schultz MJ, Pelosi P, et al. Standards for definitions and use of outcome measures for clinical effectiveness research in perioperative medicine: European Perioperative Clinical Outcome (EPCO) definitions: A statement from the ESA-ESICM joint taskforce on perioperative outcome measur. Eur J Anaesthesiol | EJA. 2015;32(2):98–102.

3. Tegegne BA, Lema GF, Fentie DY, Bizuneh YB. Perioperative risk stratification and strategies for reducing postoperative pulmonary complications following major surgery in resource limited areas: A systematic review. Int J Surg Open. 2021 Mar;30:100322.

4. Thanavaro JL, Foner BJ. Postoperative pulmonary complications. Nurs Crit Care. 2016 Jan;11(1):39–43.

5. Chandler D, Mosieri C, Kallurkar A, Pham AD, Okada LK, Kaye RJ, et al. Perioperative strategies for the reduction of postoperative pulmonary complications. Best Pract Res Clin Anaesthesiol. 2020 Jun;34(2):156–63.

6. Biccard BM, Madiba TE, Kluyts H-L, Munlemvo DM, Madzimbamuto FD, Basenero A, et al. Perioperative patient outcomes in the African Surgical Outcomes Study: a 7-day prospective observational cohort study. Lancet. 2018 Apr;391(10130):1590–2.

7. Ufoaroh CU, Ele PU, Anyabolu AE, Enemuo EH, Emegoakor CD, Okoli CC, et al. Pre-operative pulmonary assessment and risk factors for post-operative pulmonary complications in elective abdominal surgery in Nigeria. Afr Health Sci. 2019 Apr 23;19(1):1745.

8. Tadyanemhandu C, Mukombachoto R, Nhunzvi C, Kaseke F, Chikwasha V, Chengetanai S, et al. The prevalence of pulmonary complications after thoracic and abdominal surgery and associated risk factors in patients admitted at a government hospital in Harare, Zimbabwe-a retrospective study. Perioper Med. 2017;6(1):11.

9. Abdissa Denu Z, Osman Yasin M, Melekie adesse B. Postoperative Pulmonary Complications and Associated Factors among Surgical Patients. J Anesth Clin Res [Internet]. 2015;06(08):6–10. Available from: https://www.omicsonline.org/open-access/postoperative-pulmonary-complications-and-associated-factors-among-surgical-patients-2155-6148-1000554.php?aid=59597

10. Abdissa Denu Z, Osman Yasin M, Melekie adesse B, Denu ZA, Yasin MO, adesse Belayneh Melekie, et al. Postoperative Pulmonary Complications and Associated Factors among Surgical Patients. J Anesth Clin Res. 2015;06(08):6–10.

11. Miskovic A, Lumb AB. Postoperative pulmonary complications. Br J Anaesth. 2017 Mar;118(3):319–25.

12. Fernandes A, Rodrigues J, Lages P, Lança S, Mendes P, Antunes L, et al. Root causes and outcomes of postoperative pulmonary complications after abdominal surgery: a retrospective observational cohort study. Patient Saf Surg [Internet]. 2019 Dec 3;13(1):40. Available from: https://pssjournal.biomedcentral.com/articles/10.1186/s13037-019-0221-5

13. Tilak KM, Litake MM, Shingada K V. Study of risk, incidence and mortality associated with postoperative pulmonary complications using assess respiratory risk in surgical patients in catalonia score. Int Surg J [Internet]. 2019 Aug 28;6(9):3215. Available from: https://www.ijsurgery.com/index.php/isj/article/view/4647

14. Neto AS, Da Costa LG V., Hemmes SNTT, Canet J, Hedenstierna G, Jaber S, et al. The LAS VEGAS risk score for prediction of postoperative pulmonary complications: An observational study. Eur J Anaesthesiol. 2018;35(9):691–3.

15. Toori KU, Khan JS, Nomani AZ, Hussain SW, Hashmi S. A prospective study of factors predicting postoperative pulmonary complications (PPC) in patients undergoing non-cardiothoracic surgery under general anaesthsia in a developing country. Anaesthesia, Pain Intensive Care. 2012;16(3):252–6.

16. Jin Y, Xie G, Wang H, Jin L, Li J, Cheng B, et al. Incidence and risk factors of postoperative pulmonary complications in noncardiac Chinese patients: A multicenter observational study in university hospitals. Biomed Res Int. 2015;2015:11–4.

17. Ávila AC de, Fenili R. Incidência e fatores de complicações pulmonares pós-operatórias em pacientes submetidos à cirurgias de tórax e abdome. Rev Col Bras Cir. 2017 Jun;44(3):284–92.

18. Saracoglu A, Yavru A, Kucukgoncu S, Tuzuner F, Karadeniz M, Basaran B, et al. Predictive Factors Involved in Development of Postoperative Pulmonary Complications. Turkish J Anesth Reanim. 2014;42(6):253–4.

19. Fernandes A, Rodrigues JJJ, Lages PPP, Lancą S, Mendes P, Antunes LLLL, et al. Root causes and outcomes of postoperative pulmonary complications after abdominal surgery: A retrospective observational cohort study. Patient Saf Surg. 2019;13(1):3–7.

20. Jiang S-P. Multivariate analysis of the risk for pulmonary complication after gastrointestinal surgery. World J Gastroenterol. 2005;11(24):3735.

21. Kumar L, Satheesan K, Rajan S, Vasu B, Paul J. Predictors and outcomes of postoperative pulmonary complications following abdominal surgery in a South Indian population. Anesth Essays Res [Internet]. 2018;12(1):199. Available from: http://www.aeronline.org/text.asp?2018/12/1/199/211955

22. Diken O, Fazlıoğlu N, Sarıoğlu N, Ogan N, Yılmaz N, Tanrıverdi H, et al. The value of preoperative pulmonary assessment in predicting postoperative pulmonary complications. Eurasian J Pulmonol. 2019;21(1):29.

23. Charles N, Goyal MR, Datey S, Dhull K, Sharma S, Malviya S, et al. CLINICAL STUDY OF POSTOPERATIVE PULMONARY COMPLICATIONS FOLLOWING ABDOMINAL OPERATIONS IN A TERTIARY CARE CENTRE. J Evol Med Dent Sci [Internet]. 2018 Apr 9;7(15):1833–6. Available from: https://www.jemds.com/data_pdf/mohit goyal--apr-9-.pdf

24. Kirmeier E, Eriksson LI, Lewald H, Jonsson Fagerlund M, Hoeft A, Hollmann M, et al. Post-anaesthesia pulmonary complications after use of muscle relaxants (POPULAR): a multicentre, prospective observational study. Lancet Respir Med. 2019 Feb;7(2):133–40.

25. K.J. H, S. B, E.H. S, Haines KJ, Skinner EH, Berney S, et al. Association of postoperative

pulmonary complications with delayed mobilisation following major abdominal surgery: An observational cohort study. Physiother (United Kingdom). 2013;99(2):120–3.

26. Charokar K, Shrikhande A. Evaluation of Postoperative Pulmonary Complications after Emergency Abdominal Surgery- A Prospective Study. J Clin DIAGNOSTIC Res. 2020;14(8)(PC07-PC10):8.

27. Harshavardhan H, S P, B H. A PROSPECTIVE STUDY OF POSTOPERATIVE PULMONARY COMPLICATIONS FOLLOWING UPPER ABDOMINAL SURGERIES. INDIAN J Appl Res. 2020 Nov 1;10(11):12.

28. Martos-Benítez FD, Gutiérrez-Noyola A, Echevarría-Víctores A. Postoperative complications and clinical outcomes among patients undergoing thoracic and gastrointestinal cancer surgery: A prospective cohort study. Rev Bras Ter Intensiva. 2016;28(1):44–8.

29. Kodra N, Shpata V, Ohri I. Risk Factors for Postoperative Pulmonary Complications after Abdominal Surgery. Open Access Maced J Med Sci. 2016 May 22;4(2):259–63.

30. Agostini P, Cieslik H, Rathinam S, Bishay E, Kalkat MS, Rajesh PB, et al. Postoperative pulmonary complications following thoracic surgery: are there any modifiable risk factors? Thorax. 2010 Sep 1;65(9):815–8.

31. Patel K, Hadian F, Ali A, Broadley G, Evans K, Horder C, et al. Postoperative pulmonary complications following major elective abdominal surgery: a cohort study. Perioper Med. 2016;5(1):4–7.

32. Smith PR, Baig MA, Brito V, Bader F, Bergman MI, Alfonso A. Postoperative Pulmonary Complications after Laparotomy. Respiration. 2010;80(4):269–74.

33. BÜYÜK E, HOŞGÜN D, AKPINAR E, BEKİR S. Postoperative pulmonary complications in noncardiothoracic surgery. Pamukkale Med J. 2020 Sep 1;

34. Kanat F, Golcuk A, Teke T, Golcuk M. Risk factors for postoperative pulmonary complications in upper abdominal surgery. ANZ J Surg. 2007;77(3):135–41.

35. Haines KJ, Skinner EH, Berney S. Association of postoperative pulmonary complications with delayed mobilisation following major abdominal surgery: an observational cohort study. Physiotherapy. 2013 Jun 1;99(2):119–25.

36. Scholes RL, Browning L, Sztendur EM, Denehy L. Duration of anaesthesia, type of surgery, respiratory co-morbidity, predicted VO2max and smoking predict postoperative pulmonary complications after upper abdominal surgery: An observational study. Aust J Physiother. 2009;55(3):191–8.

37. Parry S, Denehy L, Berney S, Browning L. Clinical application of the Melbourne risk prediction tool in a high-risk upper abdominal surgical population: an observational cohort study. Physiotherapy. 2014 Mar;100(1):47–53.

38. Canet J, Gallart L, Gomar C, Paluzie G, Vallès J, Castillo J, et al. Prediction of postoperative pulmonary complications in a population-based surgical cohort. Anesthesiology. 2010;113(6):1344–6.

39. Garutti I, Errando CL, Mazzinari G, Bellón JM, Díaz-Cambronero O, Ferrando C. Spontaneous recovery of neuromuscular blockade is an independent risk factor for postoperative pulmonary complications after abdominal surgery. Eur J Anaesthesiol. 2020 Mar;37(3):207–11.

40. Sinouvassan V, Dayalane H, Balagurunathan S, Sahoo AK, Kanth V, Thirthar Palanivelu E. Analysis of clinico-demographic risk factors for postoperative pulmonary complications following gastrointestinal surgery. Int Surg J. 2019 Dec 26;7(1):93.

41. Charles N, Goyal MR, Datey S, Dhull K, Sharma S, Malviya S, et al. CLINICAL STUDY OF POSTOPERATIVE PULMONARY COMPLICATIONS FOLLOWING ABDOMINAL OPERATIONS IN A TERTIARY CARE CENTRE. J Evol Med Dent Sci. 2018;7(15).

42. Kumar L, Satheesan K, Rajan S, Vasu B, Paul J. Predictors and outcomes of postoperative pulmonary complications following abdominal surgery in a South Indian population. Anesth Essays Res. 2018;12(1):199.

43. Perilli V, Aceto P, Ancona P, Cicco R De, Papanice D, Magalini S, et al. Role of surgical setting and patients-related factors in predicting the occurrence of postoperative pulmonary complications after abdominal surgery. Eur Rev Med Pharmacol Sci. 2018;22(2):547–50.

44. Canet J, Gallart L, Gomar C, Paluzie G, Vallès J, Castillo J, et al. Prediction of Postoperative Pulmonary Complications in a Population-based Surgical Cohort. Anesthesiology. 2010 Dec 1;113(6):1338–50.

45. Attaallah AF, Vallejo MC, Elzamzamy OM, Mueller MG, Eller WS. Perioperative risk factors for postoperative respiratory failure. J Perioper Pract. 2019;29(3):49–53.

46. Labgaa I, Joliat G-R, Kefleyesus A, Mantziari S, Schäfer M, Demartines N, et al. Is postoperative decrease of serum albumin an early predictor of complications after major abdominal surgery? A prospective cohort study in a European centre. BMJ Open. 2016;3–7.

47. Qaseem A, Snow V, Fitterman N, Hornbake ER, Lawrence VA, Smetana GW, et al. Risk assessment for and strategies to reduce perioperative pulmonary complications for patients undergoing noncardiothoracic surgery: A guideline from the American College of Physicians. Vol. 144, Annals of Internal Medicine. 2006. p. 578.

48. Kirmeier E, Eriksson LI, Lewald H, Jonsson Fagerlund M, Hoeft A, Hollmann M, et al. Post-anaesthesia pulmonary complications after use of muscle relaxants (POPULAR): a multicentre, prospective observational study. Lancet Respir Med. 2019 Feb;7(2):129–40.

49. Hanada M, Kanetaka K, Hidaka S, Taniguchi K, Oikawa M, Sato S, et al. Effect of early mobilization on postoperative pulmonary complications in patients undergoing video-assisted thoracoscopic surgery on the esophagus. Esophagus [Internet]. 2018 Apr 16;15(2):69–74. Available from: http://link.springer.com/10.1007/s10388-017-0600-x

50. Li P, Li J, Lai Y, Wang Y, Wang X, Su J, et al. Perioperative changes of serum albumin are a predictor of postoperative pulmonary complications in lung cancer patients: A retrospective cohort study. J Thorac Dis. 2018;10(10):5759.

51. Cheng H, Clymer JW, Po-Han Chen B, Sadeghirad PhD B, Ferko NC, Cameron CG, et al. Prolonged operative duration is associated with complications: a systematic review and meta-analysis. J Surg Res. 2018 Sep 1;229:134–44.

52. Lunardi AC, Miranda CS, Silva KM, Cecconello I, Carvalho CRF. Weakness of expiratory muscles and pulmonary complications in malnourished patients undergoing upper abdominal surgery. Respirology. 2012;17(1):112.

53. Sanguineti VA, Wild JR, Fain MJ. Management of postoperative complications: general approach. Clin Geriatr Med. 2014;30(2):261–70.

Annex

CONSENT FORM (English)

(Please read out the participants)

Verbal consent form before conducting the data

Greeting

Hello, my name is _____ and I'm a data collector for the study entitled, "Incidence and Associated factors of postoperative pulmonary complication following abdominal surgery''. You will need to answer some questions which are mentioned in this form. It will take approximately 20-30 minutes. I would like to inform you that this is a purely academic study and will not be used for any other purpose. All information provided by you will keep in a locker as confidential and it will be ensured that the source of information remains anonymous and also all information will be destroyed after completion of the study. Your participation in this study is voluntary and you may withdraw yourself at any time during this study without any negative consequences. You also have the right not to answer a particular question that you don't like or do not want to answer during the interview.

Do you have any questions before I start?

So may I have your consent to proceed with the interview?

Yes: No:

Signature of the Interviewer…….. Date ……

Signature of the participant …… Date ……...

Signature of the Witness……. Date ……...

If you have any query about the study or your right as a participant, you may contact, researcher Ashenafi Eshetu, phone number 0914670890

Email address: ashenafieshetu210@gmail.com

Questionnaire

Instruction: Please circle the number of alternative that fit the response and fill the black space provided

Table 1 Basic characteristic of the patients

S.no	Questions	Answer categories'
101	Sex of the patient	1. Male 2. Female
102	Age in years	1. 15-47 2. 47-63 3. ≥ 64
103	Height (in meter)	
104	Weight (in Kg)	
105	BMI(kg/m2)	1. <18.5 2. 18.5-24.9 3. 25-34.9 4. >35
106	ASA status	1. ASA I 2. ASA II
107	Type of anesthesia	1. General 2. Regional
108	Type of operation	1. Elective 2. Emergency
119	Preoperative anemia (Hb <10 g/dl)	1. Yes 2. No
110	Active oncologic disease in the last 5 yr declared by the patient or recorded in the chart (Malignancy)	1. Yes 2. No
111	Hypertension declared by the patient or recorded in the chart	1. Yes 2. No
112	Diabetes (treated by diet, oral medication, or insulin)	1. Yes

	declared by the patient or recorded in the chart	2. No
113	Preoperative oxyhemoglobin saturation by pulse oximetry breathing air in supine position (SpO2)	1. <94% 2. ≥94%
114	Smoking status	1. Never smoker 2. Former smoker 3. Current smoker
115	Alcohol intake: positive if >24 g/d; >3 glasses of wine, or >3 beers or ≥ 2 glasses of hard liquor	1. Yes 2. No

Table 2 Intraoperative factors

201	Muscle relaxant	1. Short acting 2. Intermediate acting 3. Long acting 4. None
202	Surgical position	1. Supine 2. Lateral 3. Lithotomy
203	Duration of surgery in hours	1. <2 h 2. 2-3 h 3. >3 h
204	Surgical procedure	1. Upper abdominal 2. Lower abdominal 3. Both
205	Incision type	1. Vertical 2. Horizontal 3. Transverse 4. Subcostal
206	Intraoperative blood transfusion of at least one unit of packed red blood cells	1. Yes 2. No
207	Intraoperative blood loss	1. <500 2. ≥500

Table 3 post-operative factors

301	Postoperative albumin, g/L	1. <35 2. ≥35
302	Pain numerical rating scale	1. None 2. Mild 3. Moderate 4. Severe
303	Postoperative mobilization	1. ≤ 24hrs 2. > 24hrs

Table 4 Diagnosis criteria for PPCs based on European Perioperative Clinical Outcome (EPCO) definitions daily record on the chart postoperatively

EPCO definitions of PPCs	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
1. Pneumonia							
2. Atelectasis							
3. Pleural effusion							
4. Respiratory infection							
5. Pneumothorax							
6. Respiratory failure							
7. Bronchospasm							
8. Aspiration pneumonitis							
9. None							

ASA- American Society of Anesthesiologists physical status classification: means for categorizing patients physical status and systemic well beings.

Class Definition

ASA class I Normal healthy patient

ASA class II Patient with mild systemic disease (no functional limitations)

ASA class III Patient with severe systemic disease (some functional limitations)

ASA class IV Patient with severe systemic disease that is a constant threat to life

ASA class V Moribund patient who is not expected to survive without the operation

ASA class VI Brain-dead patient whose organs are being removed for donor purposes

E If the procedure is an emergency, the physical status is followed by "E"

Adopted from Morgan and Mikhail 5th edition