Postoperative Pulmonary Complications

Essay

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Abstract

Background: Postoperative pulmonary complications (PPC) can adversely influence a patient's clinical course following surgery and are equally as common as cardiac complications for patients undergoing non-cardiothoracic surgery.

Canet and Gallart demonstrated that Postoperative pulmonary complications were associated with a series of perioperative risk factors, such as age, smoking, chronic obstructive pulmonary disease (COPD), type of surgery, and serum albumin. A majority of these risk factors can be intervened and improved.

development of atelectasis because it is one of the primary mechanisms associated with ALI, a major cause of postoperative hypoxemia, leading to longer stay in the intensive care unit (ICU) and increased length of stay (LOS) in the hospital.

Aims: The aim of this essay is to through light on postoperative pulmonary complications concerning risk factors, diagnosis, prevention, and ICU management.

Conclusion:

Postoperative Pulmonary Complications (PPCs are an important part of the risk of surgery and prolong the hospital stay by an average of one to two weeks. Much of the literature on the assessment of perioperative risk has focused on identifying the now well-defined cardiac risk factors.

Keywords: Postoperative Pulmonary Complications, Intensive Care Unit, Chronic Obstructive Pulmonary Disease

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List of Abbreviations

ACS : Acute coronary syndrome

ACS : Abdominal compartment syndrome

ALI : Acute lung injury

ARTI : Acute respiratory tract infection

ASA : American Society of Anesthesiologists

BMI : Body mass index

BNP : Brain natriuretic peptide

BUN : Blood urea nitrogen

CABG : Coronary artery bypass grafting

COPD : Chronic Obstructive Pulmonary Disease

CPAP : Continuous Positive Airway Pressure

CT : Computed tomography

CXR : Chest radiograph

DSA : Digital subtraction angiography

DVT : Deep vein thrombosis

ELISA : Enzyme-linked immunosorbent assay

FEV1 : forced expiratory volume in 1 second

FRC : Functional residual capacity

FRC : Functional residual capacity

FVC : Forced vital capacity

HAP : Hospital acquired pneumonia

Hib : Haemophilus influenzae type b

ICU : Intensive care unit

IMA : Internal mammary artery

LOS : Length of hospital stay

MDCT : Multi-detector computed tomographic

MRA : Magnetic resonance angiography

NPPE : Negative-pressure pulmonary edema

NSQIP : National Surgical Quality Improvement Program

OHS : Obesity hypoventilation syndrome

OSA : Obstructive sleep apnea

PAP : Positive airway pressure

PE : Pulmonary embolism

PEEP : Positive End Expiratory Pressure

PFTs : Pulmonary function tests

PH : Pulmonary hypertension

PORC : Postoperative residual curarization

PP : Postoperative pneumonia

PPCs : Postoperative pulmonary complications

RSV : Respiratory syncytial virus

RV : Residual volume

RV : Right ventricle

SV : Saphenous vein

TAPSE : Tricuspid annulus plane systolic excursion

Tc : Technetium

TLC : Total lung capacity

TPN : Total parenteral nutrition

URTI : Upper respiratory tract infection

US : Ultrasound

VAP : Ventilator-acquired pneumonia

VTE : Venous thromboembolism

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Introduction

Postoperative pulmonary complications (PPC) can adversely influence a patient's clinical course following surgery and are equally as common as cardiac complications for patients undergoing non-cardiothoracic surgery. These complications include atelectasis, bronchospasm, and tracheobronchitis, which are considered self-limiting disorders known to induce perioperative hypoxemia. However, these complications may result in substantial morbidity and mortality when they progress to more severe forms or develop into respiratory failure, pulmonary embolism, postoperative pneumonia (PP), empyema, pneumothorax, acute lung injury (ALI), acute respiratory distress syndrome (ARDS), or the need for mechanical ventilation beyond 48 hours following surgery ***(Tao et al., 2014)***.

It is known that Postoperative pulmonary complications have a multifactorial etiology and had been defined broadly, including respiratory tract infection, pneumonia, respiratory failure, atelectasis, pleural effusion, pneumothorax, bronchospasm, and aspiration pneumonitis ***(Jeong et al., 2014).***

Canet and Gallart demonstrated that Postoperative pulmonary complications were associated with a series of perioperative risk factors, such as age, smoking, chronic obstructive pulmonary disease (COPD), type of surgery, and serum albumin. A majority of these risk factors can be intervened and improved. Therefore, identifying perioperative risk factors of PPCs is an important step toward improving quality of care in surgical patients ***(Canet and Gallart, 2013).***

Special attention is often given to the prevention and development of atelectasis because it is one of the primary mechanisms associated with ALI, a major cause of postoperative hypoxemia, leading to longer stay in the intensive care unit (ICU) and increased length of stay (LOS) in the hospital. Although the clinical evidence regarding Postoperative pulmonary complications prevention is often unclear and moderately strong at best, essential measures must be taken to reduce Postoperative pulmonary complications. These include carefully individualized strategies for preventing atelectasis and aspiration of oral secretions, restoring functional residual capacity, and increasing the patient's ability to mobilize and expectorate secretions ***(Hodgson et al., 2015).***

Success of postoperative recovery is dependent not only on pulmonary physiology restoration after surgery, but also on preoperative education and intraoperative clinical care management. Therefore, it is necessary to discuss the appropriateness of common interventions and how they pertain to postoperative recovery. Examples include preoperative smoking cessation, anesthetic and analgesic technique, laparoscopic vs. open procedures, nasogastric decompression, lung expansion therapy, and the use of subglottic suction endotracheal tubes ***(Kelkar, 2015).***

Aim of the Work

The aim of this essay is to through light on postoperative pulmonary complications concerning risk factors, diagnosis, prevention, and ICU management.

Chapter 1

Epidemiology and Etiology of Postoperative Pulmonary Complication

Epidemiology:

Postoperative pulmonary complications (PPCs) following surgery were first described by Pasteur in 1908 and remain an important cause of postoperative morbidity, contributing to significant increases in patient discomfort, length of hospital stay (LOS), use of resources and overall hospital cost ***(Patel et al., 2013).***

Postoperative pulmonary complications are common, especially in elderly patients with comorbidities. Nearly 5% of all patients undergoing noncardiac surgery experience significant pulmonary complications. Postoperative pulmonary complications include respiratory failure, pneumonia, and atelectasis ***(Gupta et al., 2013).***

PPCs have been defined as a pulmonary abnormality that produces identifiable disease or dysfunction that is clinically significant and adversely affects the clinical course. Over the past two decades widespread developments in postoperative pain management, together

with advances in surgical and anesthetic techniques, have led to reductions in complications following major surgery and faster discharge from hospital. Nonetheless PPCs remain an important cause of postoperative morbidity and mortality ***(Hayashi et al., 2017).***

Strategies to reduce the incidence of PPCs include screening for and modification of risk factors, optimizing preoperative status, patient education, intraoperative management and postoperative pulmonary care ***(Rafiq et al., 2017).***

Risk factors that can be assessed include the following:

- Advanced age (e.g., age greater than 65 years increases the risk of complication 4.7-fold or by 370%).
- Smoking history (e.g., smoking history of longer than 40 or more pack years increases the risk 5.7-fold or by 470%).
- A history of COPD (this increases the risk 4.2-fold or by 320%).
- Obesity (body mass index greater than 30 kg/m2 increases the risk 4.1- fold or by 310%).
- A positive cough test (this increases the risk 4.3-fold or by 330%).

- Maximal laryngeal height of 4 cm or less (this increases the risk 6.9-fold or by 590%).
- A forced expiratory time of 9 seconds or more (this increases the risk 5.7-fold or by 470%).
- Surgical time of 2.5 hours or more (this increases the risk 2.9-fold or by 190%) ***(Kim et al., 2016).***

Identification of any risk factors should prompt clinicians to perform laboratory tests for additional risk information. These tests include spirometry and arterial blood gas assessment (on room air if possible). An FEV1 (forced expiratory volume in 1 second) of less than 1 L increases the risk of postoperative pulmonary complications 7.9-fold or by 690%, while an FVC (forced vital capacity) value of less than 1.5 L increases the risk 11.1-fold or by 1000%. Hypercarbia (defined as $PaCO_2$ of 45 mm Hg or greater) on arterial blood gas assessment increases the risk 61-fold, while hypoxemia (defined as PaO_2 of less than 75 mm Hg) increases the risk 13-fold ***(Kim et al., 2016).***

Surgical patients are at risk for chemical pneumonitis resulting from the aspiration of acidic gastric contents during the perioperative period. The clinical features of chemical pneumonitis include the abrupt onset of dyspnea