Anesthetic Management of Patients With Chronic Respiratory Diseases For Major Orthopedic Surgery

An Essay
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List of Abbreviations

Abb.	Full term
ALS	*Amyotrophic lateral sclerosis*
ASRA	*American Society of Regional Anesthesia*
cAMP	*Cyclic adenosine monophosphate*
CF	*Cystic fibrosis*
CNB	*Central neuraxial block*
CO	*Cardiac output*
COPD	*Chronic obstructive pulmonary disease*
CRDs	*Chronic respiratory diseases*
CRP	*C-reactive protein*
CSEA	*Combined spinal epidural anesthesia*
CVP	*Central venous pressure*
DVT	*Deep vein thrombosis*
FRC	*Functional residual capacity*
GA	*General anesthesia*
GARD	*Global Alliance against CRDs*
i PEEP	*Intrinsic positive end-expiratory pressure*
IAP	*Intra-arterial pressure*
ICU	*Intensive care unit*
IFN-γ	*Interferon gamma*
IgE	*Immunoglobulin*
IL-1	*Interleukins-1*
IL-6	*Interleukins-6*
IL-8	*Interleukins-8*
INR	*International normalized ratio*
IPF	*Idiopathic pulmonary fibrosis*
IPPB	*Intermittent positive pressure breathing*
LMWH	*Low-molecular-weight heparin*
MAC	*Minimum alveolar concentration*
MC	*Medium concentration*
MMP-6	*Matrix-metalloproteinases -6*
MMP-9	*Matrix-metalloproteinases -9*
NSAIDs	*non-steroidal anti-inflammatory drugs*
O_2	*Oxygen*

List of Abbreviations cont…

Abb.	Full term
OLDs	*Obstructive lung diseases*
PACU	*Postanesthesia care unit*
PFTs	*Pulmonary function tests*
PNB	*Peripheral nerve block*
TCI	*Target-controlled infusion*
TIVA	*Total intravenous anesthesia*
TLC	*Total lung capacity*
TNF-α	*Tumor necrosis factor alpha*
VC	*Vital capacity*

Abstract

Anesthetic management should be a continuation of their preoperative care. Chronic pulmonary disease patients must be monitored according to the minimum monitoring standards for adequacy of oxygenation, ventilation, and circulation, both clinically and with appropriate monitors. Invasive hemodynamic monitoring as central venous pressure (CVP), intra-arterial pressure (IAP), and cardiac output (CO) must be done if indicated for monitoring and guiding fluid management, monitoring and guiding pharmacological interventions, estimating adequacy of tissue perfusion and oxygenation, and frequent blood sampling.

Regional anesthesia is the first choice in patients with chronic respiratory diseases as it gives good muscle relaxation, reduces blood loss, and reduces incidence of deep vein thrombosis (DVT). Combined spinal epidural anesthesia (CSEA) with sedation remains the technique of choice as it offers the advantage providing postoperative analgesia.

The immediate postoperative management needs to be done in the postanesthesia care unit (PACU). Patients with chronic respiratory diseases need a prolonged period of observation. These patients should be observed in an intensive care unit (ICU). This ensures close physical observation of the patient and monitoring of physiological parameters with early active management of complications.

Keywords: *Peripheral nerve block-Central venous pressure- Functional residual capacity- General anesthesia- Intra-arterial pressure- Interferon gamma- Immunoglobulin- Medium concentration*

INTRODUCTION

Chronic respiratory diseases are considered independent risk factors for mortality and major cardiopulmonary complications after surgery. Perioperative optimization of these high-risk patients deserves a thorough understanding of the patient cardiopulmonary diseases as well as the respiratory consequences of surgery and anesthesia. Along with major advances in anesthetic management, the operative mortality and morbidity rates have been considerably lowered over the past 20 years ***(Halbert et al., 2006).***

The commonest routine preoperative test of pulmonary function is the measurement of forced vital capacity, with the results expressed as the forced expiratory volume in one second (FEV_1), and also as a percentage of the slow vital capacity (VC). The theoretical hazards of impaired ventilatory capacity in relation to anesthesia are widely appreciated, but there is no reference to the actual level of reduction of FEV_1, which in itself constitutes a definite hazard or contraindication to anesthesia and surgery. Diament and Palmer, however, claim that a reduction in FEV_1 below 700.0 ml indicates that a patient is at risk of developing postoperative pulmonary complications ***(Zollinger et al., 2002).***

During general anesthesia, patients with respiratory disease are threatened by various unphysiologic conditions. Supine position and positive pressure ventilation can hamper

borderline respiratory function by reduction in functional residual capacity (FRC) and increase atelectasis. Upper airway instrumentation (eg, tracheal intubation) and inhalation of irritants (e.g., desflurane, external disinfectants) may trigger vagally-mediated reflex bronchoconstriction thereby promoting the expiratory collapse of the peripheral airways with incomplete lung alveolar emptying ***(Hedenstierna et al., 2005).***

Perioperative management as well as modern intensive care concepts are based on avoidance of tracheal intubation if possible by usage of laryngeal mask or using regional anesthesia techniques and the early liberation from invasive mechanical ventilation. Noninvasive ventilation has become more and more utilized in recent years to stabilize patients with acute exacerbations of COPD and to treat postoperative pulmonary complications in order to avoid reintubation ***(Henzler et al., 2003).***

Regional anesthesia avoids many of the respiratory problems associated with general anesthesia and has added the advantage of providing good postoperative analgesia. However patients must be able to tolerate lying flat. Most blocks can safely be performed with or without sedation. Effective analgesia is vital in order to optimise respiratory function for patients who have undergone major spine operations ***(Bonnet and Marret, 2005).***

Postoperative management of COPD patient by lying in semisitting position, applying oxygen at low volume –to maintain hypoxic drive- and using lung expansion maneuvers as incentive spirometry, deep breathing exercises, postural drainage, cough, suctioning, mobilization, intermittent positive pressure breathing (IPPB), and CPAP reduces postoperative pulmonary complications ***(Weingarten et al., 2013).***

AIM OF THE STUDY

This study is mainly directed to update the knowledge about the optimal preoperative assessment and management of chronic respiratory disease patients undergoing major orthopedic surgeries, and to highlight the new concepts about tailoring the best anesthetic technique for each individual patient as well as to address the postoperative care strategy especially for high risk patients.

Chapter One

PATHOPHYSIOLOGY OF CHRONIC LUNG DISEASES

Chronic respiratory diseases (CRDs) are diseases of the airways and other structures of the lung. In addition to tobacco smoke, other risk factors include air pollution, occupational chemicals and dusts, and frequent lower respiratory infections during childhood. CRDs are not curable, however, various forms of treatment that help dilate major air passages and improve shortness of breath can help control symptoms and increase the quality of life for people with the disease. The WHO Global Alliance against CRDs (GARD) has a vision of a world in which all people breathe freely, and focuses in particular on the needs of people with CRDs in low-income and middle-income countries ***(Beaglehole, 2011).***

Chronic lung diseases are classified as obstructive lung diseases or restrictive lung diseases. Obstructive lung diseases include conditions that make it hard to exhale all the air in the lungs. Meanwhile, People with restrictive lung disease have difficulty fully expanding their lungs with air. Obstructive and restrictive lung diseases share the same main symptom: shortness of breath with exertion. They are identified using pulmonary function tests, imaging (x-ray film, CT scan) and bronchoscopy ***(Mason et al., 2010).***

Obstructive lung diseases

People with obstructive lung disease have shortness of breath due to difficulty exhaling all the air from the lungs. Because of damage to the lungs or narrowing of the airways inside the lungs, exhaled air comes out more slowly than normal. At the end of a full exhalation, an abnormally high amount of air may still linger in the lungs. The most common causes of obstructive lung disease are: ***(Mason et al., 2010)***

- Chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis.
- Asthma.
- Bronchiectasis.
- Cystic fibrosis.

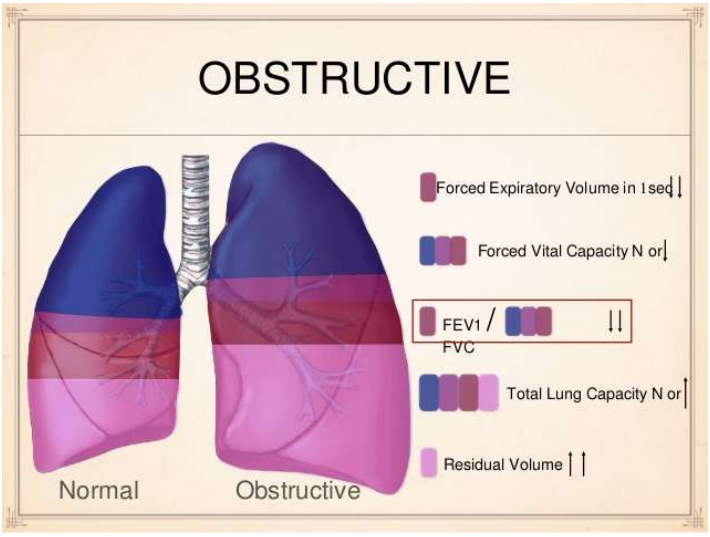

Figure (1): Obstructive lung diseases ***(Rabe et al., 2007).***

Pathophysiology of obstructive lung diseases

Chronic obstructive pulmonary disease (COPD)

COPD is an umbrella term that encompasses chronic bronchitis and emphysema. It is a common and preventable, treatable disease, characterized by persistent airflow limitation that is usually progressive, and associated with an enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases. It also includes a significant extra-pulmonary component, systemic inflammation ***(GOLD, 2013).***

COPD is a complex syndrome comprised of airway inflammation, mucociliry dysfunction and consequent airway structural changes ***(Agusti, 2010).***

- ***Airway inflammation:***

COPD is characterized by chronic inflammation of the airways, lung tissue and pulmonary blood vessels as a result of exposure to inhaled irritants such as tobacco smoke. The inhaled irritants cause inflammatory cells such as neutrophils, $CD8^+$ T-lymphocytes, B cells and macrophages to accumulate. When activated, these cells initiate an inflammatory cascade that triggers the release of inflammatory mediators such as tumor necrosis factor alpha (TNF-α), interferon gamma (IFN-γ), matrix-metalloproteinases (MMP-6, MMP-9), C-reactive protein (CRP), interleukins (IL-1, IL-6, IL-8) and fibrinogen. These inflammatory mediators sustain the inflammatory process and