Comparison between different weaning methods in chronic obstructive pulmonary disease patients with respiratory failure (BIPAP, CPAP and T piece)

A Thesis

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Ahmed Farag

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List of Abbreviations

Abb.	Full term
ABG	Arterial blood gas
AECOPD	Acute exacerbations of COPD
ARF	Acute respiratory failure
BIPAP	Bilevel positive airway pressure
COPD	Chronic Obstructive Pulmonary Disease
CPAP	Continuous positive airway pressure
DBP	Diastolic blood pressure
DH	Dynamic hyperinflation
EELV	End expiratory lung volume
EFL	Expiratory flow limitation
FEV_1	Forced expiratory volume
FVC	Forced vital capacity
HR	Heart rate
IC	Inspiratory capacity
MMRC	Modified Medical Research Council
MV	Mechanical ventilation
NIPPV	Non invasive positive pressure ventilation
PEEP	External positive end expiratory pressure
PEEPi	Intrinsic PEEP
PIP	Peak inspiratory pressure
RR	Respiratory rate
SABA	Short acting beta agonist
SBP	Systolic blood pressure
SBT	Spontaneous breathing trial
V/Q	Ventilation/perfusion
VT	Tidal volume
WOB	Work of breathing

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INTRODUCTION

Prolonged mechanical ventilation (MV) leads to high resource utilization and poor outcomes. Increasing use of MV for the management of COPD associated respiratory failure has in turn increased the burden of patients with difficult weaning in Intensive Care Units (ICUs) worldwide. Weaning from MV is a process where MV is gradually withdrawn and the patient resumes spontaneous breathing ***(Ghauri et al., 2019)*** thereby meaning liberation or freedom from ventilator. Difficult-to-wean patients are defined as those who require more than 7 days of weaning after first spontaneous breathing trial (SBT) ***(Boles et al., 2007).***

Invasive ventilation leads to considerable reduction in respiratory muscle strength and increase in the incidence of ventilator associated pneumonia (VAP). If the weaning procedure is started early, it can often lead to cardiorespiratory failure. On the other hand, if it is started too late, it can be unsuccessful because of respiratory muscle weakness caused by deconditioning and disrupted breathing regulation, so optimal time of decision to wean is of utmost importance in modern ICUs. Liberating a COPD patient from ventilator is a continuous process as with any other disease condition which starts with recognition of patient being ready to be weaned from ventilator by letting the patient breathe on T-piece and, if successful, proceeding to SBT followed by extubation, if it is tolerated well (simple weaning).

Patients after successful extubation may require reintubation due to “extubation failure,” which carries high mortality and morbidity and needs to prevented using accurate predicting indices prior to extubation.

While patient is being put on SBT and bridging with NIPPV either Continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BIPAP) in high risk for failed weaning, but in current study I bridge the patients with NIPPV immediately after extubation and compare it with simple weaning Using various clinical and laboratory parameters.

Aim of the Work

The aim of this study is to compare among the different methods of weaning in chronic obstructive pulmonary disease patients with respiratory failure weaned with different methods ie BIPAP, CPAP and T-Piece.

Chapter 1

CHRONIC OBSTRUCTIVE PULMONARY DISEASE

Definition:

Chronic Obstructive Pulmonary Disease (COPD) is a common preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities usually caused by significant exposure to noxious particles or gases ***(GOLD, 2019).***

The chronic airflow limitation that is characteristic of COPD is caused by a mixture of small airways disease (e.g., obstructive bronchiolitis) and parenchymal destruction (emphysema) ***(GOLD, 2019).***

Signs and Symptoms of COPD

Symptoms and signs of COPD can be different for each person, but common symptoms are:

- History of more than 55 pack-years
- Increased shortness of breath
- Frequent coughing (with and without mucus)
- Increased breathlessness
- Wheezing on auscultation or Self reported ***(Devine et al., 2008).***

Extra pulmonary effects of COPD include: weight loss, nutritional abnormalities, skeletal muscle dysfunction, risk for myocardial infarction, angina, osteoporosis, bone fractures, depression and sleep disorders ***(Watz et al., 2008).***

Defferential diagnosis of COPD:

- *Interstial pulmonary fibrosis*
- *Bronchectasis*
- *Cystic fibrosis*
- *Congestive heart failure*
- *Adult respiratory distress syndrome*
- *Pneumonia*
- *Myocardial infarction*
- *Pneumothorax*
- *Pulmonary embolism* ***(Han et al., 2015)***

Risk factors for COPD:

- Genes.
- Inhalation exposure.
- Tobacco smoking.
- Occupational dusts.
- Indoor air pollution.
- Outdoor air pollution.
- Oxidative stress.

- Age and Gender.
- Respiratory infection.
- Socioeconomic status.
- Nutrition.
- Asthma and bronchial hyper reactivity.
- Chronic Bronchitis.
- Previous tuberculosis.
- Lung growth and development ***(Sutradhar et al., 2019)***.

Pathophysiology of COPD:

Chronic obstructive pulmonary disease (COPD) is characterised by poorly reversible airflow obstruction and an abnormal inflammatory response in the lungs. The latter represents the innate and adaptive immune responses to long term exposure to noxious particles and gases, particularly cigarette smoke. All cigarette smokers have some inflammation in their lungs, but those who develop COPD have an enhanced or abnormal response to inhaling toxic agents. This amplified response may result in mucous hypersecretion (chronic bronchitis), tissue destruction (emphysema), and disruption of normal repair and defence mechanisms causing small airway inflammation and fibrosis (bronchiolitis).

These pathological changes result in increased resistance to airflow in the small conducting airways, increased compliance of the lungs, air trapping, and progressive airflow obstruction all characteristic features of COPD ***(Tuder et al., 2012)***.

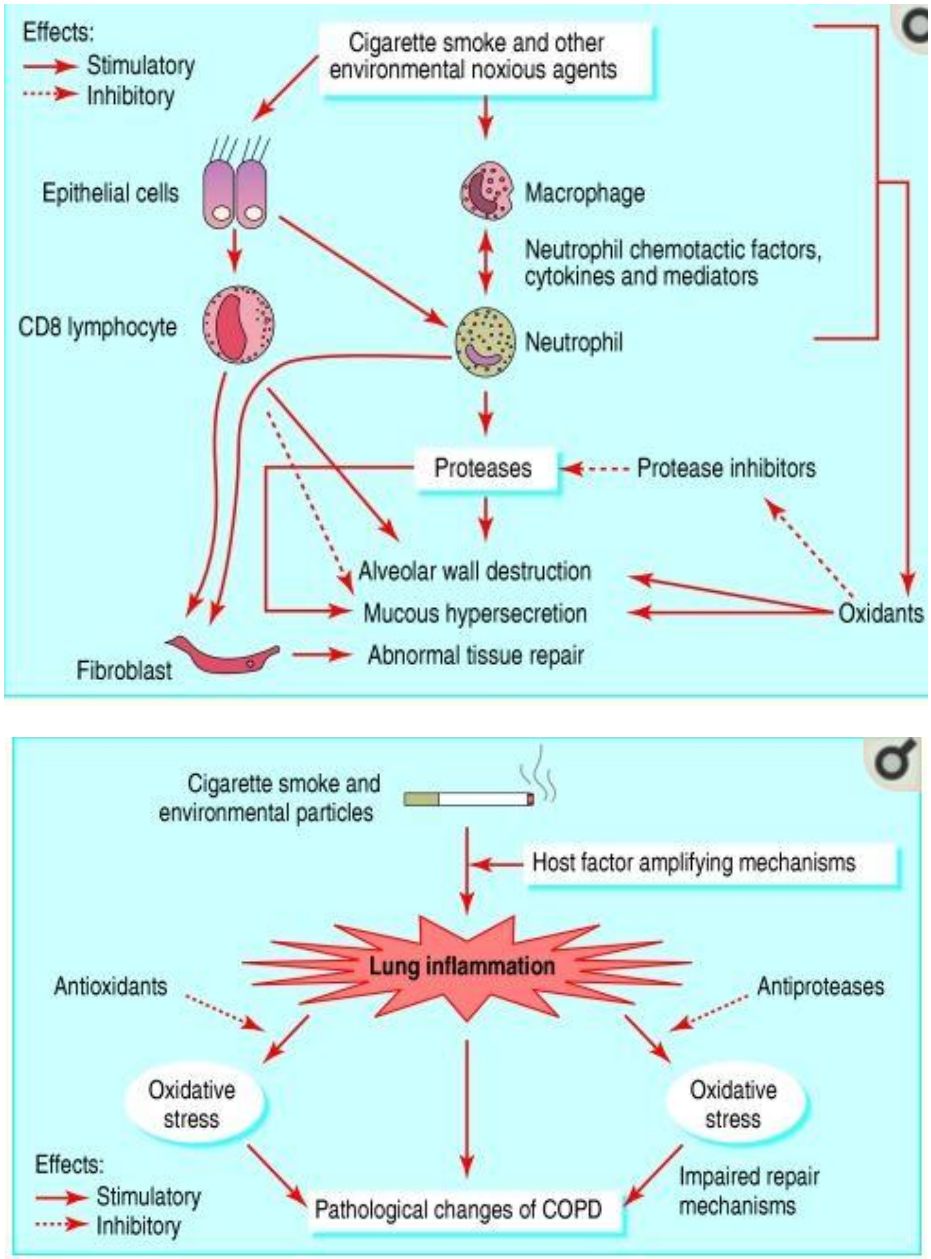

Figure (1): Description of the inflammatory process of COPD ***(Barnes et al., 2011)***.

Diagnosis:

The diagnosis of COPD should be considered in anyone over the age of 35 to 40 who has shortness of breath, a chronic cough, sputum production, or frequent winter colds and a history of exposure to risk factors for the disease. Spirometry is then used to confirm the diagnosis screening those without symptoms is not recommended ***(Vestbo et al., 2013).***

Spirometry

Spirometry measures the amount of airflow obstruction present and is generally carried out after the use of a bronchodilator, a medication to open up the airways. Two main components are measured to make the diagnosis, the forced expiratory volume in one second (FEV_1), which is the greatest volume of air that can be breathed out in the first second of a breath, and the forced vital capacity (FVC), which is the greatest volume of air that can be breathed out in a single large breath. Normally, 75–80% of the FVC comes out in the first second and a FEV_1/FVC ratio less than 70% in someone with symptoms of COPD defines a person as having the disease. Based on these measurements, spirometry would lead to over diagnosis of COPD in the elderly. The National Institute for Health and Care Excellence criteria additionally require a FEV less than 80% of predicted. People with COPD also exhibit a decrease in diffusing capacity of the lung for carbon monoxide due to decreased surface area in the alveoli, as well as damage