

Difficult Weaning From Mechanical Ventilation And The Role Of Noninvasive Ventilation

Essay

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By □

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بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

قَالَ

سَبَّحَانَكَ لَا عِلْمَ لَنَا
إِلَّا مَا عَلَّمْتَنَا إِنَّكَ أَنْتَ
الْعَلِيمُ الْعَظِيمُ

صدق الله العظيم

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Contents

Subjects	Page
List of abbreviations.....	II
List of Figures.....	IV
List of Tables.....	V
• Introduction.....	1
• Chapter (1): Anatomy and Physiology of the Respiratory System.....	4
• Chapter (2): Indications of Mechanical Ventilation.....	26
• Chapter (3): Complications of Mechanical Ventilation.....	47
• Chapter (4): Difficult Weaning From Mechanical Ventilation.....	63
• Chapter (5): Role of Non Invasive Ventilation.....	83
• Summary.....	92
• References.....	95
• Arabic Summary	

List of Abbreviations

AARC	: American Association for Respiratory Care
ABG	: Arterial Blood Gases
ACCP	: American College of Chest Physicians
ACV	: Assist-Control Ventilation
AHCPR	: Agency for Healthcare Policy and Research
APRV	: Airway Pressure Release Ventilation
ARDS	: Adult Respiratory Distress Syndrome
ARF	: Acute Respiratory Failure
BiPAP	: Bilevel Positive Airway Pressure
COPD	: Chronic Obstructive Pulmonary Disease
CPAP	: Continuous Positive Airway Pressure
CVP	: Central Venous Pressure
DRGs	: Dorsal Respiratory Groups
ETT	: Endotracheal tube
FIO2	: Fraction of Inspired Oxygen
HFOV	: High Frequency Oscillatory Ventilation
ICU	: Intensive Care Unit
IMV	: Intermittent Mandatory Ventilation
LV	: Left ventricle
LVEDP	: Left Ventricular end- diastolic pressure
MDR	: Multidrug- Resistance
MIP	: Maximal inspiratory pressure
MV	: Mechanical Ventilation
NIV	: Non Invasive Ventilation

List of Abbreviations

NPPV	: Non invasive Positive Pressure Ventilation
PaCO₂	: Partial Pressure of arterial Carbon dioxide
PAO	: Pressure at the airway opening
PaO₂	: Partial Pressure of arterial oxygen
Paw	: Mean airway pressure
PEEP	: Positive End Expiratory Pressure
PPV	: Positive pressure ventilation
PSV	: Pressure Support Ventilation
RSBI	: Rapd Shallow Breathing Index
SCCM	: Society of Critical Care Medecine
SBT	: Spontaneous Breathing Trial
SIMV	: Synchronized intermittent mandatory ventilation
VAP	: Ventilator Associated Pneumonia
VILI	: Ventilator Induced Lung Injury
V/Q	: Ventilation/Perfusion ratio
VRGs	: Ventral respiratory groups
VT	: Tidal Volume
WOB	: Work of Breathing

List of Figures

No.	Figure	Page
<u>1</u>	Sagittal section of head, showing the upper airway.	5
<u>2</u>	Diagram showing respiratory excursions during normal breathing and during maximal inspiration and maximal expiration.	8
<u>3</u>	Ventilation–perfusion (V/Q) relationships	17
<u>4</u>	Movement of O ₂ and CO ₂ across the alveolar–capillary membrane.	18
<u>5</u>	Gas exchange	20
<u>6</u>	Dorsal view of the brainstem	23
<u>7</u>	Effect of hypoxia on ventilation	25
<u>8</u>	Iron lung patients in a 1950s polio ward	26
<u>9</u>	Intermittent mandatory ventilation (IMV)	42
<u>10</u>	Airway pressure oscillations during high frequency oscillatory ventilation	46
<u>11</u>	Pathogenesis of the various forms of barotrauma	52
<u>12</u>	Seven stages of weaning	63
<u>13</u>	Full face mask	84

No.	Table	Page
<u>1</u>	Indications for intubation & ventilation	28
<u>2</u>	Causes of hypoventilation	30
<u>3</u>	Etiology of ventilator-associated pneumonia	54
<u>4</u>	VAP bundles	56
<u>5</u>	Potential pathogens associated with VAP and recommended antibiotics	57
<u>6</u>	Evidence-based guidelines for weaning	67
<u>7</u>	Factors that may increase ventilatory workload	78
<u>8</u>	Factors That May Reduce Ventilatory Drive	80
<u>9</u>	Factors that reduce the success of weaning	81
<u>10</u>	Indications for use of non invasive ventilation	86

Introduction

Mechanical ventilation is a method to mechanically assist or replace spontaneous breathing. There are two main divisions of mechanical ventilation; invasive ventilation and non-invasive ventilation **(Cabrini et al., 2011)**.

The lungs primary function is to add oxygen (O₂) to, and to remove carbon dioxide (CO₂) from, blood passing through the pulmonary capillary beds. For this to occur, the gas must be matched to the blood flowing through the lungs **(Gabrielli et al., 2009)**.

The indication of mechanical ventilation, rather than acute respiratory failure are coma, acute exacerbation of chronic obstructive pulmonary disease, neuromuscular disorders and other disorders including ; acute respiratory distress syndrome, heart failure, pneumonia, sepsis, complications of surgery and trauma **(Bilan et al., 2009)**.

It is important to realize that complications in ventilated patients are relatively common, and meticulous monitoring is vital for their prevention. Prompt corrective action may be life saving if some of these complications (such as pneumothorax or sudden

blockage of an endotracheal tube) occur **(Hasan, 2010)**.

The process of discontinuing mechanical ventilation is known as weaning. During weaning, the work of breathing is transferred from the ventilator to the patient. Weaning is typically achieved by clinicians reducing ventilator support and/or conducting tests to determine whether a patient can breathe on his/her own **(Burns et al., 2014)**.

The difficult-to-wean patient has already failed at least one spontaneous breathing trial or has required reintubation within 48 hours of extubation. The failure of a spontaneous breathing trial may be accompanied by a significantly increased inspiratory effort, which may strain the respiratory muscles **(Deutschman and Neligan, 2010)**.

In 1992, Udwadia and colleagues were the first to report that difficult-to-wean patients could be freed from mechanical ventilation after extubation with a brief period of noninvasive ventilation **(Esquinas, 2010)**.

The increasing clinical use and familiarity with noninvasive ventilation (NIV) in the critical care setting makes it an attractive tool in the difficult-to-wean patient. The potential advantages of NIV are to avoid the complications of intubation and sedation and

to reduce the total time of invasive mechanical ventilation. The use of NIV in weaning can be separated into preventing extubation failure in selected patients, providing a rescue therapy for postextubation respiratory distress, and permitting early extubation in patients who fail to meet standard extubation criteria (**Deutschman and Neligan, 2010**).

Anatomy and Physiology of the Respiratory System

Anatomy of the Respiratory System:

Upper airway:

The upper airway consists of the nose , oral cavity, pharynx, and larynx(Fig-1).The primary functions of the upper airway are :to act as aconductor of air, to humidify and warm or cool the inspired air, to prevent foreign materials from entering the tracheobronchial tree, and to serve as an important area involved in speech and smell(**Des Jardins, 2013**).

Lower Respiratory Tract

The tracheobronchial tree, which consists of a series of branching airways commonly referred to as generations, or orders. These airways become progressively narrower, shorter, and more numerous as they branch throughout the lungs (**Des Jardins, 2013**).

The conducting tubes of the tracheobronchial tree end with the terminal bronchioles. The structures distal to the

terminal bronchioles are collectively referred to as the respiratory zone the structures distal to the terminal bronchioles are the functional units of gas exchange. They are composed of about three generations of respiratory bronchioles, followed by about three generations of alveolar ducts and, finally, ending in 15 to 20 grapelike clusters, the alveolar sacs **(Des Jardins, 2013).**

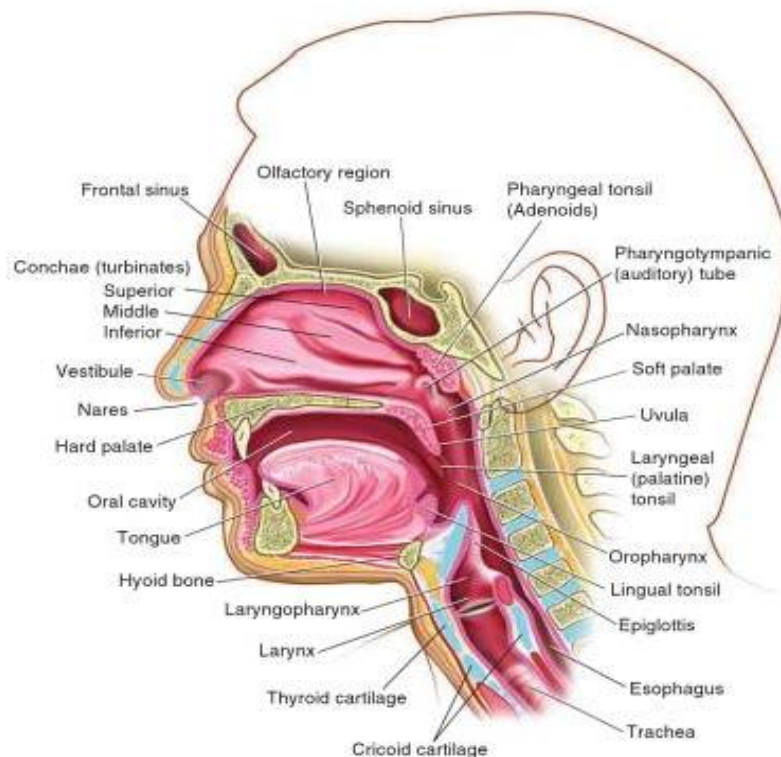


Fig-1: Sagittal section of head, showing the upper airway **(Des Jardins, 2013).**

Vascular supply:

The lung receives two blood supplies: the pulmonary arteries and the bronchial arteries (**Walter and Emile, 2012**). The pulmonary arteries, by far the major blood supply to the lung, carry the relatively deoxygenated mixed-venous blood. After arising from the right ventricle, they bifurcate as they follow the bronchial tree, and their divisions ultimately form a dense, richly anastomosing, hexagonal array of capillary segments that supply the alveoli of the terminal respiratory unit. After gas exchange in the alveoli, the blood eventually collects in the pulmonary veins (**Walter and Emile, 2012**).

The bronchial arteries are branches of the aorta and thus carry freshly oxygenated blood. They supply the conducting airways. At the level of the respiratory bronchioles, capillaries derived from bronchial arteries anastomose with those derived from pulmonary arteries. Because capillaries of the bronchial circulation drain partially into pulmonary veins, there is some venous admixture of the partially deoxygenated blood from the bronchial circulation and the newly oxygenated blood. This mixing represents part of a small physiological shunt. A

small amount of the bronchial blood drains into the azygos and accessory hemiazygos veins (**Walter and Emile, 2012**).

Physiology of the respiratory system

Ventilation:

The term ventilation is defined as the process that moves gases between the external environment and the alveoli. It is the mechanism by which oxygen is carried from the atmosphere to the alveoli and by which carbon dioxide (delivered to the lungs in mixed venous blood) is carried from the alveoli to the atmosphere. (**Des Jardins, 2013**).

Ventilation can be related to a simplified version of the equation of motion for the respiratory system:

$$\text{Pressure} = \frac{\text{Volume}}{\text{Compliance}} + (\text{Resistance} \times \text{Flow})$$

where: Pressure = Force generated by the respiratory muscles or a mechanical ventilator, or both, during inspiration

Volume = Volume change (e.g., the tidal volume V_T)