كيفية التعامل داخل وحدة العناية المركزة مع حالات فشل الجهاز التنفسى الحادة

رسالة

توطئة للحصول على درجة الماجستير في العناية المركزة

مقدمة من

حازم محمود فضالى عبدالحميد
بكالوريوس الطب والجراحة

تحت اشراف

الأستاذة الدكتورة / سهير عباس محمد صادق
أستاذة التخدير والرعاية المركزة
كلية الطب - جامعة عين شمس

الدكتورة / أمل حامد ربيع
مدرس التخدير والرعاية المركزة
كلية الطب - جامعة عين شمس

الدكتور / عمرو أحمد قاسم
مدرس التخدير والرعاية المركزة
كلية الطب - جامعة عين شمس

كلية الطب

جامعة عين شمس

٢٠١٥

Intensive Care Management of Acute Respiratory Failure

Essay

Submitted for Partial Fulfillment of
Master Degree in Intensive Care

By

Hazem Mahmoud Fadali Abdelhameed
M.B.,B.Ch (2003)

Supervised By

Prof. Dr. Sohair Abbas Mohammed Sadek
Professor of Anaesthesia and Intensive Care
Faculty of Medicine – Ain Shams University

Dr. Amal Hamed Rabie
Lecturer of Anaesthesia and Intensive Care
Faculty of Medicine – Ain Shams University

Dr. Amr Ahmed Kasem
Lecturer of Anaesthesia and Intensive Care
Faculty of Medicine – Ain Shams University

Faculty of Medicine
Ain Shams University
2015

First of all, thanks to Allah whose magnificent help was the main factor in completing this work.

I wish to express my deepest gratitude to ***Prof. Dr. Sohair Abbas Mohammed Sadek***, Professor of Anaesthesia and Intensive Care, Ain Shams University, for her sincere guidance, kind supervision, and continuous encouragement through the whole work.

I am very grateful to ***Dr. Amal Hamed Rabie,*** Lecturer of Anaesthesia And Intensive Care, Ain Shams University, for her precious supervision.

I am very grateful to ***Dr. Amr Ahmed Kasem,*** Lecturer of Anaesthesia And Intensive Care, Ain Shams University, for his constant assistance and valuable support.

Lastly I would like to thank my ***Father***, my ***Mother*** and my ***Wife*** for their guidance and support.

سورة البقرة الآية: ٣٢

CONTENTS

List of Abbreviations

ABG : Arterial blood gases.

AECOPD : Acute exacerbations of COPD.

AHRF : Acute hypercapnic respiratory failure.

ARDS : Acute respiratory distress syndrome.

ARF : Acute respiratory failure.

AVC : Assist volume control.

BMI : Body mass index.

Ca O2 : Arterial oxygen content.

CBC : Complete blood count.

CC O2 : Capillary oxygen content.

CHD : Coronary heart disease.

CMV : Conventional (invasive) mechanical ventilation.

CNS : Central nervous system.

CO : Cardiac output.

COPD : Chronic obstructive pulmonary disease.

CPAP : Continuous positive airway pressure.

CSF : Cerebro-spinal fluid.

$C_v O_2$: Mixed venous oxygen content.

CVD : Cardiovascular disease.

DH : Dynamic hyperinflation.

ECG : Electrocardiography.

ETI : Endotracheal intubation.

ETMV : Endotracheal mechanical ventilation.

FEV_1 : Forced expiratory volume in 1 second.

FI O2 : Fractional concentration of oxygen in inspired gas.

FVC : Forced vital capacity.

GI : Gastrointestinal.

ICU : Intensive care unit.

IMV : Invasive mechanical ventilation.

INPV : Intermittent negative pressure ventilation.

LV : Left ventricle.

MV : Mechanical ventilation.

NAVA : Neurally adjusted ventilatory assist.

NIMV : Non invasive mechanical ventilation.

NIPPV : Non invasive positive pressure ventilation.

NPPV : Noninvasive positive pressure ventilation.

PA CO2 : Alveolar PCO2.

Pa CO2 : Arterial carbon dioxide tension.

PA O2 : Alveolar PO2.

Pa O2 : Arterial oxygen tension.

PAV : Proportional assist ventilation.

Paw (t) : The inspiratory pressure provided by the ventilator.

P_B : Barometric pressure.

PEEPi : Intrinsic positive end-expiratory pressure.

PFTs : Pulmonary functions tests.

PH_2O : Water vapor pressure at 37°C.

PSV : Pressure-support ventilation.

Ptot (t) : Driving pressure.

QS/QT : The shunt fraction.

RS : Respiratory system.

RV : Right ventricle.

Sa, **O2** : Arterial oxygen saturation.

SV, O2 : Mixed venous oxygen saturatution.

V/Q : Ventilation/perfusion.

VA : Alveolar ventilation.

VAP : Ventilation-acquired pneumonia.

VCO2 : Carbon dioxide ventilation.

VD : Dead space volume.

VR : Venous return.

VT : Tidal volume.

WOB : Work of breathing.

LIST OF TABLES

LIST OF FIGURES

Introduction

Respiratory failure results from disturbances of gas exchange due to impairments in either oxygenation, or elimination of carbon dioxide, or both, that is severe enough to be a threat to life**.** ***(Roussos et al., 2003).***

For clinical routine purposes, respiratory failure is usually defined by an arterial oxygen tension (PaO_2) of less than 60 mmHg and/or an arterial carbon dioxide tension ($PaCO_2$) greater than 45 mmHg. From a pathophysiological point of view the respiratory system comprises two major compartments: the lung as a gas exchange device and the ventilatory pump powering this device. Functional failure of the lung itself (type I respiratory failure) primarily results in arterial hypoxemia, associated with normal or even reduced levels of $PaCO_2$ as aconsequence of compensatory augmented ventilation. In contrast, ventilatory pump failure (type II [hypercapnic] respiratory failure) is caused by mechanical disadvantage such as lung hyperinflation in COPD, Central nervous system abnormalities, or respiratory muscle dysfunction and leads to an elevation of $PaCO_2$ levels, often in company with hypoxemia due to alveolar hypoventilation. ***(Calverley et al., 2003).***

Acute respiratory failure patient presents in ICU with symptoms and signs of those of the underlying disease combined with those of hypoxemia or hypercapnia. The symptoms and signs of acute respiratory failure are both insensitive and nonspecific; therefore, the physician must maintain a high index of suspicion and obtain arterial blood gas analysis if respiratory failure is suspected ***(Garpestad et al., 2007).***

Intensive care management of the patient with acute respiratory failure consists of respiratory supportive care directed toward the maintenance of adequate gas exchange, general supportive care and specific therapy directed towards the underlying disease. Respiratory support has both nonventilatory and ventilatory aspects. Assessment of airway, breathing and circulation (ABC) is the first step**.** Nonventilatory aspects; aim to ensure adequate oxygenation of vital organs ***(Garpestad et al., 2007).***

Ventilatory support consists of maintaining patency of the airway and ensuring adequate alveolar ventilation. Mechanical ventilation may be provided via face mask (noninvasive) ***(Antonelli et al., 2004)*** or through tracheal intubation. Potential complications of mechanical ventilation are numerous ***(Ambrosino et al., 2008).***

General supportive care aim to maintenance of adequate nutrition, sedative-hypnotics and analgesics, temporary paralysis with anondepolarizing neuromuscular blocking agent facilitate mechanical ventilation and to lower oxygen consumption, Stress gastritis and ulcers. psychological and emotional support of the patient and family, skin care, and meticulous avoidance of hospital-acquired infection and complications. ***(MacIntyre et al., 2005).***

The specific treatment depends on the etiology of respiratory failure but Hypoxemia is the major immediate threat to organ function. After the patient's hypoxemia is corrected and the ventilatory and hemodynamic status have stabilized, every attempt should be made to identify and correct the underlying pathophysiologic process that led to respiratory failure in the first place ***(Zhang et al., 2012).***

Patients generally are prescribed bed rest during early phases of respiratory failure management. However, ambulation as soon as possible helps ventilate atelectatic areas of the lung. Mechanical ventilation is used for 2 essential reasons: (1) to increase $P_a O_2$ and (2) to lower $P_a CO_2$. Mechanical ventilation also rests the respiratory muscles and is an appropriate therapy for respiratory muscle fatigue ***(Cosentini et al., 2010).***

The use of mechanical ventilation during the polio epidemics of the 1950s was the impetus that led to the development of the discipline of critical care medicine. Before the mid-1950s, negative-pressure ventilation with the use of iron lungs was the predominant method of ventilatory support. Currently, virtually all mechanical ventilatory support for acute respiratory failure is provided by positive-pressure ventilation. Nevertheless, negative-pressure ventilation still is used occasionally in patients with chronic respiratory failure ***(Zhang et al., 2012).***

Aim of the Study

The aim of this study is to discuss the recent issues of intensive care management of acute respiratory failure.

Respiratory Failure

Definition:

Respiratory failure is a condition in which the respiratory system fails in one or both of its gas-exchanging functions— i.e., oxygenation of, and carbon dioxide elimination from, mixed venous (pulmonary arterial) blood. Hence, respiratory failure is a syndrome rather than a disease. Many diseases result in respiratory failure ***(Ata and Michael, 2012).***

Respiratory failure may be acute or chronic. The clinical presentations of patients with acute and chronic respiratory failure usually are quite different.

While acute respiratory failure is characterized by life-threatening derangements in arterial blood gases and acid-base status, the manifestations of chronic respiratory failure are more indolent and may be clinically unapparent ***(Rubenfeld et al., 2005)***.

Classification of respiratory failure:

Respiratory failure is commonly classified as either acute or chronic. Acute respiratory failure occurs when the body's lungs cannot meet metabolic demands. Chronic respiratory failure results in chronically low oxygen levels or chronically high carbon dioxide levels; it can often be treated less urgently than the acute type, and individuals may not necessarily need to be hospitalized. **(*Vincent et al., 2004).***

Respiratory failure may be classified as hypercapnic or hypoxemic (fig. 1). Hypercapnic respiratory failure is defined as an arterial PCO2 (PaCO2) greater than 45 mmHg. Hypoxemic respiratory failure is defined as an arterial PO2 (PaO2) less than 55 mmHg when the fraction of oxygen in inspired air (FiO2) is 0.60 or greater. In many cases, both forms of respiratory failure coexist. Disorders that initially cause hypoxemia may be complicated by respiratory pump failure and hypercapnia. Conversely, diseases that produce

respiratory pump failure are frequently complicated by hypoxemia due to secondary pulmonary parenchymal processes (e.g., pneumonia or atelectasis) or vascular disorders (e.g., pulmonary embolism).Acute hypercapnic respiratory failure is defined as a PaCO2 greater than 45 mmHg with accompanying acidemia (pH less than 7.30) ***(Ata and Michael, 2012).***

The physiological effect of a sudden increment in Paco2 depends on the prevailing level of serum bicarbonate anion. In patients with chronic hypercapnic respiratory failure—e.g., due to chronic obstructive pulmonary disease (COPD)—a long-standing increase in PaCO2 results in renal "compensation" and an increased serum bicarbonate concentration. A superimposed acute increase in Paco2 has a less dramatic effect than does a comparable increase in a patient with a normal bicarbonate level.

Distinction between acute and chronic hypoxemic respiratory Failure may not be readily made on the basis of arterial blood gas values. The presence of markers of chronic hypoxemia (e.g., polycythemia or cor pulmonale) may provide clues to a long-standing disorder, whereas abrupt changes in mental status suggest an acute event ***(Ata and Michael, 2012).***

Tissue oxygen delivery is determined by the product of cardiac output and blood oxygen content (the latter, in turn, depends on hemoglobin concentration and oxygen saturation. Therefore, factors that lower cardiac output or hemoglobin concentration, or inhibit dissociation of oxygen from hemoglobin at the tissue level, may promote tissue hypoxia without technically producing respiratory failure **(Wang,** ***2005).***