Comparative Study between Invasive and Non-invasive Mechanical Ventilation in Management of Patients With Mild Acute Respiratory Distress Syndrome

Thesis

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By

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List of Abbreviations

AECC : American-European Consensus Conference

ALI : Acute Lung Injury

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APACHE : Acute physiology age chronic health evaluation

ARDS : Acute respiratory distress syndrome

COPD : Chronic Obstructive Pulmonary Disease

CPAP : Continuous positive airway pressure

CT : Computed tomography

DEX : Dexmedetomidine

ET : Endotracheal tube

FACTT : Fluids and Catheters Treatment Trial

FiO_2 : Fraction of oxygen in the inspired air

HI : Hypoxic index

HR : Heart rate

ICU : Intensive care unit

MOF : Multiple Organ Failure

MV : Mechanical ventilation

NIV : Noninvasive ventilation

NMBs : Neuromuscular blockers

PaO_2 : Arterial blood oxygen

PBW : Predicted body weight

دراسة مقارنة بين التهوية الميكانيكية التداخلية وغير التداخلية في علاج المرضى المصابين متلازمة الضائقة التنفسية الحادة البسيطة

رسالة

توطئة للحصول على درجة الماجستير في العناية المركزة

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PCO_2	: Pressure of carbon dioxide
PCWP	: Pulmonary catheter wedge pressure
PEEP	: Positive end-expiratory pressure
RASS	: Richmond sedation agitation score
RR	: respiratory rate
TEE	: Transesophageal echocardiography
TNF	: Tumor Necrosis Factor
VILI	: Ventilator-induced lung injury

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Introduction

Acute respiratory distress syndrome (ARDS) is a major cause of acute respiratory failure and it is associated with high mortality and morbidity **(Modrykamien, 2015).**

A range of physical methods for the general treatment of respiratory diseases is available. Among these methods, noninvasive ventilation (NIV) is a widely accepted treatment that has been used for diseases such chronic obstructive pulmonary disease exacerbation and cardiogenic pulmonary edema for more than 2 decades **(Schnell et al., 2014).**

The advantages of NIV include not requiring for endotracheal intubation, which lowers the risk of ventilator-associated pneumonia, a shorter intensive care unit (ICU) length of stay, and decreased hospitalization costs **(Brochard et al., 2002).**

However, the use of (NIV) for the treatment of (ARDS) is somewhat controversial. A meta-analysis to assess the percentage of (ARDS) patients who were treated with (NIV) and required endotracheal intubation between 1995 and 2009, as well as the mortality rate of these patients is conducted by Agarwal and co-workers who

found that approximately 50% of the (ARDS) patients treated with (NIV) were spared from endotracheal intubation. Therefore, (NIV) can be used in selected patients, especially those presenting mild to moderate (ARDS) **(Agarwal et al., 2010).**

However, some studies have indicated that once (NIV) fails, the prognosis becomes worse. Thus, the timing of subsequent invasive ventilation (IV) may be critical **(Antonelli et al., 2007).**

Aim of the Work

The aim of the present study is to evaluate whether using noninvasive mechanical ventilation can achieve a good improvement in patients with mild (ARDS) compared to those treated with endotracheal intubation and invasive mechanical ventilation.

Review of Literature

Acute respiratory distress syndrome:

Acute respiratory distress syndrome (ARDS) is a life threatening respiratory condition characterized by hypoxemia, and stiff lungs **(**without mechanical ventilation most patients would die). (ARDS) represents a stereotypic response to many different inciting insults and evolves through a number of different phases: alveolar capillary damage to lung resolution to a fibro-proliferative phase. The pulmonary epithelial and endothelial cellular damage is characterized by inflammation, apoptosis, necrosis and increased alveolar-capillary permeability, which lead to development of alveolar edema. (**Ware and Matthay, 2000)**

Since its first description in 1967, there have been a large number of studies addressing various clinical aspects of the syndrome (risk factors, epidemiology and treatment) as well as studies addressing its pathogenesis (underlying mechanisms, biomarkers, genetic predisposition). However, despite this intense research activity, there are very few effective therapies for (ARDS) other than the use of lung protection strategies. This lack of therapeutic modalities is certainly related to the complex, pathogenesis of this

syndrome with multiple signaling pathways activated depending on the type of lung injury. In addition, the lack of sensitive and specific diagnostic criteria to diagnose (ARDS) has hampered progress **(Ashbaugh et al., 1967).**

Old definitions and recent update:

(ARDS) is a syndrome with multiple risk factors that trigger the acute onset of respiratory insufficiency. The pathogenic mechanisms vary depending on the inciting insult, but as demonstrated on autopsy findings, there are a number of common pathological pulmonary features **,** such as increased permeability as reflected by alveolar edema due to epithelial and endothelial cell damage, and neutrophil infiltration in the early phase of (ARDS) **(Esteban et al., 2004).**

One of the most accepted definition of ARDS for use at the bedside or to conduct clinical trials was the American-European Consensus Conference (AECC) definition, published in 1994. (ARDS) was defined as: the acute onset of respiratory failure, bilateral infiltrates on chest radiograph, hypoxemia as defined by a PaO2/FiO2 ratio ≤200 mmHg, and no evidence of left atrial hypertension or a pulmonary capillary pressure <18 mmHg (if measured) to rule out cardiogenic edema. In addition,

Acute Lung Injury (ALI), the less severe form of acute respiratory failure, was different from (ARDS) only for the degree of hypoxemia, in fact it was defined by a 200 < PaO2/FiO2 ≤300 mmHg **(Bernard et al., 1994).**

The reliability of the chest radiographic criteria of ARDS has been demonstrated to be moderate, with substantial interobserver variability **(meade et al., 2000)**

In addition, the hypoxemia criterion (i.e. PaO2/FiO2 <200 mmHg) can be markedly affected by the patient's ventilator settings, especially the (PEEP) level used**. (villar et al.,2007)**

Finally, the wedge pressure can be difficult to interpret and if a patient with (ARDS) develops a high wedge pressure that should not preclude diagnosing that patient as having(ARDS) **(Rubenfeld et al., 1999).**

In a series of 138 (ARDS) patients, the definition had relatively low specificity (51%) when compared with autopsy findings **(Ferguson et al., 2005).**

Based on these concerns, the European Society of Intensive Care Medicine with endorsement from the American Thoracic Society and the Society of Critical Care Medicine convened an international expert panel to revise