بسم الله الرحمن الرحيم

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ملاحظات: لا يوجد

Utility of Lung Ultrasound in Adjustment of the Initial Mechanical Ventilation Settings in Patients with ARDS

Thesis

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Chest Diseases

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قالوا

سبحانك لا علم لنا إلا ما علمتنا إنك أنت العليم الحكيم

صدق الله العظيم

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Menna Allah Magdy Mohamed El-Sayed

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List of Abbreviations

Abb.	Full term
ARDS	*Acute respiratory distress syndrome*
ICU	*Intensive care unit*
TRALI	*Transfusion-associated acute lung injury*
PEEP	*Positive end-expiratory pressure*
LUS	*Lung ultrasonography*
ALI	*Acute lung injury*
AECC	*American European Consensus Conference*
PaO_2	*Arterial oxygen partial pressure*
FiO2	*Inspired fraction of oxygen*
PAOP	*Pulmonary artery occlusion pressure*
PEEP	*Positive end expiratory pressure*
SpO2	*Saturation of peripheral oxygen*
DAD	*Diffuse alveolar damage*
DAMPs	*Danger-associated molecular patterns*
e.g.	*Example*
BAL	*Broncho-alveolar lavage*
G-CSF	*Granulocyte colony-stimulating factor*
VAP	*Ventilator-associated pneumonia*
TNF	*Tumor necrosis factor*
VALI	*Ventilator-associated lung injury*
PCP-III	*Procollagen peptide III*
CT	*Computed tomography*
NIV	*Non-Invasive Ventilation*
HFNC	*High flow nasal cannula*
CO2	*Carbon dioxide*
PBW	*Predicted body weight*
PCV	*Pressure-controlled ventilation*
VILI	*Ventilator-associated lung injury*
VCV	*Volume-controlled ventilation*

List of Abbreviations (Cont.…)

Abb.	Full term
RR	*Respiratory rate*
I/E Ratio	*Inspiratory/expiratory ratio*
RM	*Recruitment maneuver*
EIT	*Electrical impedance tomography*
PaCO2	*Partial pressure of carbon dioxide*

INTRODUCTION

Acute respiratory distress syndrome (ARDS) represents 10.4% of intensive care unit (ICU) admissions and 23.4% of all ICU patients requiring mechanical ventilation and is associated with a mortality rate of up to 40% ***(Bellani et al., 2016).***

ARDS underwent serial definitions and finally in 2011 Berlin definition of ARDS was declared after prolonged studies and discussions in which bilateral chest imaging shadows not fully explained by effusions, collapse or nodules within one week of a known clinical insult or new worsening respiratory symptoms resulting in respiratory failure not fully explained by cardiac failure or fluid overload helped by echocardiography. It grades it into mild, moderate and severe ***(Ranieri et al., 2012; Fanelli et al., 2013).***

ARDS represents a stereotypic response to many different inciting insults (pneumonia, non - pulmonary sepsis, aspiration of gastric contents, major trauma, pulmonary contusion, pancreatitis inhalational injury, severe burns, non - cardiogenic shock, drug overdose, multiple transfusions or transfusion - associated acute lung injury (TRALI), pulmonary vasculitis and drowning and others. Its mortality remains between 30 - 50%, despite early aggressive intervention ***(Ferguson et al., 2012; Ranieri et al., 2012; Jabbari et al., 2013).***

A protective lung ventilation strategy (as low – tidal - volume ventilation) remains the cornerstone of therapy in ARDS, reducing morbidity and mortality, and is mainly linked to attenuating ventilator - associated lung injury ***(Walkey et al., 2017).***

However, many patients with ARDS develop refractory hypoxemia; thus, several other therapies need to be offered in escalating fashion, ranging, among others, from positive end expiratory pressure (PEEP) / lung recruitment maneuvers and prone positioning to external oxygenation devices ***(Bein et al., 2016).***

Monitoring aeration in ARDS can be performed in several ways according to complexity, ranging from physical examination, blood gas analysis, esophageal pressure monitoring, and trans -pulmonary pressure assessment to the stress index and several imaging techniques, such as chest radiography, lung ultrasonography (LUS), chest computed tomography, positron emission tomography, magnetic resonance imaging, and electrical impedance tomography ***(Pesenti et al., 2016).***

Given that many of the a fore mentioned techniques are poorly accurate, seldom available in practice, costly, or expose patients to hazards such as ionizing radiation or the need to transfer patients to the radiology department, considering LUS; its widespread availability, low costs, bedside application, and nonionizing radiation as a basic application, appears as an attractive technique for monitoring aeration in ARDS ***(Ball et al., 2017).***

AIM OF THE WORK

The aim of this study was to assess the value of thoracic ultrasound in adjustment of initial ventilator settings in cases with acute respiratory distress syndrome “ARDS”.

Chapter 1
ADULT RESPIRATORY DISTRESS SYNDROME

Historical review and serial definitions

The clinical entity of acute lung injury (ALI) in its most severe form, ARDS, was originally described by ***Ashbaugh et al.*** in 1967 and represents a common clinical problem in ICU patients. The most widely adopted current definition of ALI and ARDS is based on the recommendations given by the American European Consensus Conference (AECC) committee ***(Silversides and Ferguson, 2013).***

Clearly, ARDS is not a disease with a well-defined pathophysiology. It should be considered as a set of effects (hence the term "syndrome") of incompletely understood pathophysiology ***(De Lange, 2017).***

ARDS is characterized by diffuse alveolar damage and is frequently complicated by pulmonary hypertension. The single biggest advance in the management of ARDS has been the institution of lung protective ventilation. However, mortality remains unacceptably high, ranging from the 32% to 41% reported in randomized controlled trials and up to 44% in published observational studies ***(Ryan et al., 2014; El-Naggar et al., 2016).***

ALI and its most severe form ARDS underwent serial definitions. The original clinical pattern described by Ashbaugh and his coworkers in 1967 included severe tachypnea, cyanosis that was refractory to oxygen supplementation, the loss of lung compliance, and diffuse alveolar infiltrates on a chest radiograph. Despite the fact that this definition of ARDS was nonspecific and was dichotomous, it was used for many decades ***(De Lange, 2017).***

In 1988, Murray and colleagues elaborated on this model and added a grading system to the definition. This so-called Murray score introduced the ratio of (PaO_2) and inspired fraction of oxygen (FiO_2) as a measure of severity of ARDS (table 1). If the patient had an average Murray score exceeding 2.5 points, the ARDS was considered severe ***(De Lange, 2017).***

In 1992, the (AECC) came up with a distinction between ALI and ARDS (table 2) depending on the severity of the PaO_2/FiO_2 ratio. An important improvement was the exception of cardiogenic edema as a cause of respiratory failure. By definition, the patient needed to have a pulmonary artery occlusion pressure (PAOP) of less than 18 mmHg; otherwise, it is considered congestive pulmonary edema. The severity of the ALI/ARDS was correlated with mortality outcome. Mortality of severe ARDS (PaO_2/FiO_2 ratio $<$ 100 mmHg) exceeded 50% in some studies, although the ARDS-associated mortality declined throughout the years ***(Silversides and Ferguson, 2013; de Lange, 2017).***

In 2011 Berlin definition of ARDS was declared (table2) after prolonged studies and discussions in which bilateral chest imaging shadows not fully explained by effusions, collapse or nodules within one week of a known clinical insult or new worsening respiratory symptoms resulting in respiratory failure not fully explained by cardiac failure or fluid overload helped by echocardiography ***(Silversides and Ferguson, 2013)***.

It grades it into mild (200 < PaO_2/FiO_2 <300 with positive end expiratory pressure (PEEP)>5 cmH2O), moderate (100 < PaO_2/FiO_2 <200 with PEEP > 5 cmH2O) and severe (PaO_2/FiO_2 < 100 with PEEP > 5 mH2O) ***(De Lange, 2017)***.

This definition predicts mortality slightly better than the previous AECC one when applied to a cohort of 4400 patients from past randomized trials ***(Agmy, 2015).***

The Berlin definition includes prominent issues; ALI now is considered as mild ARDS, the onset of ARDS must be acute within 72 h of recognition of the assumed trigger, bilateral opacities consistent with pulmonary edema must be present on computed tomography or chest radiography and patients with high pulmonary capillary wedge pressures or known congestive heart failure with left atrial hypertension can still have ARDS. An objective assessment by an echocardiogram should be performed if there is no clear risk factor present such as trauma or sepsis ***(Agmy, 2015)***.