Prevalence and Prognostic Values of Right Ventricular and Pulmonary Artery Echo Findings In Ventilated Patients with Adult Respiratory Distress Syndrome (ARDS)

Thesis

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CONTENTS

List of Abbreviations

ABG	:	Arterial blood gases
ACP	:	Acute corpulmonal
AECC	:	American European Consensus Conference
ALI	:	Acute lung injury
ALT	:	Alanine aminotransferase
ARDS	:	Adult Respiratory Distress Syndrome
AST	:	Aspartate aminotransferase
BAL	:	Broncho alveolar lavage
DAD	:	Diffuse alveolar damage
DAMPs	:	Danger-associated molecular patterns
FiO2	:	Inspired fraction of oxygen
G-CSF	:	Granulocyte colony-stimulating factor
HCO_3		Bicarbonate
HPV		Hypoxic pulmonary vasoconstriction
IL	:	Interleukin
INR	:	International normalized ratio
LV	:	Left ventricle
LVEF	:	Left ventricular ejection fraction
M-mode	:	Motion mode
$PaCO_2$	:	Partial pressure of arterial carbon dioxide
PaO_2	:	Partial pressure of arterial oxygen
PAOP	:	Pulmonary artery occlusion pressure
PCP-III	:	Procollagen peptide III
PEEP	:	Positive end expiratory pressure
PFO	:	Patent foramen oval
Pplat	:	Plateau airway pressures
PTT	:	Partial thromboplastin time
PVR	:	Pulmonary vascular resistance
RAP	:	Right atrial pressure
RHC	:	Right heart catheterization
RV	:	Right ventricular
RV/LV	:	right ventricular/left ventricular end-diastolic area ratio
RVEDA	:	Right ventricular end diastolic area
SaO_2	:	Arterial hemoglobin saturation of oxygen

sPAP	:	Systolic pulmonary arterial pressure
TAPSE	:	Tricuspid annular plane systolic excursion
TEE	:	Trans-esophageal echocardiography
TNF	:	Tumor necrosis factor
TR	:	Tricuspid regurge
TRALI	:	Transfusion-associated acute lung injury
TRV	:	Tricuspid regurgitation peak velocity
TEE	:	Trans- esophageal echocardiography
TTE	:	Trans-Thoracic echocardiography
VALI	:	Ventilator-associated lung injury
VEGF	:	Vascular endothelial growth factor

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ABSTRACT

Background: ARDS is a life threatening respiratory condition. Bedside echocardiography can be performed simply assessing the left and right ventricular structure and function. **Objectives:** To detect the prevalence and prognostic values of right ventricular and pulmonary artery echo findings in ventilated patients with ARDS.

Subject and methods: A prospective study randomly recruited 40 ARDS patients underwent trans-thoracic echocardiography commenting on left ventricular ejection fraction (LVEF), right ventricular systolic pressure (RVSP), Right ventricular end diastolic area to left ventricular end diastolic area ratio (RV/LV), tricuspid annular plane systolic excursion (TAPSE) and paradoxical septal motion (PSM) to correlate prognosis. **Results:** day 1 TAPSE in died patients was19.0±4.5 and survivors 22.2±2.3 with p value 0.019. TAPSE of day 3 in died patients was 18.7±3.4 and survivors 21.5±2.2 with p value 0.020. RV/LV increased in 7 deaths (53.8%) at day three and no one of survivors with significant p value (0.005). PSM was positive in 6 deaths (50%), and a survivor with significant p value (0.026). Acute cor-pulmonale (ACP) was present in 6 died patients (54.5%), and none of survivors with significant p value (0.003). RVSP mean in non-ACP patients was 30.7±7.3 while 43.2±9.4 in ACP patients (p value 0. 005). **Conclusion:** RV dilatation and/or PSM has bad prognosis. RVSP is higher in patients with ACP.

Keywords: Adult respiratory distress syndrome, echocardiography, tricuspid annular plane systolic excursion, acute core-pulmonale, systolic pulmonary artery pressure, right venricular systolic pressure, paradoxical septal motion.

INTRODUCTION

Acute respiratory distress syndrome (ARDS) is a life threatening respiratory condition characterized by hypoxemia, and stiff lungs and without ventilation the patient mostly will die ***(Jabbari et al., 2013).*** 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 ***(Ranieri et al., 2012).*** 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).***

Recently, mechanical ventilation by lung protection strategy in patients with ARDS, resulting in higher pulmonary functions and rates of weaning from the ventilator. Lung protection was based on maintaining low inspiratory driving pressures with lower tidal volumes (4-6 mL/kg) and use of limited airway pressure, with the use of high positive end expiratory pressure (PEEP) which improves hypoxemia and decreases intrapulmonary shunting. The lung protection strategy permitted plateau airway pressures (Pplat) up to 40 cm H_2O; however, plateau airway pressures rarely exceeded 35 cm H_2O with this strategy. ARDS affects also the pulmonary circulation; it significantly elevates mean pulmonary artery pressure magnified by the application of a PEEP***.(Meade et al., 2008; Jabbari et al., 2013)***

An right ventricular (RV) protective approach has recently been formalized by the development of critical care echocardiography respecting the pulmonary circulation and the right ventricle. Briefly, this approach is based first on strictly limiting (Pplat) to below 27 cm H_2O and driving pressure to below 17 cm H_2O. second on limiting partial pressure of arterial carbon dioxide (PaCO2) to below 60 mm Hg, third on PEEP settings according to RV function, and finally on the use of prone position in the patients with the most severe ARDS as it is able to increase partial pressure of arterial oxygen (PaO2) without PEEP elevation and to decrease $PaCO_2$ and Pplat by recruiting the lung preserving the pulmonary circulation and to unload the

right ventricle. ***(Repessé et al. 2015; Lhéritier et al. 2013; Vieillard-Baron et al. 2013)***

Three elements, which can be all investigated by echocardiography, characterize the pulmonary vascular alterations and its effects on the right ventricle and systemic circulation in ARDS: a) systolic pulmonary arterial pressure (sPAP); b) RV dimension and function; c) septal dyskinesia. Acute corpulmonal (ACP) that is defined as the association of RV dilatation with a paradoxical septal motion at end-systole. Thus, ACP combines RV systolic and diastolic overload ***(Lazzeri et al., 2016).*** The clinical significance of each of these three elements has not yet been elucidated ***(Repessé, Charron and Vieillard-Baron, 2015; Lazzeri and Peris, 2016).***

However, several questions are still debated. Does ACP have an impact on outcome? Is the RV failure is the cause of death or only an association? Should we distinguish between RV dysfunction and RV failure? Does the isolated RV dilatation without paradoxical septal motion have an impact? Is it a warning signal that something will happen? ***(Repessé, Charron and Vieillard-Baron, 2015)***

In this study we tried to find answers for these questions.

AIM OF THE WORK

This study aims to detect the prevalence and prognostic values of right ventricular and pulmonary artery echocardiographic findings in ventilated patients with ARDS.