WEANING INDUCED PULMONARY EDEMA

Thesis

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الفطام المتسبب في الارتشاح الرئوي

رسالـــة

مقدمة للحصول على درجة الماجستير

فى طب الرعاية المركزة

مقدمة من

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Summary

Acute cardiac dysfunction and cardiogenic pulmonary edema may occur during weaning from mechanical ventilation, especially in patients with a history of left heart disease and COPD. Among the complex and intricate mechanisms, myocardial ischemia, excessive increased LV afterload, and increased cardiac preload play predominant contributing roles.

Measuring the elevation in PAOP using right heart catheterization was first proposed as a means of diagnosing weaning failure of cardiac origin. Less invasive tools, such as transthoracic echocardiography or measurements of plasma protein concentration, have recently been proposed as valuable alternative diagnostic methods for weaning induced pulmonary edema.

Weaning-induced pulmonary oedema can require pulmonary artery catheterization providing evidence of the increase in PAOP during the weaning test. The decrease in SvO_2 during the test may also detect weaning failure of cardiovascular origin. The PiCCO system, by demonstrating an increase in extravascular lung water during weaning, could be helpful in detecting weaning-induced pulmonary oedema, but its clinical utility for this purpose has not been yet fully established.

Transthoracic echocardiography with measurement of the E/Ea ratio can identify patients at risk of weaning failure at the bedside. A reduced LVEF did not seem to influence the weaning outcome, whereas diastolic abnormalities with impaired relaxation and no ability to enhance relaxation during the SBT are closely associated with weaning failure.


بسم الله الرحمن الرحيم
قالُوا سُبْحَانَكَ لاَ عِلْمَ لَنَا إِلاَّ مَا
عَلَّمْتَنَا إِنَّكَ أَنتَ الْعَلِيمُ الْحَكِيمُ
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Waleed Abd Allah Anter

Contents

List of Abbreviations

ACV	:	Assist-control ventilation
ARDS	:	Acute Respiratory Distress Syndrome
ASV	:	Adaptive support ventilation
ATC	:	Automatic tube compensation
BNP	:	B-type natriuretic peptide
CINMA	:	critical illness neuromuscular abnormalities
COPD	:	Chronic obstructive pulmonary disease
CPAP	:	Continuous positive airway pressure
CPR	:	Cardiopulmonary resuscitation
CRRT	:	Continuous renal replacement therapy
CVP	:	Central venous pressure
ECMO	:	Extra corporeal membrane oxygenation
EDT	:	E wave deceleration time
EF	:	Ejection fraction
Ers	:	Patient's elastance
EVLW	:	Extravascular lung water
f/VT	:	frequency/tidal volume ratio
FA	:	Flow assist
FIO۲	:	Fraction of inspired oxygen
GEDV	:	Global end diastolic volume
IABP	:	Intra-aortic balloon pump
ICU	:	Intensive Care Unite
ITBV	:	Intrathoracic blood volume
ITP	:	Intrathoracic pressure
IV	:	Intravenous
LA	:	Left atrium
LV	:	Left ventricle
LVEDV	:	Left ventricular end-diastolic volume
LVSV	:	Left ventricular systolic volume
MV	:	Mechanical ventilation
MVV	:	Maximal voluntary ventilation
NIV	:	Noninvasive ventilation

List of Abbreviations (Cont.)

NT-proBNP	:	N-terminal proBNP
O٢	:	Oxygen
PA	:	Pressure in the alveoli
Pa	:	Pressure in the arteries
PAC	:	Pulmonary artery catheter
PAOP	:	Pulmonary artery occlusion pressure
PAV	:	Proportional-assist ventilation
PEEP	:	Positive end-expiratory pressure
PiCCO	:	The pulse-induced contour cardiac output
PSV	:	Pressure support ventilation
Pv	:	Pressure in the veins
Rrs	:	The patient's resistance
RSBI	:	Rapid shallow breathing index
RV	:	Right ventricle
RVSV	:	Right ventricular stroke volume
SaO٢	:	Oxygen saturation
SB	:	Spontanous breathing
ScvO٢	:	Central venous oxygen saturation
SIMV	:	synchronized intermittent mandatory ventilation
SvO٢	:	True mixed venous oxygen saturation
TEE	:	Transesophageal echocardiography
TPP	:	Transpulmonary pressure
V/Q	:	ventilation/perfusion ratio
VA	:	Volume assist
VC	:	Volume-controlled
VMA	:	Vanilmandelic acid

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Introduction

Weaning-induced pulmonary edema is the cause of weaning failure in predisposed patients, particularly in those with pre-existing cardiac disease.

The mechanisms by which weaning-induced pulmonary edema develops are complex and include the reduction of intrathoracic pressure, the increase in work of breathing, and the catecholamine discharge that may occur during weaning. ***(Lamia, ٢٠٠٩).***

Reduction of intrathoracic pressure tends to increase systemic venous return pressure gradient and central blood volume.

It also tends initially to decrease the pressure gradient between the left ventricle and the extrathoracic arteries. Consequently, the left ventricle must generate a higher pressure to eject the same volume of blood from the thorax, with a resulting augmentation of left ventricular afterload. ***(Lamia, ٢٠٠٥)***

A large increase in work of breathing may increase cardiac work and myocardial oxygen demand. The increased adrenergic tone may also increase venous return, left ventricular afterload, cardiac work, and myocardial oxygen demand and may thus potentially result in myocardial ischemia. ***(Lamia, ٢٠٠٩)***

Because the clinical presentation is often nonspecific (intolerance to spontaneous breathing), recognition of weaning-induced pulmonary edema is difficult and may require pulmonary artery catheterization for analyzing the

response of pulmonary artery occlusion pressure (PAOP) to a spontaneous breathing***.(Richard, ٢٠٠٥)***

Doppler echocardiography is increasingly used at the bedside for assessing the diastolic function of the left ventricle and, therefore, could be a noninvasive tool for detecting weaning-induced left ventricular filling pressure elevation ***(Dokainish, ٢٠٠٤)***.

The treatment of weaning induced pulmonary edema must be logically adjusted according to the mechanism that is most likely to have occurred. This requires an individual pathophysiological analysis. ***(Lamia, ٢٠٠٥)***

In terms of ventilatory modalities, there is no definite recommendation. After unsuccessful weaning of cardiac origin, reinstitution of mechanical ventilation is mandatory. ***(Jean-Louis, ٢٠١٠).***

Aim of Essay

In this review, the mechanisms by which pulmonary edema may develop during weaning will be discussed. Then how weaning failure of cardiac origin can be detected at the bedside since significant progress has recently been made in this field. Finally, the therapeutic options currently available will be discussed.

Weaning from Mechanical Ventilation

Mechanical ventilation is often life saving, but it is associated with numerous complications. Accordingly, it is imperative to disconnect patients from the ventilator at the earliest feasible time. Deciding the right time to initiate this disconnection process, usually referred to as weaning, is one of the greatest challenges in critical care medicine. If a physician is too conservative and postpones the initiation of weaning, the patient is placed at an increased risk of life-threatening, ventilator-associated complications. Conversely, if weaning is begun prematurely, the patient may suffer cardiopulmonary or psychological decompensation of sufficient severity to set back a patient's clinical course. ***(Tobin, ٢٠٠٦)***

Since weaning from mechanical ventilatory support is a cardiovascular stress, it is not surprising that weaning-associated ECG and thallium cardiac blood flow scan-related signs of ischemia have been reported in both subjects with known coronary artery disease and in otherwise normal patients. Similarly, initiating mechanical ventilation in patients with severe heart failure and/or ischemia can reverse myocardial ischemia. ***(Pinsky, ٢٠٠٥)***

It is important to recognize that there are stages from the initiation of mechanical ventilation to liberation from the ventilator and these include:

Stage ١: Treating the cause of acute respiratory failure
Stage ٢: Suggestion that weaning may be possible
Stage ٣: Assessment of readiness to wean
Stage ٤: Spontaneous breathing trials (SBT)
Stage ٥: Extubation
Stage ٦: Reintubation

(Smith, ٢٠١٠)