Med Intensiva. 2015;39(6):345–351

medicina intensiva

www.elsevier.es/medintensiva

ORIGINAL

Efficacy of an extravascular lung water-driven negative fluid balance protocol

L. Díaz-Rubia[a], S. Ramos-Sáez[a], R. Vázquez-Guillamet[b], F. Guerrero-López[a], F. Pino-Sánchez[a], M. García-Delgado[a], F.J. Gómez-Jiménez[c], E. Fernández-Mondéjar[a,d,*]

[a] *Intensive Care Unit, Virgen de las Nieves Hospital, Granada, Spain*
[b] *Pulmonary and Critical Care Department, University of New Mexico, United States*
[c] *Departament of Medicine to Granada University, Granada, Spain*
[d] *Instituto de Investigación Biosanitaria (IBS), Granada, Spain*

Received 1 May 2014; accepted 30 July 2014
Available online 7 October 2014

KEYWORDS
Extravascular lung water;
Negative fluid balance;
Acute lung injury;
Acute respiratory distress syndrome;
Intensive Care Unit;
Hypoxemic patients

Abstract
Objective: To analyze the efficacy of negative fluid balance in hypoxemic patients with an elevated extravascular lung water index (EVLWI).
Design: A retrospective observational study was made.
Setting: Intensive Care Unit of Virgen de las Nieves Hospital (Spain).
Participants: Forty-four patients participated in the study.
Interventions: We analyzed our database of hypoxemic patients covering a period of 11 consecutive months. We included all hemodynamically stable and hypoxemic patients with EVLWI > 9 ml/kg. The protocol dictates a negative fluid balance between 500 and 1500 ml/day. We analyzed the impact of this negative fluid balance strategy upon pulmonary, hemodynamic, and renal function.
Main variables of interest: Demographic data, severity scores, clinical, hemodynamic, pulmonary, metabolic and renal function data.
Results: Thirty-three patients achieved negative fluid balance (NFB group) and 11 had a positive fluid balance (PFB group). In the former group, PaO_2/FiO_2 improved from 145 (IQR 106, 200) to 210 mm Hg (IQR 164, 248) ($p < 0.001$), and EVLWI decreased from 14 (11, 18) to 10 ml/kg (8, 14) ($p < 0.001$). In the PFB group, EVLWI also decreased from 11 (10, 14) to 10 ml/kg (8, 14) at the end of the protocol ($p = 0.004$).
For these patients there were no changes in oxygenation, with a PaO_2/FiO_2 of 216 mm Hg (IQR 137, 260) at the beginning versus 205 mm Hg (IQR 99,257) at the end of the study ($p = 0.08$).
Conclusion: Three out of four hypoxic patients with elevated EVLWI tolerated the NFB protocol. In these subjects, the improvement of various analyzed physiological parameters was greater and faster than in those unable to complete the protocol.

* Corresponding author.
E-mail address: efermonde@gmail.com (E. Fernández-Mondéjar).

http://dx.doi.org/10.1016/j.medin.2014.07.008

Patients who did not tolerate the protocol were usually in more severe condition, though a larger sample would be needed to detect specific characteristics of this group.

PALABRAS CLAVE
Agua pulmonar extravascular;
Balance hídrico negativo;
Lesión pulmonar aguda;
Síndrome de distress respiratorio agudo;
Unidad Cuidados Intensivos;
Pacientes hipoxémicos

Eficacia de un protocolo de balance hídrico negativo orientado al agua pulmonar extravascular

Resumen
Objetivo: Analizar la eficacia del balance hídrico negativo en pacientes hipoxémicos y con Agua Pulmonar Extravascular Indexada (EVLWI) elevada.
Diseño: Estudio retrospectivo y observacional.
Ámbito: Unidad de Cuidados Intensivos del Hospital Virgen de las Nieves.
Participantes: 44 pacientes.
Intervenciones: Se analizó la base de datos de pacientes hipoxémicos durante 11 meses consecutivos. Se incluyeron los pacientes hipoxémicos, hemodinámicamente estables y con EVLWI > 9 ml/kg. El protocolo dicta un balance hídrico negativo entre 500 y 1500 ml/día. Se analizó el impacto de esta estrategia de balance negativo en la función respiratoria, hemodinámica y renal.
Variables de interés principales: Datos demográficos, escalas de gravedad y datos clínicos hemodinámicos, respiratorios, metabólicos y de función renal.
Resultados: 33 pacientes lograron balance hídrico negativo (Grupo BHN) y 11 tuvieron balance hídrico positivo (Grupo BHP). En el grupo BHN la PaO_2/FiO_2 pasó de 145 (IQR 106,200) a 210 (IQR 164, 248) mmHg ($p < 0.001$), el EVLWI descendió de 14 (11, 18) a 10 (8, 14) ml/kg ($p < 0.001$). En el grupo BHP, el EVLWI también descendió de 11(10, 14) a 10 (8, 14) ml/kg al final del protocolo ($p = 0.004$); en este último grupo no hubo cambios estadísticamente significativos en la oxigenación y la PaO_2/FiO_2 pasó de 216 (IQR 137, 260) a 205 (IQR 99, 257) mmHg ($p = 0.08$).
Conclusión: Tres de cada cuatro pacientes hipoxémicos y con EVLWI elevados toleraron el protocolo; en ellos, la mejora de diversos parámetros analizados fue mayor y más rápida que en los pacientes que no hicieron balance negativo. Los pacientes que no toleraron el protocolo fueron los más graves aunque se necesitaría una muestra mayor para determinar las características específicas en estos.

Introduction

The negative fluid balance is associated with improvements in oxygenation[1–3] and a shorter stay in the Intensive Care Unit (ICU)[4]; however, negative fluid balance strategies may have a theoretical risk of renal and other organ hypoperfusion, although available data do not support this assumption.[5] More than two decades ago, the determination of extravascular lung water index (EVLWI) was used as a useful tool in the management of fluid therapy in critically ill patients.[6,7] Then the method for determining EVLW was double indicator.

Currently, the determination of EVLW can be performed by a method that although invasive, is much simpler, transpulmonary thermodilution requiring central venous catheter and a femoral artery. In hemodynamically stable, hypoxemic patients the inclusion of EVLWI in the fluid therapy decision tree has an impact on the amount of fluid administered.[8] Although the evidence is not completely clear, it seems logical to attempt a negative fluid balance to avoid volume overload. EVLWI is a parameter that provides essential physiological information,[9] such as the degree of pulmonary edema. Traditionally, quantification of pulmonary edema was performed using chest radiography but their accuracy is low.[10] In patients with increased pulmonary capillary permeability, achieving a negative fluid balance decreases the capillary pulmonary pressure (CPP) thereby decreasing the amount of fluid filtered into the interstitium.[11] In our center, the fluid therapy protocol for hemodynamically stable, hypoxemic patients includes a negative fluid balance with the goal of lowering EVLWI and improving gas exchange. While there is little literature on the topic, De Laet et al.[3] found that a negative fluid balance after renal replacement therapy yields minimal drops in EVLWI; however, this study was performed in a heterogeneous group of critically ill patients, some with normal EVLWI.

The objective of our study was to analyze the efficacy of negative fluid balance in hypoxemic patients with elevated levels of EVLWI.