



ORIGINAL

## Compliance-guided versus FiO<sub>2</sub>-driven positive-end expiratory pressure in patients with moderate or severe acute respiratory distress syndrome according to the Berlin definition

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### KEYWORDS

Mechanical ventilation;  
Acute respiratory distress syndrome;  
Positive end-expiratory pressure;  
Outcomes;  
Static compliance;  
Multiple organ failure

### Abstract

**Objective:** To study the effect of setting positive end-expiratory pressure (PEEP) in an individualized manner (based on highest static compliance) compared to setting PEEP according to FiO<sub>2</sub> upon mortality at 28 and 90 days, in patients with different severity acute respiratory distress syndrome (ARDS).

**Setting:** A Spanish medical-surgical ICU.

**Design:** A post hoc analysis of a randomized controlled pilot study.

**Patients:** Patients with ARDS.

**Interventions:** Ventilation with low tidal volumes and pressure limitation at 30 cm H<sub>2</sub>O, randomized in two groups according to the method used to set PEEP: FiO<sub>2</sub>-guided PEEP group according to FiO<sub>2</sub> applied and compliance-guided group according to the highest compliance.

**Primary variables of interest:** Demographic data, risk factors and severity of ARDS, APACHE II and SOFA scores, daily Lung Injury Score, ventilatory measurements, ICU and hospital stay, organ failure and mortality at day 28 and 90 after inclusion.

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**Results:** A total of 159 patients with ARDS were evaluated, but just 70 patients were included. Severe ARDS patients showed more organ dysfunction-free days at 28 days ( $12.83 \pm 10.70$  versus  $3.09 \pm 7.23$ ;  $p=0.04$ ) and at 90 days ( $6.73 \pm 22.31$  vs.  $54.17 \pm 42.14$ ,  $p=0.03$ ), and a trend toward lower 90-days mortality (33.3% vs. 90.9%,  $p=0.02$ ), when PEEP was applied according to the best static compliance. Patients with moderate ARDS did not show these effects.

**Conclusions:** In patients with severe ARDS, individualized PEEP selection based on the best static compliance was associated to lower mortality at 90 days, with an increase in organ dysfunction-free days at 28 and 90 days.

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## PALABRAS CLAVE

Ventilación mecánica;  
Síndrome de distrés  
respiratorio agudo;  
Presión positiva al  
final de la espiración;  
Resultados;  
Compliance estática;  
Fracaso multiorgánico

## Presión positiva al final de la espiración guiada por la compliance versus $\text{FiO}_2$ aplicada en pacientes con distrés respiratorio agudo moderado o severo según la definición de Berlín

### Resumen

**Objetivo:** Estudiar el efecto de programar la presión positiva al final de la espiración (PEEP) de manera individualizada (basada en la mejor compliance estática) comparada con la programada según la  $\text{FiO}_2$  sobre la mortalidad a 28 y 90 días, en pacientes con diferente gravedad de síndrome de distrés respiratorio agudo (SDRA).

**Ámbito:** UCI española médico-quirúrgica.

**Diseño:** Análisis *post hoc* de un estudio piloto controlado y aleatorizado.

**Pacientes:** Pacientes con SDRA.

**Intervenciones:** Ventilación con volúmenes tidales bajos y presión limitada a 30  $\text{cmH}_2\text{O}$ , divididos en función de la manera de programar la PEEP: según la fracción inspirada de oxígeno o la mejor compliance estática pulmonar.

**Variables de interés principales:** Datos demográficos, factores de riesgo y gravedad del SDRA, escalas APACHE II y SOFA, Escala de Daño Pulmonar diaria, parámetros ventilatorios, estancia en UCI y hospitalaria, fracaso orgánico y mortalidad a día 28 y 90.

**Resultados:** Valoramos 159 pacientes con SDRA, de los que se incluyeron 70. En los pacientes con SDRA grave, observamos un mayor número de días sin fracaso multiorgánico a los 28 ( $12,83 \pm 10,70$  vs.  $3,09 \pm 7,23$ ,  $p=0,04$ ) y 90 días ( $6,73 \pm 22,31$  vs.  $54,17 \pm 42,14$ ,  $p=0,03$ ), y una menor mortalidad a 90 días (33,3% vs. 72,7%,  $p=0,16$ ), cuando la PEEP se programaba según la mejor compliance estática. No encontramos dichos efectos en el SDRA moderado.

**Conclusiones:** En pacientes con SDRA grave, programar la PEEP según la mejor compliance estática se asocia a una menor mortalidad a 90 días y a un aumento de los días libres de fracaso multiorgánico a 28 y 90 días.

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## Introduction

Although mechanical ventilation is potentially lifesaving in patients with acute respiratory distress syndrome (ARDS), it may cause ventilator-associated lung injury.<sup>1</sup> In 2000 the ARDSNetwork study demonstrated that ventilation with low tidal volume ( $V_T$ ) and positive end expiratory pressure (PEEP) application may reduce ARDS mortality near 9%.<sup>2</sup> So, protective mechanical ventilation with lower tidal volume ( $V_T$ ) and PEEP application was generalized. Nonetheless, the mortality of ARDS still remains high.<sup>3,4</sup>

Ventilation with PEEP is essential for patients with ARDS, as it was early observed that PEEP greatly improves oxygenation in ARDS,<sup>5</sup> but also it may induce lung injury. High PEEP levels may open collapsed alveoli and decrease intrapulmonary shunt and avoid repetitive alveolar opening and

closing during the respiratory cycle, but also may induce overdistension promoting lung injury.<sup>6,7</sup> Several methods have been proposed to set the level of PEEP, although the preferred method is still controversial.<sup>7,8</sup>

Previously, we conducted an open, randomized controlled pilot study<sup>9</sup> to test the hypothesis that individualized PEEP set based on highest compliance would improve oxygenation, compared to setting PEEP based on  $\text{FiO}_2$  (fraction of inspired oxygen) according to ARDSNetwork study.<sup>2</sup> We found that, although there were not differences on oxygenation, patients with ARDS ventilated with PEEP determined according their highest compliance had a strong trend toward lower mortality at day 28 and a significant increase in organ-dysfunction-free days at 28 days.<sup>9</sup>

This current study is a post hoc analysis of our earlier study.<sup>9</sup> We stratified patients with ARDS according to the last

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