

LETTER



CORE-REA: COPD right heart and respiratory acidosis

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Dear editor,

Influence of respiratory acidosis on right ventricular (RV) function in severe acute exacerbation (AE) of chronic obstructive pulmonary disease (COPD) patients remains unclear. Although lactic acidosis with $\text{pH} < 7.10$ could decrease contractile function in cardiomyocytes [1], respiratory acidosis with $\text{pH} < 7.20$ and $\text{PaCO}_2 > 90$ mmHg may increase cardiac output [2] or increase RV afterload [3] and systolic pulmonary artery pressure (sPAP) [4].

We aimed to detect influence of PaCO_2 decrease induced by the extracorporeal CO_2 removal (ECCO₂R) on the RV function in AE-COPD patients requiring invasive mechanical ventilation (IMV).

This was a monocentric observational ancillary study of the REXECOR study (NCT02965079). According to our local protocol, ECCO₂R was implanted if PaCO_2 remained > 55 mmHg and intrinsic positive end-expiratory pressure (PEEP) > 5 cmH₂O in IMV AE-COPD patients with the following mechanical ventilator parameters: tidal volume (VT): 8 mL/kg, respiratory rate (RR): 12/min in the assist-controlled mode. Hemlung® (ALung, Pittsburgh, USA) was the device used during the study period. IMV parameters (PEEP, VT and RR) were kept unmodified during 2 h before and one after the initiation of ECCO₂R. Transthoracic echocardiographic (TTE) studies were performed at baseline and 1 h after starting ECCO₂R. Respiratory parameters were simultaneously collected. The RV systolic function was assessed by the S' wave at tricuspid annulus (S' wave) and

the TAPSE [5]. We chose S' wave at tricuspid annulus (S' wave) and the TAPSE, as surrogate of RV function as they were found to be less load dependent compared to RV dimensions in critically ill patients [6].

All data assessing RV and LV functions were recorded using TTE according to guidelines from the American Society of Echocardiography and the European Association of Cardiovascular Imaging (electronic supplemental material (ESM) 1).

Seven patients [(5 women, median age 63 years (IC25–75: 56–73), median body mass index 39.5 kg/m² (IC25–75: 24.1–47.0)] were included from 11/2017 to 02/2018. Median SAPS2 at admission was 32 (IC25–75: 29–40) and respiratory SOFA was 3 (IC25–75: 2–3).

All patients had RV hypertrophy defined as RV free wall superior to 5 mm. Interestingly, no RV dysfunction was reported according to S' wave and TAPSE values (Table 1, ESM).

The implantation of ECCO₂R led to a significant reduction of PaCO_2 from 68 mmHg (IC25–75: 67–75) to 57 mmHg (IC25–75: 52–59), $p < 0.009$.

The evolutions of the main clinical and biological parameters are reported on ESM, Table 2. Figure 1 shows evolution of RV parameters and PaCO_2 before and after implantation of ECCO₂R. There was no difference between S' wave values before or after reduction of PaCO_2 induced by ECCO₂R ($p = 0.16$), whereas systolic pulmonary artery pressures (sPAP) decreased from 50.0 mmHg (IC25–75: 44.5–55.5) to 45.0 mmHg (IC25–75: 37.5–46.0), $p = 0.04$. Of note, there was a trend toward a decrease in PVR from 2.00 UW (IC25–75: 1.73–2.53) to 1.75 UW (IC25–75: 1.53–2.12), $p = 0.07$.

Despite some limitations due to the study design including small sample size, we conducted the first physiological study in a homogeneous population. The

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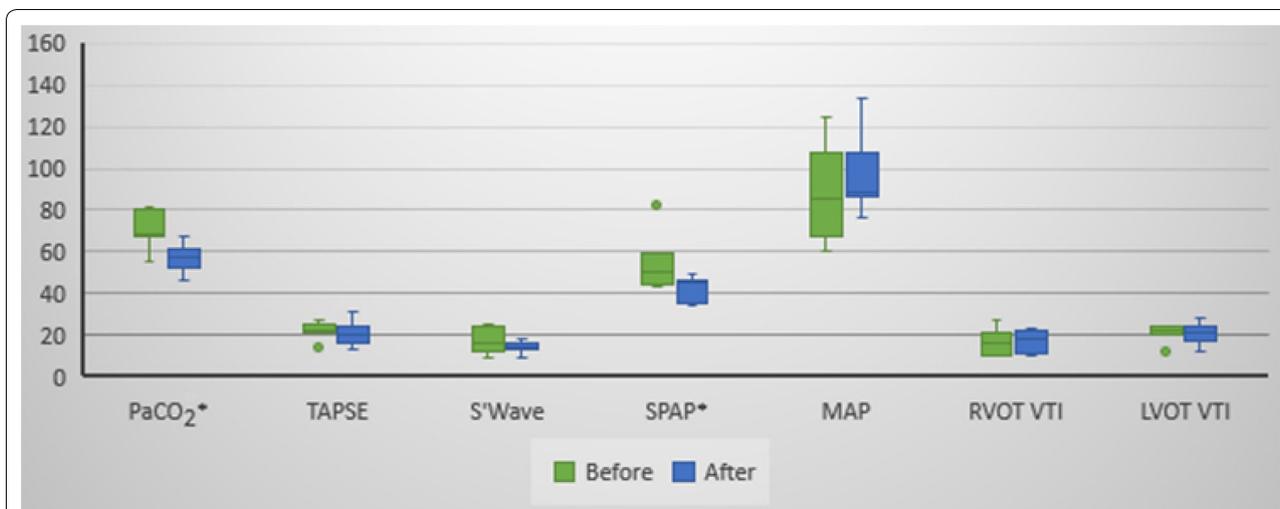


Fig. 1 Evolution of RV echocardiographic parameters according to PaCO₂ variations. PaCO₂ arterial CO₂ partial pressure, TAPSE tricuspid annular plane systolic excursion, S' wave S' wave at tricuspid annulus, SPAP systolic pulmonary arterial pressure, MAP mean arterial pressure, RVOT VTI right ventricular outflow tract velocity time integral, LVOT VTI left ventricular outflow tract velocity time integral. Results are exprimed in median and IC25–75, extreme values are showed; **p* < 0.05

decrease in PaCO₂ in AE-COPD patients requiring IMV induces decrease in sPAP without modifying the RV systolic parameters. It also leads to an afterload drop reflected by the PVR decrease even though our results did not reach statistical significance.

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Supplementary information

Supplementary information accompanies this paper at <https://doi.org/10.1007/s00134-019-05748-1>.

Compliance with ethical standards

Conflicts of interest

Dr. J.L. Diehl reported receiving research support and personal fees from Alung and Novalung/Xenios.

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