Estimate of Oxygen extraction ratio with an arterial and central venous blood sample: analysis on a preclinical trial

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Introduction

Oxygen extraction ratio (OER) is a valuable parameter to predict oxygen delivery (DO_2) adequacy [1]. Its value can be monitored, with other variables [2], to set an adequate therapy in states of low oxygen delivery to tissues (i.e. in low perfusion and/or distributive shock), as also evaluated in some physiological studies [3,4]

Methods

We conducted a post-hoc analysis on 136 mechanically ventilated piglets. First, we calculated the OER (OER_{real}) conventionally (using SaO_2, SvO_2, paO_2, pvO2 and Hb. Figure 1; panel c; equation I, II and III). Thereby, we calculated the OER without the contribution of the pulmonary artery catheter, using the $ScVO_2$ instead of the SvO_2, and the $pcvO_2$ instead of the pvO_2 (Figure 1; panel c; equation IV). Lastly, we analyzed and described the relation between these two parameters.

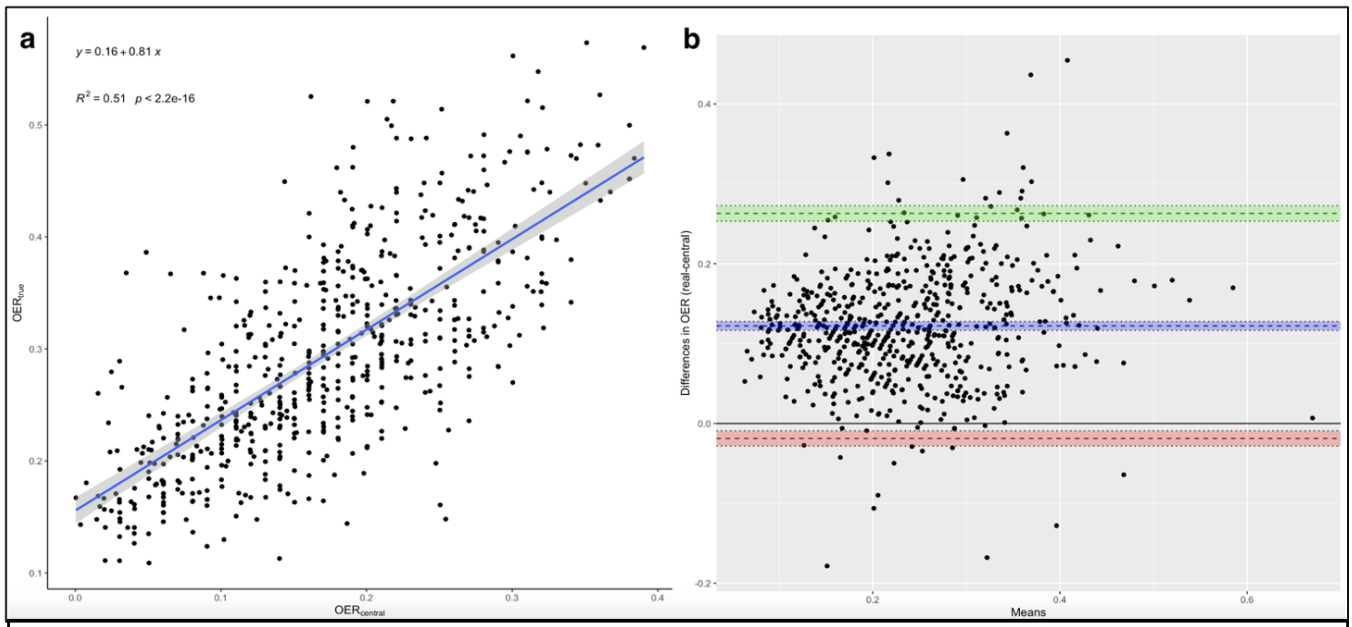
Results

The linear regression showed a significant correlation between OER_{real} and $OER_{central}$, with an R^2 of 0.51 (figure 1, panel A). In our experimental setting, the relation between OER_{real} and $OER_{central}$ is explained by the following equation: *OERreal= 0.16 + 0.81 * (OERcentral).*
At the Bland-Altman comparison, the two methods showed a bias of 0.122 [0.116-0.128], an upper level of agreement (LOA) of 0.263 [0.253-0.272] and a lower LOA of -0.018 [-0.028-(-0.009)] (figure 1, panel B).

Discussion and conclusion

The OER is a consistent parameter to assess DO_2 adequacy in critically ill patients, in low perfusion and/or distributive shocks. A pulmonary artery catheter is necessary for its measure. We suggest an alternative way to derive the OER from the $ScvO_2$ and SaO_2 only. In our setting of healthy mechanically ventilated piglets, the OER_{real} is higher than the $OER_{central}$ (mean-value=0.122), due to the higher values of $ScVO_2$ when compared to SvO_2. Further, clinical investigations are necessary to

evaluate the validity of this approach in humans.



C

$$I)\ OER_{real} = \frac{VO_2}{DO_2}$$

$$II)\ OER_{real} = \frac{\cancel{CO} * (CaO_2 - CvO_2)}{\cancel{CO} * CaO_2}$$

$$III)\ OER_{real} = \frac{(Hb * 0.36 * SaO_2/100 + paO_2 * 0.0031) - (Hb * 0.36 * \boldsymbol{SvO_2}/100 + \boldsymbol{pvO_2} * 0.0031)}{(Hb * 0.36 * SaO_2/100 + paO2 * 0.0031)}$$

$$IV)\ OER_{central} = \frac{(Hb * 0.36 * SaO_2/100 + paO_2 * 0.0031) - (Hb * 0.36 * \boldsymbol{ScvO_2}/100 + \boldsymbol{pcvO_2} * 0.0031)}{(Hb * 0.36 * SaO_2/100 + paO2 * 0.0031)}$$