Oxygenation Indices in Adult COVID ARDS Patients

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Dear Editor,

We read with interest the study by Vadi S et al.[1] the authors estimate the correlation and compare predictive validity for mortality between oxygenation indices namely oxygen saturation index (OSI) ((FiO_2 × mean airway pressure (MAP) × 100)/SpO_2), oxygenation index (OI) (FiO_2 × MAP × 100)/PaO_2) and P/F (PaO_2/FiO_2) ratio in adult COVID acute respiratory distress syndrome (ARDS) patients. They found that OSI correlated strongly with both OI and P/F ratio and all three indices predict mortality. While pulse oximetry is considered a reliable alternative for PaO_2 measurements particularly in resource-constrained settings, current SpO_2 monitoring devices may overlook instances of occult hypoxemia (SaO_2 levels below 88% despite normal SpO_2 readings (≥92%) in specific adult populations.[2]

We highlight some issues with the current study. First, the authors have overlooked the SpO_2/FiO_2 (S/F) ratio, a noninvasive alternative to the P/F ratio that can be readily assessed at the bedside without requiring arterial blood gas sampling. The global definition of ARDS for adult patients advocates the use of the S/F ratio, calculated using Rice's nonlinear equation, to determine oxygenation severity: mild (235 < S/F ≤ 315), moderate (148 < S/F ≤ 235), and severe (S/F ≤ 148), provided SpO_2 is less than 97%.[3] Second, there are common factors that contribute to the expected strong correlation between the three indices: PaO_2 and FiO_2 between P/F ratio and OI, and MAP and FiO_2 between OI and OSI. Essentially, the comparison between OI and OSI includes PaO_2 and SpO_2, variables that are known to be highly correlated. A robust regression analysis that takes into account potential collinearity issues and adjusts for all relevant factors to predict ICU mortality before receiver operating curve (ROC) curve analysis would be more appropriate.

We recently designed the P/FP (mm Hg/cm H_2O) ratio which incorporates positive end expiratory pressure (PEEP) into the P/F (mm Hg) ratio and multiplies with a correction factor of 10 [(PaO_2 × 10)/(FiO_2 × PEEP)]—a pragmatic index suitable to be used at any time point for categorization of ARDS severity, therefore, assesses prognosis and potentially guides treatment.[4] In 3,442 patients across seven ARDS network trials, the P/FP ratio showed superior hospital mortality prediction to the P/F ratio, with area under the ROC curve (AUCs) PEEP >5 cm H_2O (0.710 vs 0.659, $p < 0.001$) and PEEP ≥18 cm H_2O (0.963 vs 0.828, $p < 0.001$). With the same severity thresholds of ≤100, 101–200, and 201–300 for both ratios, when the P/FP ratio was used instead of the P/F ratio, 15 and 12.5% of patients with mild and moderate ARDS respectively were reclassified to more severe categories, while 13.9 and 33.6%

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of patients with severe and moderate ARDS respectively were reclassified to milder categories. Patients recategorized to severe ARDS had a median PEEP and FiO_2 of 14 cm H_2O and 0.70 while those recategorized to mild ARDS had a median PEEP and FiO_2 of 5 cm H_2O and 0.40, respectively. Furthermore, The P/FP ratio outperformed OI in predicting hospital mortality with increasing PEEP levels (>5 cm H_2O: AUC 0.706 vs 0.692, $p < 0.001$; >18 cm H_2O: AUC 0.968 vs 0.947, $p < 0.001$).[5]

In our view, refining the current model with additional analysis could yield deeper insights. The analysis underscores the necessity for methodological enhancements, especially advocating for the use of robust regression analysis followed by ROC curves. It remains to be seen that the pulse oximeter-based oxygen saturations can be used to guide treatment decisions in adult ARDS patients, and if so, whether similar thresholds would still be applicable in these patients.

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