Letter

Clinical relevance of the Pao_2/Fio_2 ratio

Mohamad F El-Khatib[1] and Gassan W Jamaleddine[2]

[1]American University of Beirut, PO Box 11-0236, Beirut 1107-2020 Lebanon
[2]SUNY, Downstate Medical Center, 450 Clarkson Ave, Brooklyn, New York 11203, USA

Corresponding author: Mohamad F El-Khatib, mk05@aub.edu.lb

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See related research by Karbing *et al*., http://ccforum.com/content/11/6/R118

We read with interest the report by Karbing and coworkers [1] in which they assess the clinical relevance of variation in the arterial oxygen tension (Pao_2)/fractional inspired oxygen (Fio_2) ratio, a widely used oxygenation index, alongside changes in Fio_2. In mechanically ventilated and spontaneously breathing patients, they showed that the clinical utility of Pao_2/Fio_2 ratio is doubtful unless the Fio_2 level at which the Pao_2/Fio_2 ratio is measured is specified. They included data from 28 mechanically ventilated patients and from an additional eight mechanically ventilated patients at one or two different positive end-expiratory pressure (PEEP) settings.

We commend Karbing and coworkers and agree with their findings in patients who are spontaneously breathing. However, for mechanically ventilated patients we believe that the Pao_2/Fio_2 ratio might not be the best reflection of oxygenation status. We have previously developed a new oxygenation index, $Pao_2/(Fio_2 \times MAP)$, where MAP is the mean airway pressure, and showed that the new oxygenation index is superior to Pao_2/Fio_2 ratio in reflecting intrapulmonary shunting and lung oxygenation status in mechanically ventilated patients [2]. By incorporating MAP, $Pao_2/(Fio_2 \times MAP)$ can better account for the functional status of the lung resulting from changes in end-expiratory lung volume caused by manipulation of PEEP and/or inspiratory to expiratory (I:E) ratio. It would have been interesting to see the results of an assessment by Karbing and coworkers of the behavior of $Pao_2/(Fio_2 \times MAP)$ in their mechanically ventilated patients occurring in response to changes in Fio_2.

Nevertheless, the study of Karbing and coworkers [1] and our study [2] demonstrate that there is a need to be more specific in terms of Fio_2 and MAP when using the Pao_2/Fio_2 ratio to assess lung gas exchange status and the extent of lung injury in mechanically ventilated patients.

Authors' response

Dan S Karbing and Stephen E Rees

We thank El-Khatib and Jamaleddine for their comments. We agree that the Pao_2/Fio_2 ratio is a poor index; our study showed it to vary with Fio_2 in both spontaneously breathing and mechanically ventilated patients. This analysis was based on the premise that any index describing oxygenation or pulmonary gas exchange should not vary with Fio_2, and that the physiologic effects of varying Fio_2, namely hypoxic vasoconstriction and absorption atelectasis, are small when Fio_2 is varied over the range described in our report.

Although pulmonary gas exchange indices should not vary with Fio_2, this is not the case for PEEP, or other measurements of airway pressure. Indeed, PEEP is a therapeutic intervention, increases in which should increase alveolar pressure, recruit alveoli, and hence improve gas exchange [3,4]. It is therefore difficult for us to see the utility of the $Pao_2/(Fio_2 \times MAP)$ index, which should factor out the effects of airway pressure changes. In our opinion, it should be such changes that we must measure as variation in gas exchange parameters if we are to elucidate the effects of PEEP.

We believe that therapeutic interventions such as PEEP should be evaluated using a combination of measurements of functional residual capacity, lung mechanics, and gas exchange. Our proposal is to use a mathematical model to describe gas exchange problems that includes two para-

Fio_2 = fractional inspired oxgen; MAP = mean arterial pressure; Pao_2 = artial oxygen tension; PEEP = positive end-expiratory pressure.

meters describing pulmonary shunt and ventilation perfusion mismatch, with the aim being to develop a technique that is simple enough for use in the clinic but complex enough to describe pulmonary gas exchange [5].

Competing interests

The authors declare that they have no competing interests.

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