Intensive Care Med (2022) 48:785–786
https://doi.org/10.1007/s00134-022-06696-z

CORRESPONDENCE

What about permissive acidosis?

Philip Fortuna[1*], Simão Rodeia[1] and Rui Morais[2]

We read with great interest the systematic review and meta-analysis by Gendreau and colleagues [1] examining the relation between hypercapnia and mortality in patients affected by acute respiratory distress syndrome (ARDS). We would like, however, to raise two concerns.

The first pertains to the methodological choice of dividing hypercapnia in "permissive hypercapnia" and "induced hypercapnia", based on the study design. Acknowledging the effort to establish an operational basis for the meta-analysis, we nevertheless feel the categories created do not reflect actual clinical/physiological differences. As such, the conclusion *clinical effects of hypercapnia were conflicting depending on the mechanism of hypercapnia* seems inaccurate, for two reasons. The mechanism is the same – reduced alveolar ventilation leading to reduced CO_2 removal; and those differences more probably reflect study protocol or standard clinical care employed (time lapse of studies included spans over 20 years).

The second concern refers to the true meaning of hypercapnia when we could not find a single reference to pH throughout the paper. In biological systems, the CO_2 molecule seems to be relatively nontoxic as long as its hydration does not lead to an acute accumulation of excess amounts of hydrogen ions [2]. Paramount to homeostatic functions, pH is kept at narrow range by shifts in HCO_3^-/CO_2 balance, with acute adjustments relying on CO_2 removal regulation (through alveolar ventilation). Moreover, pH shift leads to important physiologic derangements mainly in protein based reactions, whose failure ultimately leads to multiorgan dysfunction [2, 3].

In ARDS, evidence based practice entails limiting volume and pressure delivered through mechanical ventilation to less compliant lungs, these measures jointly referred to as protective ventilation. Such volume limitation frequently leads to incomplete CO_2 removal and hypercapnia. This can in itself have diverse effects in organ systems [2], with different analysis yielding conflicting results [4, 5]. Nevertheless, current guidelines recommend permissive hypercapnia, with some Authors specifically referring a pH target. In any two random patients, mechanically ventilated in an intensive care unit (ICU) we can have the same $PaCO_2$ value but very different physiological status brought by associated acute kidney injury, shock or other metabolic imbalances leading to acidosis. It will be the overall homeostatic capacity of the patient the true determinant of the ability to overcome protective ventilation associated hypercapnia and subsequent acid/base buffer imbalance. This is why we feel pH is a better target, when talking about respiratory acidosis in ARDS mechanically ventilated patients. We acknowledge CO_2 direct effects on some organs, leading to considerable dysfunction in these critically ill patients, but we feel that only a comprehensive analysis of gas exchange and acid–base status allows for correct physiological integration of disease severity and therapeutic strategic planning—should we be considering/analyzing permissive hypercapnia or permissive acidosis?

And this is precisely why we feel the analysis by Gendreau and colleagues should have somehow considered pH, either as a variable or at the very least as a confounder. Regardless of these concerns, we applaud the authors for the breadth of data reviewed, bringing a new look into existing data regarding an important aspect of ARDS patient care.

Author details
[1] Centro Hospitalar Universitário de Lisboa Central EPE, Lisbon, Portugal. [2] Centro Hospitalar de Lisboa Ocidental EPE, Lisbon, Portugal.

*Correspondence: philipfortuna@gmail.com
[1] Centro Hospitalar Universitário de Lisboa Central EPE, Lisbon, Portugal
Full author information is available at the end of the article

Springer

Declarations

Conflicts of interest
The authors declare that they have no conflit of interest.

Publisher's Note

Accepted: 31 March 2022
Published: 20 April 2022

References

1. Gendreau S, Geri G, Pham T, Vieillard-Baron A, MekontsoDessap A (2022) The role of acute hypercapnia on mortality and short-term physiology in patients mechanically ventilated for ARDS: a systematic review and meta-analysis. Intens Care Med. https://doi.org/10.1007/s00134-022-06640-1
2. Curley G, Laffey JG, Kavanagh BP (2010) Bench-to-bedside review: carbon dioxide. Crit Care 14:220
3. Feihl F, Perret C (1994) Permissive hypercapnia how permissive should we be? Am J Respir Crit Care Med 150:1722–1737
4. Nin N et al (2017) Severe hypercapnia and outcome of mechanically ventilated patients with moderate or severe acute respiratory distress syndrome. Intens Care Med 43:200–208
5. Madotto F et al (2020) Patterns and impact of arterial CO_2 management in patients with acute respiratory distress syndrome. Chest 158:1967–1982