

MATTERS ARISING

Open Access



Time-dependent effect of prone position in ARDS: considerations for future research

Yuxian Wang¹ and Ming Zhong^{1,2,3*}

To the Editor

We have read the article by Yuan et al. [1] with great interest, where they indicated that prone position significantly reduced ventilation/perfusion (V/Q) mismatch in patients with early ARDS, while it increased V/Q mismatch in persistent ARDS patients. However, there are several factors that might influence the reported findings:

Firstly, it is important to consider that the effect of prone position is time-dependent. Instead of defining a 20% improvement in PaO₂/FiO₂ at 2 h as a responder, it would be more appropriate to compare PaO₂/FiO₂ at the end of the prone position to the baseline. PP has a timely gravity effect on the change of ventilation, and also takes time to gradually open up collapsed or consolidated alveoli and drainage secretion. Additionally, previous studies have shown that PaO₂/FiO₂ increases during the first 3 h of PP, but further improvement in PaO₂/FiO₂ occurs in later stages due to increased ventilation and blood flow then more matched regions [2]. Therefore, we believe that using the PaO₂/FiO₂ at 2 h in the PP may not accurately define the reactivity of PP at 12 h. In the study, out of the 24 patients with persistent ARDS, 23 (95.8%) had moderate ARDS. Although the Shunt-EIT% (including

ventral and dorsal) and Total unmatched units increased significantly, there was no statistical difference in the PaO₂/FiO₂ of these patients after 12-h PP (Table 2). There is a lack of information on changes in matching or oxygenation during the 12-h period. It would be valuable to understand whether there is a peak effect of PP and its timing, as this could provide guidance for implementing this intervention. Therefore, further investigations which assess the time-dependent effect of PP in ARDS of different severity and time stage are warranted.

Secondly, this study defined ARDS days as starting from the initiation of non-invasive or invasive ventilation until the first PP. The initiation of non-invasive or invasive ventilation alone cannot be classified as ARDS without the support of imaging results at the time and the exclusion of heart failure. Figure E2 illustrates that the initial PaO₂/FiO₂ values were around 200 mmHg during the first two days of non-invasive/invasive use but decreased thereafter with a downward trend. There might have been a delay for intubation or PP in some persistent ARDS cases where it took seven days before initiating PP. Therefore, it is possible that the effectiveness of PP is not solely attributed to persistent ARDS, but also influenced by underlying pathological mechanisms, such as excessive respiratory drive leading to patient self-inflicted lung injury (P-SILI) [3, 4] or VILI [5], and aggravated basic disease. Moreover, the impact of early PP on the progression of ARDS necessitates further investigation.

Considering an early attempt at awake PP might also be reasonable. For persistent ARDS cases with suboptimal improvements in oxygenation despite PP, it is worth considering alternative approaches. Could an extended duration of PP or combining PP with inhaled nitric oxide (iNO) yield better results? Further research is needed to

This comment refers to the article available online at <https://doi.org/10.1186/s13054-023-04749-3>.

*Correspondence:

Ming Zhong

zhong.ming@zs-hospital.sh.cn

¹ Department of Critical Care Medicine, Zhongshan Hospital of Fudan University, Shanghai 200032, China

² Shanghai Institute of Infectious Disease and Biosecurity, School of Public Health, Fudan University, Shanghai, China

³ Shanghai Key Laboratory of Lung Inflammation and Injury, Shanghai, China



© The Author(s) 2024. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

address these questions and explore how it can lead to less shunting and facilitate efficient gas exchange.

Abbreviations

ARDS	Acute respiratory distress syndrome
V/Q	Ventilation/perfusion
PP	Prone position
EIT	Electrical impedance tomography
P-SILI	Patient self-inflicted lung injury
iNO	Inhaled nitric oxide

Acknowledgements

Not applicable.

Author contributions

YW wrote the main manuscript text. All authors reviewed relevant literatures, discussed about the topic, and reviewed the manuscript. All authors approved the manuscript.

Funding

This work was supported by Shanghai Health Commission Clinical Research Project (202240334).

Availability of data and materials

Not applicable.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Received: 8 February 2024 Accepted: 14 April 2024

Published online: 18 April 2024

References

1. Yuan X, Zhao Z, Chao Y, Chen D, Chen H, Zhang R, Liu S, Xie J, Yang Y, Qiu H, et al. Effects of early versus delayed application of prone position on ventilation-perfusion mismatch in patients with acute respiratory distress syndrome: a prospective observational study. *Crit Care*. 2023;27(1):462.
2. Wang YX, Zhong M, Dong MH, Song JQ, Zheng YJ, Wu W, Tao JL, Zhu L, Zheng X. Prone positioning improves ventilation-perfusion matching assessed by electrical impedance tomography in patients with ARDS: a prospective physiological study. *Crit Care*. 2022;26(1):154.
3. Brochard L, Slutsky A, Pesenti A. Mechanical ventilation to minimize progression of lung injury in acute respiratory failure. *Am J Respir Crit Care Med*. 2017;195(4):438–42.
4. Elabbadi A, Urbina T, Berti E, Contou D, Plantefève G, Soulier Q, Milon A, Carteaux G, Voiriot G, Fartoukh M, et al. Spontaneous pneumomediastinum: a surrogate of P-SILI in critically ill COVID-19 patients. *Crit Care*. 2022;26(1):350.
5. Katira BH. Ventilator-induced lung injury: classic and novel concepts. *Respir Care*. 2019;64(6):629–37.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.