Intensive Care Med (2019) 45:1498–1499
https://doi.org/10.1007/s00134-019-05742-7

CORRESPONDENCE

Calculation of mechanical power for pressure-controlled ventilation: author's reply

Tobias Becher* and Matthias van der Staay

Dear Editor,

Dr. van der Meijden and colleagues proposed an alternative equation for the calculation of mechanical power (MP) during pressure-controlled ventilation (PCV), which they evaluated in a dataset of 25 pressure–volume loops obtained in 17 patients [1]. They correctly stated that their results should be verified in a larger dataset. Therefore, we tested their proposed equation using our dataset of 301 pressure–volume loops obtained in 42 patients [2]. We found that on average, it led to an underestimation of MP with a bias of −0.56 J/min (95% LoA: −4.01 to +2.89) and a correlation coefficient of $r^2 = 0.937$ (Fig. 1a), which is inferior both to our "simplified" and "comprehensive" equations ($r^2 = 0.981$ and $r^2 = 0.985$, respectively). This is because their proposed equation erroneously assumes an end-inspiratory flow of zero and pressure rise times of zero. In cases with end-inspiratory flow above zero, it will lead to an underestimation of MP, while pressure rise times above zero will be associated with an overestimation of MP with their proposed equation.

We give two patient examples illustrating this underestimation of MP when end-inspiratory flow is above zero (Fig. 1b) and its overestimation when end-inspiratory flow approaches zero (Fig. 1c) with the equation proposed by van der Meijden and coworkers.

In conclusion, van der Meijden and coworkers proposed an equation that carries the same limitations as our "simplified equation" [2] and unnecessarily introduces another limitation, namely inaccurate results when end-inspiratory flow rates are above zero. Therefore, we do not recommend using this equation for the calculation of MP during PCV.

*Correspondence: tobias.becher@uksh.de
Universitätsklinikum Schleswig Holstein, Campus Kiel, Kiel, Germany

Springer

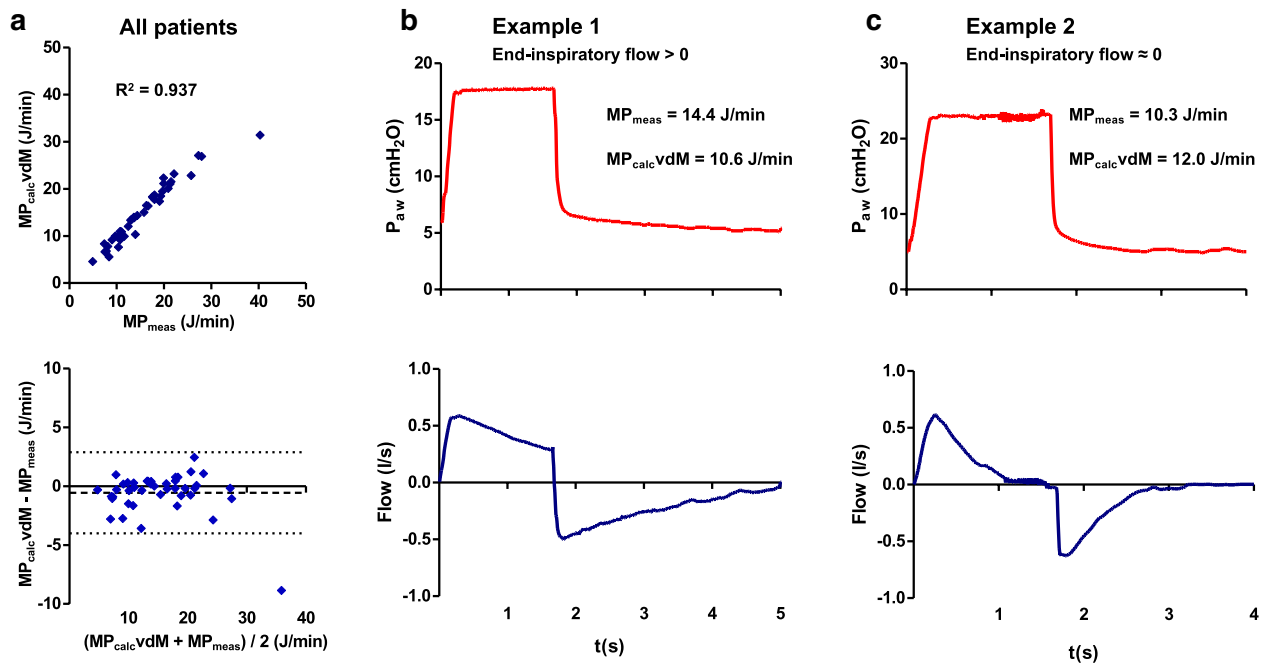

Fig. 1 **a** Correlation (above) and Bland–Altman plot (below) comparing mechanical power (MP) calculated with the equation proposed by van der Meijden et al. ($MP_{calc}vdM$) [1] and MP measured by integrating the actual pressure–volume loops (MP_{meas}). $R^2 = 0.937$; $p < 0.0001$; bias = −0.56 J/min; 95% limits of agreement = −4.01 to +2.89. **b** Airway pressure (above) and flow (below) in a patient with airflow above zero at end-inspiration. The reference value MP_{meas} was 14.4 J/min. Calculated MP was 14.8 J/min with our simplified Eq. (2), 14.5 J/min with our comprehensive Eq. (2) but only 11.6 J/min with the equation proposed by van der Meijden et al. [1]. This bias can be explained by the fact that in order to provide accurate results, the equation proposed by van der Meiden et al. requires airflow to be close to zero at end-inspiration which was not the case in this patient. **c** Airway pressure and flow in a patient with airflow approaching zero at end-inspiration and pressure rise time (slope) of 0.3 s. The reference value MP_{meas} was 10.3 J/min. Calculated MP was 12.1 J/min with our simplified Eq. (2), 10.7 J/min with our comprehensive Eq. (2), and 12.0 J/min with the equation proposed by van der Meijden et al. [1]. This bias can be explained by the fact that similar to our simplified equation, the equation proposed by van der Meijden et al. does not take into account inspiratory pressure rise time (slope)

Compliance with ethical standards

Conflicts of interest

Tobias Becher received lecture fees from Drägerwerk AG & Co. KGaA (Lübeck, Germany), unrelated to the present work. Matthias van der Staay is an employee of imt and works for imtmedical, Buchs, Switzerland.

Publisher's Note

Accepted: 9 August 2019
Published online: 20 August 2019

References

1. Van der Meijden S, Molenaar M, Somhorst P, Schoe A (2019) Calculating mechanical power for pressure-controlled ventilation. Intesive Care Med. https://doi.org/10.1007/s00134-019-05698-8 **(in press)**
2. Becher T, van der Staay M, Frerichs I et al (2019) Calculation of mechanical power for pressure-controlled ventilation. Intensive Care Med. https://doi.org/10.1007/s00134-019-05636-8 **(in press)**