Conservative management of COVID-19 associated hypoxaemia

From the authors:

We would like to thank W. Windisch and colleagues for their recognition of our work. Their comments refer to the Early View version of our article, which was immediately uploaded upon acceptance but is not the final, copy-edited version. Unfortunately, there were some technical formatting changes between our submitted version and the version that was uploaded to the *ERJ Open Research* website. In table 2, for instance, temperature, saturation, respiratory rate, heart rate, and systolic and diastolic blood pressure refer to measurements taken on admission under room air conditions, which explains why the saturation values differ from the nadir oxygen saturation values shown in figure 3.

The referencing was also impacted by this process, which has been corrected in the final version. All measurements of oxygen saturation were performed by means of pulse oximetry, as correctly pointed out by W. Windisch and colleagues. Thus, according to studies on comparative measurements of S_{aO_2} and S_{pO_2} [1, 2], we would have rather overestimated the oxygenation in our patients, which strengthens our finding that hypoxaemia was well tolerated. Values are labelled S_{pO_2} in the proofread version. We are surprised, however, that W. Windisch and colleagues confused the terms "clinical work of breathing" and "measured work of breathing". Our protocol clearly uses the term "clinical work of breathing", which is characterised by the clinical picture or so-called gestalt, as previously suggested by TOBIN and co-workers [3, 4]. The absolute measured work of breathing by means of oesophageal pressure and airflow measurements is a poor predictor of the success of noninvasive ventilation (NIV) techniques in acute hypoxaemic respiratory failure, and only the reduction in respiratory work during NIV predicts failure or success [5]. The clinical picture of respiratory stress and respiratory muscle overload is characterised by rapid, shallow breathing. A more rapid and shallow breathing pattern might result in a reduced measured work of breathing even when corrected for alveolar ventilation, as members of our group have previously shown [6]. We would like to emphasise once more that our study was of a retrospective nature. Oesophageal pressure measurements are not the standard of care during noninvasive respiratory support in hypoxic respiratory failure. Especially in SARS-CoV-2-positive patients, these catheters might induce leakage during mask application and increase the risk of spreading infectious aerosols. W. Windisch and colleagues furthermore suggest that the respective measurements for determination of the oxygen content were collected in a staggered fashion. This, of course, is untrue. Measurements were performed on the same day in timely association. Inspired fraction of oxygen (F_{IO_2}) in spontaneously breathing patients were calculated as suggested by SHAPIRO *et al.* [7] and details on oxygen therapy are usually completely documented in well-organised care settings.

The last and most important issue is treatment escalation protocols. W. Windisch and colleagues propose to include newer versions of the guidelines [8, 9] in our paper. Of course, we had to cite the guidelines that were valid at the time we collected our data. It is of particular importance that the guideline we refer to [10] recommends aiming for a S_{pO_2} ⩾90% and recommends making the indication for the use of nasal high-flow or NIV with caution. However, all the newer guidelines W. Windisch and colleagues mentioned agree to use the arterial oxygen tension/F_{IO_2} ratio (Horovitz index) as one indicator for intubation [8, 9]. However, the Horovitz index is, to a certain extent, a marker of the oxygen uptake performance of the respiratory system. It in no way provides any information about the amount of available oxygen and the oxygen supply in the body. Our protocol is new in this regard. W. Windisch and colleagues complain that

@ERSpublications
This correspondence argues that happy hypoxaemic patients should not be intubated as long as they remain happy https://bit.ly/3csrpWO

Cite this article as: Voshaar T, Stais P, Köhler D. Conservative management of COVID-19 associated hypoxaemia. *ERJ Open Res* 2021; 7: 00134-2021 [https://doi.org/10.1183/23120541.00134-2021].

none of our patients met the pre-defined oxygen content cut-off and that none of our patients was intubated based on a lack of oxygen supply. This is exactly true and is the main message of our work. If oxygen supply parameters are selected wisely, intubations can potentially be avoided. Our investigation describes only a small, retrospective investigation presented by a minor group of researchers who would like to encourage other clinicians to use markers of oxygen supply for future protocols. We are still convinced that happy hypoxaemic patients should not be intubated as long as they remain happy!

Thomas Voshaar[1], Patrick Stais[1], Dieter Köhler[2] and Dominic Dellweg[2,3]
[1]Bethanien Hospital Moers, Moers, Germany. [2]Kloster Grafschaft, Schmallenberg, Germany. [3]Philipps University Marburg, Marburg, Germany.

Correspondence: Dominic Dellweg, Kloster Grafschaft, Annostr. 1, 57392 Schmallenberg, Germany. E-mail: d.dellweg@fkkg.de

Received: 27 Feb 2021 | Accepted: 4 March 2021

Conflict of interest: None declared.

References

1 Sjoding MW, Dickson RP, Iwashyna TJ, *et al.* Racial bias in pulse oximetry measurement. *N Engl J Med* 2020; 383: 2477–2478.
2 Thijssen M, Janssen L, le Noble J, *et al.* Facing S_{pO_2} and S_{aO_2} discrepancies in ICU patients: is the perfusion index helpful? *J Clin Monit Comput* 2020; 34: 693–698.
3 Tobin MJ. Basing respiratory management of COVID-19 on physiological principles. *Am J Respir Crit Care Med* 2020; 201: 1319–1320.
4 Tobin MJ, Jubran A, Laghi F. Noninvasive strategies in COVID-19: epistemology, randomised trials, guidelines, physiology. *Eur Respir J* 2021; 57: 2004247.
5 Tonelli R, Fantini R, Tabbì L, *et al.* Early inspiratory effort assessment by esophageal manometry predicts noninvasive ventilation outcome in *de novo* respiratory failure: a pilot study. *Am J Respir Crit Care Med* 2020; 202: 558–567.
6 Dellweg D, Haidl P, Siemon K, *et al.* Impact of breathing pattern on work of breathing in healthy subjects and patients with COPD. *Respir Physiol Neurobiol* 2008; 161: 197–200.
7 Shapiro B, Harrison R, Trout C. Clinical Application of Respiratory Care. 2nd Edn. Chicaco, Yearbook Medical Publishers, 1979.
8 Windisch W, Weber-Carstens S, Kluge S, *et al.* Invasive and non-invasive ventilation in patients with COVID-19. *Dtsch Ärzteblatt Int* 2020; 117: 528–533.
9 Kluge S, Janssens U, Welte T, *et al.* S2k guideline – recommendations for inpatient therapy of patients with COVID-19. *Pneumologie* 2021; 75: 88–112.
10 Kluge S, Janssens U, Welte T, *et al.* German recommendations for critically ill patients with COVID-19. *Med Klin Intensivmed Notfallmed* 2020; 115: Suppl. 3, 111–114.