

Respiratory Events and Health-Related Quality of Life in Long-Term Non-Invasive Ventilation: How Can We Optimize and Prevent Failure?

Anne Louise Kleiven^a Heidi Øksnes Markussen^{b, c} Ole Henning Skjønsberg^{a, e}
Jean-Paul Janssens^d Sigurd Aarrestad^a

^aDepartment of Pulmonary Medicine, Oslo University Hospital, Oslo, Norway; ^bWestern Norway University of Applied Sciences, Bergen, Norway; ^cDepartment of Thoracic Medicine, Haukeland University Hospital, Bergen, Norway; ^dDivision of Pulmonary Diseases, Geneva University Hospital, Genève, Switzerland; ^eInstitute of Clinical Medicine, University of Oslo, Oslo, Norway

We thank Pedro Miguel Nogueira Costa and colleagues for their comments about our article [1].

Nogueira Costa et al. [2] suggest that it would have been beneficial to analyse data on exacerbations and therefore not to exclude patients with recent hospital admissions due to exacerbations. They hypothesize that exacerbations could have been triggered by poor adherence, which again could be due to a high frequency of undesired respiratory events during long-term non-invasive ventilation (LTNIV). In fact, in our study, only 4 cases were excluded because of a recent exacerbation, i.e., a small proportion of the study population. A possible explanation for this low number of exacerbations is that one of the inclusion criteria was treatment with LTNIV for a minimum of 3 months. Thus, major side effects (leaks or undesired respiratory events) may have been corrected during the initial period of NIV implementation. In addition, excluding patients with recent exacerbations was important to study a stable population for the other endpoints of this work. It would indeed be interesting to study the potential relationship between poor adherence to LTNIV and undesired respiratory events, as suggested by Nogueira Costa et al. However, this would require much larger groups since non-adherence seems to be less

of a problem in LTNIV than in continuously positive airway pressure or adaptive servo-ventilation [3, 4].

The authors further suggest that we should have distinguished between different types of patient-ventilator asynchronies (PVA) and analysed each of them in relation to the different subscales of the Severe Respiratory Insufficiency (SRI) Questionnaire. We scored auto-triggering, double triggering, and desynchronization including ineffective efforts. As outlined in our earlier publication, we did not include additional indicators of inspiratory effort such as oesophageal pressure or diaphragm electromyogram [5] and could therefore not score cycling asynchrony. However, Ramsay et al. [6] found cycling asynchrony to be of low frequency in their study. In our study, very few patients had auto-triggering and double triggering [5]. Therefore, we found it reasonable to summarize events as an asynchrony score and to compare the total amount of PVA with the different subscales of the SRI. Definition of asynchrony in this setting varies between authors [7]. We used rather strict criteria for scoring desynchronization with an uncoupling of the patient's inspiratory efforts and onset of the ventilator pressurization for ≥ 10 s and at least three consecutive breaths. Since our study, the classification of asynchrony has been

improved [8], and we agree with Nogueira Costa and colleagues that in future studies, distinguishing between different types of PVA may bring further insight as to how PVA influences HRQoL. However, this requires a considerable number of cases to be studied: in our patient group, only 14 patients spent >10% of the night with PVA (21%) [5].

Ventilator modes and settings were rather homogeneous in our study population. All but one patient had bi-level pressure-cycled ventilators with a backup respiratory rate. PEEP settings were higher in patients with obesity hypoventilation syndrome as expected. Thus, it would have been difficult to relate different ventilator modes to outcomes and HRQoL.

Conflict of Interest Statement

Anne Louise Kleiven has received the ResMed grant from the Norwegian Society of Pulmonary Medicine. Sigurd Aarrestad has received fees for lecturing from Philips-Respironics and ResMed, outside of the presented work. All other authors have no competing interests to declare.

References

- 1 Kleiven AL, Markussen HO, Skjonsberg OH, Janssens JP, Aarrestad S. Effect of respiratory events on health-related quality of Life in patients treated with long-term noninvasive ventilation. *Respiration*. 2022;101(12):1099–109.
- 2 Nogueira Costa P, Pereira JO, Esquinas AM. Respiratory Events and Health-Related Quality of Life in Long-Term Noninvasive Ventilation: How Can We Optimize and Prevent Failure? *Respiration*. 2023;1–2.
- 3 Patout M, Lhuillier E, Kaltsakas G, Benattia A, Dupuis J, Arbane G, et al. Long-term survival following initiation of home non-invasive ventilation: a European study. *Thorax*. 2020; 75(11):965–73.
- 4 Cantero C, Adler D, Pasquina P, Uldry C, Egger B, Prella M, et al. Long-term noninvasive ventilation in the geneva lake area: indications, prevalence, and modalities. *CHEST*. 2020;158(1):279–91.
- 5 Aarrestad S, Qvarfort M, Kleiven AL, Tollefsen E, Skjonsberg OH, Janssens JP. Sleep related respiratory events during non-invasive ventilation of patients with chronic hypoventilation. *Respir Med*. 2017;132:210–6.
- 6 Ramsay M, Mandal S, Suh ES, Steier J, Douiri A, Murphy PB, et al. Parasternal electromyography to determine the relationship between patient-ventilator asynchrony and nocturnal gas exchange during home mechanical ventilation set-up. *Thorax*. 2015;70(10):946–52.
- 7 Aarrestad S. [Monitoring long-term nocturnal non-invasive ventilation for chronic hypercapnic respiratory failure: what are the basic tools?](#) Oslo: Faculty of Medicine; 2020. [cited Degree of Philosophica Doctor; 117]. Available from: <https://www.duo.uio.no/handle/10852/74185>.
- 8 Gonzalez-Bermejo J, Janssens JP, Rabec C, Perrin C, Lofaso F, Langevin B, et al. Framework for patient-ventilator asynchrony during long-term non-invasive ventilation. *Thorax*. 2019;74(7):715–7.

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Author Contributions

Anne Louise Kleiven has full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Anne Louise Kleiven and Sigurd Aarrestad contributed substantially to acquisition of data. Anne Louise Kleiven, Sigurd Aarrestad, Heidi Øksnes Markussen, Ole Henning Skjønsberg, and Jean-Paul Janssens contributed substantially to the study concept and design, data interpretation, critical revision of the manuscript for important intellectual content, and final approval of the manuscript.