Journal of Mechanical Ventilation

Letter to the Editor

Flow beyond intended expiratory flow termination: Why inspiratory pressure rise time should be integrated into Airway Pressure Release Ventilation (APRV) recommendations

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DOI: https://doi.org/10.53097/JMV10161

Cite: Neetz B, Fiedler-Kalenka MO, Weigand MA, Rehn P. Letter to the Editor: Flow beyond intended expiratory flow termination: Why inspiratory pressure rise time should be integrated into Airway Pressure Release Ventilation (APRV) recommendations. J Mech Vent 2026; 7(3):157-158.

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Conflict of interest/Disclosures: None

To the Editor,

We read with great interest the expert recommendations for setting and adjusting Airway Pressure Release Ventilation (APRV) in the context of the Time-Controlled Adaptive Ventilation (TCAV) protocol. [1] The authors provide a comprehensive and highly valuable framework for standardizing the application of this ventilatory strategy. We would like to supplement their important work with our own recent findings to further improve methodological consistency.

The authors highlight that the TCAV protocol requires adjusting T_{Low} to terminate expiratory flow at approximately 75% of the peak expiratory flow rate (PEFR). Allowing the expiratory flow to decay further (e.g., below 75% of PEFR) prolongs the release phase, which may result in alveolar instability and atelectrauma. This recommendation is supported by animal experiments, in which extending the termination of the PEFR from 75% to 50% resulted in a sixfold increase in alveolar microstrain (0.05 ± 0.03 vs. 0.29 ± 0.04), a 16% reduction in the number of end-expiratory inflated alveoli (51 ± 7.35 vs. 44 ± 5.89) as well as dynamic heterogeneity between inspiration and expiration. [2,3] Thus, deviations from the recommended 75% may increase alveolar stress and instability, thereby compromising the protective nature of this strategy. Accordingly, a recently published study that allowed a termination of the PEFR range of 75% to 50% has been criticized for this approach. [4,5]

In our recent prospective study, we investigated the role of the inspiratory rise time (IPRT) within the TCAV protocol and found that it significantly impacts the duration of the release phase. [6] Specifically, we observed that increasing the IPRT (e.g., from 0 ms to 1000 ms) can prolong the release phase by more than 350 ms. While the nominal T_{Low} setting on the ventilator remains unchanged, a prolonged IPRT delays the pressure rise back to Phigh, thereby functionally extending the period of negative flow into the T_{High} phase. [6] Our data demonstrate that this phenomenon is associated with reduced end-expiratory lung volume (EELV) and lower intrinsic PEEP ($PEEP_i$), as well as an increased driving pressure (DP) and increased release volume (i.e., tidal volume). Furthermore, we observed that measuring PEEPi with an expiratory hold maneuver cannot detect this reduction of PEEPi during the release phase, making it misleading in the presence of a prolonged IPRT. [7] We are aware that we used IPRT values that are slightly higher than standard clinical values. Our experimental setup included IPRT values of 500 ms and 1000 ms. However, considering the decrease in PEEPi of 3.3 ± 1.4 to 4.8 ± 1.5 cmH_2O, the pathophysiological implications discussed above, and the fact that, to the best of our knowledge, this phenomenon has not yet been described anywhere, we believe that taking it into account in clinical practice is justified. Consequently, unmonitored variations in IPRT within the TCAV protocol might inadvertently influence the overall efficacy of this promising ventilation strategy.

Given these findings, we hope that our observations will be further clinically validated. Exploring this variable and raising awareness of its impact on conventional measurements could help refine the assessment of PEEPi and driving pressure, thereby safeguarding EELV and keeping

lung strain within safe limits. Ultimately, incorporating IPRT into future iterations of these expert guidelines could significantly improve the methodological consistency and safety of APRV application.

In summary, this letter highlights the role of the inspiratory rise time (IPRT) within the Time-Controlled Adaptive Ventilation (TCAV) protocol. While current guidelines emphasize adjusting T_{Low} to terminate expiratory flow at approximately 75% of the peak expiratory flow rate to prevent alveolar instability and atelectrauma, the potential impact of IPRT on these flow kinetics has been largely unrecognized. Our prospective data suggest that increasing the IPRT can prolong the release phase, which may be associated with a reduction in end-expiratory lung volume (EELV) and intrinsic PEEP (PEEPi), alongside a potential increase in driving pressure and tidal volume. Notably, conventional assessment methods, such as the expiratory hold maneuver, may fail to detect these alterations, which could limit the reliability of standard clinical monitoring in this context. To safeguard EELV and optimize the protective nature of this strategy, we suggest that future clinical investigations evaluate whether managing IPRT as a protocol consideration can further refine the safety and consistency of the TCAV protocol.

References

1. Nieman GF, Bates JHT, Andrews PL, et al. Expert recommendations for setting and adjusting airway pressure release ventilation based on clinical experience and basic science evidence. Front Med (Lausanne) 2026; 13:1741129.

2. Kollisch-Singule M, Emr B, Smith B,. Mechanical breath profile of airway pressure release ventilation: the effect on alveolar recruitment and microstrain in acute lung injury. JAMA Surg 2014; 149(11):1138-1145.

3. Kollisch-Singule M, Jain S, Andrews P, et al. Effect of Airway pressure release ventilation on dynamic alveolar heterogeneity. JAMA Surg 2016; 151(1):64-72.

4. Ibarra-Estrada MÁ, García-Salas Y, Mireles-Cabodevila E, et al. Use of airway pressure release ventilation in patients with acute respiratory failure due to COVID-19: Results of a single-center randomized controlled trial. Crit Care Med 2022; 50(4):586-594.

5. Habashi NM, Andrews P, Kollisch-Singule Met al. A ventilator mode cannot set itself, nor can it be solely responsible for outcomes. Crit Care Med 2022; 50(4):695-699.

6. Neetz B, Rehn P, Kraus N, et al. Impact of inspiratory pressure rise time on lung-emptying in time controlled adaptive ventilation. Respir Care 2025; 70(12):1547-1555.

7. Rola P, Daxon B. Airway pressure release ventilation with time-controlled adaptive ventilation (TCAV™) in COVID-19: A community hospital's experience. Front Physiol 2022; 13:787231.