016

Understanding the interaction between respiratory muscle effort and assisted proportional ventilation plus in a mechanical simulator

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Introduction: In assisted mechanical ventilation, the work of breathing (WOB) should be shared by patient and ventilator.[1,2] In PAV+, there is an association between respiratory muscle pressure and the pressure generated by the ventilator.[1,3,4] There are still knowledge deficits about the influence of different types of inspiratory efforts on mechanical ventilator outputs during PAV+ assistance.

Objective: To evaluate how the interaction between different inspiratory effort (-3, -7 and -11cmH2O) and inspiratory delay (5%, 10% and 15%) behaves in the PAV+ ventilation mode coupled to a mechanical simulator (compliance of 100mL/cmH2O and resistance of 10cmH2O/L/sec), analyzing the response variables inspiratory time (IT), expiratory tidal volume (ETV), peak inspiratory flow (PIF) and peak pressure (PP). Check the difference in behavior between the PAV+ mode and the PSV mode using the same effort combinations and the same response variables.

Methods: The simulator was coupled to the mechanical respirator and the experiment started with the sequential recording (script) of three different inspiratory effort (-3, -7, -1cmH2O) and three different delays (5%, 15% and 20%) (Figure 1) pre-programmed in the ASL5000 simulator software, totaling 9 combinations of inspiratory efforts. For each of the 19 levels of assist and 16 PSV values, the effort and delay were combined. Response variables were collected from the ASL5000_SW software.

Results: In PAV+ mode, a significant variation was found in the comparison of inspiratory effort, delay and levels of assist, with ascending values of the response variables in the combination of the three factors and separately. The effort out over delay in the variation of variables, and its increase was amplified with changes in the levels of assist. We observed an increase in ETV (Figure 2) with the use of a greater inspiratory delay, and the increase of PP (Figure 3) with inspiratory delay occurred mainly from medians e higher level of assist (remained within safe values). In PSV mode, lost effort was found in combinations with the effort of -3cmH_2O, from the PSV of 6 cmH2O, and in the effort of -7cmH_2O, from the PSV of 17cmH_2O. In these situations of undetected efforts, there was an increase in ETV and IT (Figure 4) with the use of a lower effort. The change in the response variables was more related to the change in PSV than to the inspiratory effort and delay.

Conclusion: PAV+ responded promptly to variations in effort and delay, with a proportional increase in terms of response variables. It was possible to increase the ETV with the use of a greater inspiratory delay, keeping the PP at safe values for clinical use. The response of the variables studied in PSV, in the face of variations in effort, did not fluctuate in an effort-dependent manner, as occurred in PAV+. PAV+ seems to provide adequate ventilatory assistance with the normal inspiratory variability of each patient.

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REFERENCES

1. Kataoka J, Kuriyama A, Norisue Y, Fujitani S. Proportional modes versus pressure support ventilation: a systematic review and meta-analysis. Ann Intensive Care. 2018;8:123.
2. de Vries H, Jonkman A, Shi ZH, Spoelstra-de Man A, Heunks L. Assessing breathing effort in mechanical ventilation: physiology and clinical implications. Ann Transl Med. 2018;6(19):387.
3. Younes M. Proportional assist ventilation, a new approach to ventilatory support: theory. Am Rev Respir Dis. 1992;145(1):114–20.
4. Jonkman AJ, Rauseo M, Carteaux G, Telias I, Sklar MC, Heunks L, et al. Proportional modes of ventilation: technology to assist physiology. Intensive Care Med. 2020;1-13.

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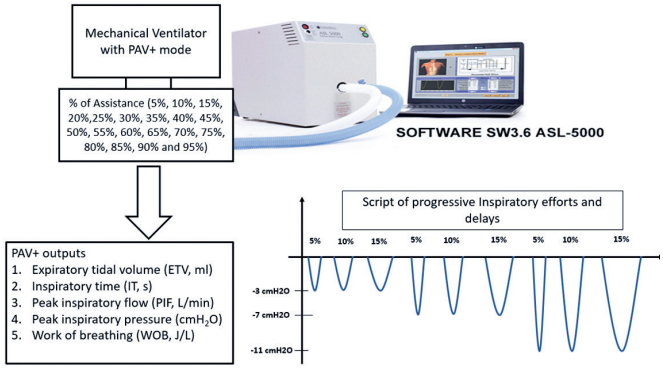

Figure 1. Script of the sequence of inspiratory effort (-3, -7, -11 cmH_2O) and inspiratory delay (5, 10, 15%)

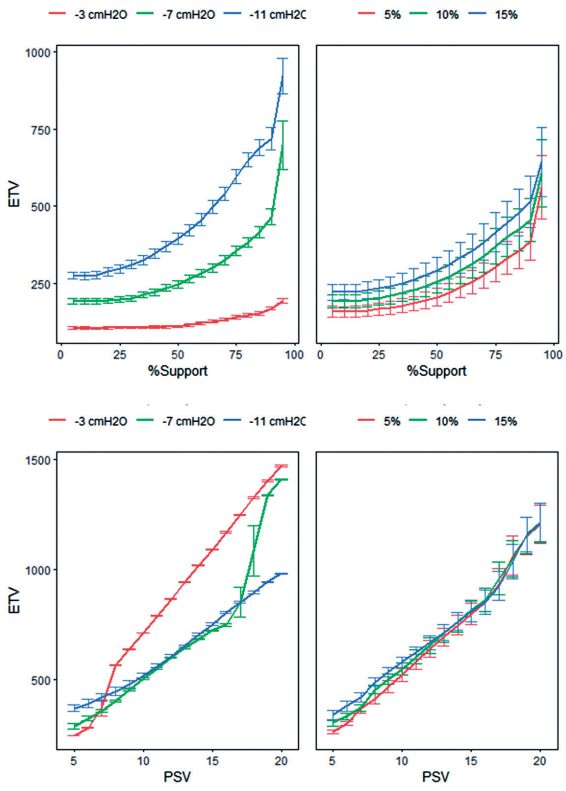

Figure 2. ETV average profiles by value of PSV and PAV+ ventilation modes in each inspiratory effort (-3, -7, -11 cmH_2O) and inspiratory delay (5, 10, 15%)

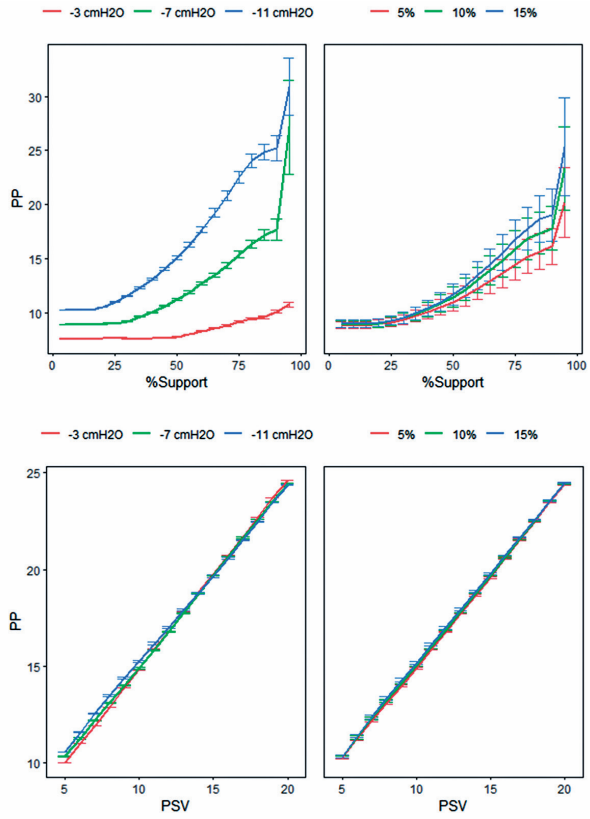

Figure 3. PP average profiles by value of PSV and PAV+ ventilation modes in each inspiratory effort (-3, -7, -11 cmH_2O) and inspiratory delay (5, 10, 15%)

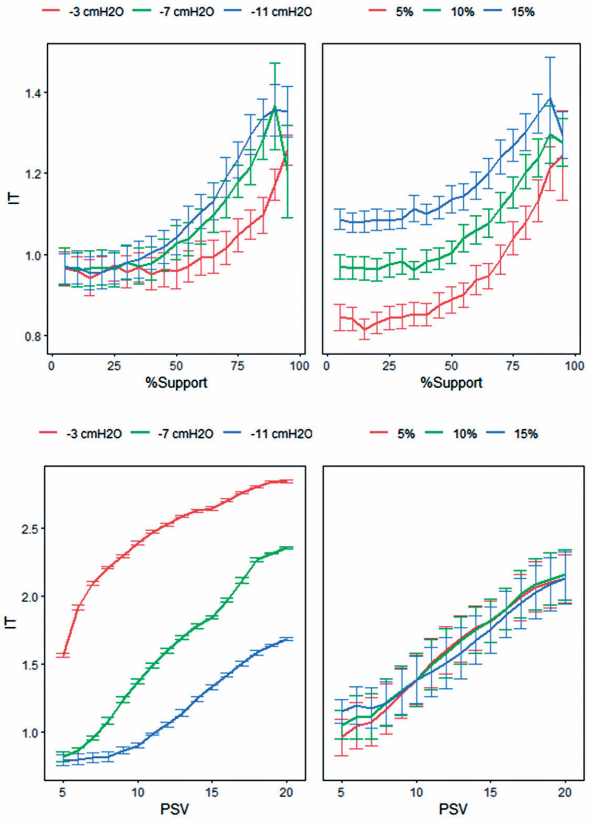

Figure 4. IT average profiles by value of PSV and PAV+ ventilation modes in each inspiratory effort (-3, -7, -11 cmH_2O) and inspiratory delay (5, 10, 15%)