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EDITORIAL

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Pressure-support ventilation: still a simple mode?

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Pressure support ventilation (PSV) presents several attractive features. One of them is its apparent simplicity. The study by Bonmarchand et al. in this issue is another piece of evidence, however, that many different aspects of PSV influence its efficacy [1]. These authors show convincingly that manipulating the "pressure rise time" – or the time to reach the set plateau pressure – has a significant influence on the patient's effort. They found that lengthening the pressure rise time almost invariably increased the work of breathing in patients with chronic obstructive pulmonary disease who were ventilated with PSV, as well as several other indexes of patient's effort, whereas the breathing pattern was essentially not modified. Such an effect was easily predicted for the longer rise times used, since the set pressure was not reached at the end of inspiration. This, however, suggested a clinical evaluation for the other settings. For the purpose of their study, the authors used the feature offered by a commercially available ventilator to vary this pressure rise time. This feature is now proposed by the manufacturers of several of the new generation ventilators (including Siemens, Bear, Taema, and Dräger). One of the questions raised by the study of Bonmarchand et al. is: "Do we really need this?" In other words, do we really need to add a new setting, and hence complexity, or could we select from the studies done by Bonmarchand and other investigators the optimal setting of the pressure wave shape that manufacturers should implement in their ventilators?

This study suggests that the two or three highest peak flows (the fastest ramps) were optimal both for the group as a whole and individually for most patients. On the one hand, this reinforces the important influence of a high peak flow setting as shown by a number of investigators [2, 3]. Their results also agree with preliminary (but unpublished in full format) results from our group looking at two different wave shapes, also indicating a lower level of effort with the fastest ramp [4], and with data from Braschi's group [5]. Our results suggested that this effect was mediated through a difference in mean airway pressure. These results also agree with a recent study by Mancebo et al. who compared in patients the efficacy of the same level of pressure support delivered by three different ventilators [6]. They found that the ventilator delivering the pressure with the fastest ramp of flow showed the greatest efficacy in reducing the work. When several ventilators are compared, however, many features may differ among them and may influence the results. Many studies, therefore, agree that a "fast" pressure wave shape may be desirable. Whether this means a high peak flow, an early peak flow, or both, is not clearly elucidated, however. Also, the higher the speed of pressurization, the faster the servocontrol mechanism of the ventilator should be. Indeed, a risk exists of rapidly generating pressure in excess of the set pressure level and activating one of the cycling criteria to expiration.

The results reported by Bonmarchand et al., however, contrast with the study by MacIntyre and Ho, who found that an individual titration of this parameter seemed necessary to optimize the efficacy of pressure support [7]. Their reasoning, however, was not based on measurements of patient effort but essentially on optimizing tidal volume (or the airway pressure-volume product). In the study presented here, there was no significant difference in terms of patient effort among the three first situations (0.1, 0.25, or 0.5 s of pressure rise time), whereas tidal volume tended to increase, although not significantly, from the first to the third setting. Thus, what is the best combination in terms of inspired volume and inspiratory work for a given pressure support level may still be a matter of debate and may require further studies. Indeed, an extremely early peak flow will tend to terminate the breath rapidly and potentially sooner than the patient's own inspiratory time. On the other hand, a prolonged time may promote activation of the expiratory muscles to terminate the breath [8].

Another interesting aspect of this study is the significant alteration of inspiratory time and duty cycle (Ti/Ttot) which resulted from modification of the pressure rise time and which illustrates the complexity of machine-patient interaction. This alteration in duty cycle may have followed a modification of the patient's own breathing pattern. More likely, it resulted from a modification of the machine's pattern independently of the patient's own inspiratory time, because of the specific algorithm of pressure support where the end of the breath is a function of the peak flow rate. Since the peak flow was gradually delayed with an increasing pressure rise time, this resulted in a lengthening of the inspiratory time. This clearly indicates that during pressure support, the patient is not as "free" as expected in terms of breathing pattern (another attractive feature of PSV). For this reason, manipulation of the settings imposed by the machine on the patient should be done cautiously and, ideally, adapted to the patient's needs. From a practical point of view, the clinical relevance of these phenomena of asynchrony (between the patient and the ventilator) remains unclear. A high prevalence of these events, however, would be a strong argument for the use of a new ventilatory support mode aimed at optimizing patient-ventilator interaction and referred to as "proportional assist ventilation" [9].

Therefore, it may not be desirable today to try to use a wide range of pressure wave shapes in every patient on PSV, because of the risks of major asynchrony with settings at either extreme. A standard setting can probably be obtained by inferring data from the different studies assessing this aspect of PSV, certainly including future studies, and this setting could be proposed for use in the majority of patients on PSV [1, 7, 10]. Then, as a second, non-mandatory step, this parameter could be adjusted when ventilatory support does not appear to be optimal. What will then remain to be defined is just what "suboptimal ventilatory support" means.

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