It is evident to everyone that a unique language has evolved related to mechanical ventilation. The alphabet soup of acronyms for various strategies of providing ventilatory support continues to expand. The list includes PCV, PCIRV, auto flow, auto mode, IMV, SIMV, MMV, APRV, biLevel, BiPAP, PRVC, VAPS, PSV, HFJV, HFOV, PPS, PAV, CMV — and, of course, plain old volume ventilation.

Why do we need all of these options? The manufacturers who promote the latest mode incorporated into their ventilator all proclaim the virtues and superiority of their new mode. Isn’t there a best way to ventilate? Apparently not; and if there is, it is lost in the confusion of the subtle differences between most of these methods. Doesn’t this alphabet soup cause errors and a lack of consistency, as well as inhibit the perfection of a best way to provide mechanical ventilatory support? Perhaps, but conscientious, competent respiratory therapists can overcome the confusion.

It simply isn’t important which mode one chooses to use, and the exact recipe doesn’t matter as long as the people using it understand and follow the basic principles associated with that particular approach. Also, some modes seem to be better suited for certain types of patient problems or circumstance (control versus weaning) of support desired. For example, airway pressure release ventilation (APRV) may work the best as a lung protection strategy for acute respiratory distress syndrome (ARDS) patients; but for patients with chronic obstructive pulmonary disease, the concept behind APRV just doesn’t apply. However, if you were insistent upon using APRV, you could set the parameters to fit the needs of the obstructed patient; but then you would simply be utilizing that mode to mimic the more traditional modes of ventilation without some of the synchronization afforded in those more traditional modes. Sounds like it’s better to have some options so as to meet the specific needs of the diverse patient predicaments and physician preferences we encounter.

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has vastly improved software and can respond to the patient’s changing requirements much better. This allows for some more acronyms, a few more options to confuse us, and the potential for mistakes.

Once the particular mode of ventilation is chosen for use, it is imperative that the respiratory therapist be completely familiar with the concept, appropriate applications, physiological principles, alarms, mechanical settings, and features of the ventilator when operating in that particular mode along with the pitfalls that must be anticipated. Physicians may know the general concept and the direction they wish to take their patient, but from a quality standpoint, “the devil is in the details,” and that is where the respiratory therapist comes in. In simple terms, the therapist must understand all of the implications of utilizing that mode and be competent to operate the ventilator in a manner that is tailored to the individual patient.

The fundamentals

Historically, there are two common fundamental approaches to ventilation: pressure and volume. Pressure ventilators were initially used for long-term support; but then, new technology allowed for control of tidal volume and for many years it was believed that volume pre-set ventilation was superior because the clinician could assure that an adequate tidal volume would be maintained even with changing resistance and compliance. You could count on the ventilator to deliver the breath as prescribed without worrying about hypoventilation. More recently, investigators have identified the major perils associated with traditional assist/control, volume ventilation:

- Ventilator-associated lung injury from overdistention of the well-functioning alveoli secondary to the persistent tidal volume delivered with each breath that may be preferentially distributed to the still-healthy lung regions, and
- Lack of patient/ventilator synchrony because of the fixed flowrate associated with the true volume modes cause an increased work of breathing and higher peak pressure.

These perils can lead to progressive damage to the lung and deterioration of gas exchange as well as the need for drugs to control the patient’s drive to breathe on his own. Thus, pressure-directed ventilatory modes came back into favor along with permissive hypercapnia. Many believe that in the face of ventilator-induced lung injury with persistent volumes, it would be better to limit the pressure, ventilate more gently, and put up with some increased carbon dioxide (CO₂) levels. Although there is a mounting body of evidence to support the more gentle, patient-friendly pressure approach to mechanical ventilation, not everyone is entirely comfortable with pressure-support ventilation (PSV) or pressure-control ventilation (PCV) secondary to the lack of volume assurance with those modes. Thus, the pressure-targeted modes tend to be secondary considerations in many hospitals.

Automatic adjustments

Some of the latest ventilators to hit the market in the United States have blended the pressure-driven concept with the volume-control approach. Pressure-regulated volume control (PRVC) from Siemens and AutoFlow from Dräger are examples of setting a tidal volume target while allowing the ventilator to function as a pressure generator with variable flow.

The software in these machines allows for the automatic adjustment of inspiratory pressure necessary to deliver an average set tidal volume. In conjunction with appropriate high tidal volume alarm and limits, along with maximum pressure settings, the volume targeted, pressure ventilators seem the most versatile, practical, and user-friendly at this point in time. These machines automatically adjust pressure during the course of operation to use as little pressure as possible to deliver the volume target. Additionally, there is no need to change the thinking of everyone on the health care team; physicians and nurses can continue to think in terms of tidal volume delivery and operate from that concept while the patient receives the benefit of the pressure-driven, variable-flow ventilator.

Another relatively new concept can be found on the Dräger and Mallinckrodt ventilators, allowing the patient to breathe around the machine, during all phases of the ventilator cycle. This open or floating exhalation valve means the patient can spontaneously inhale or exhale regardless of the timing of the mechanical
breath cycle. With the Mallinckrodt ventilator, this capability only exists in the pressure modes. The Dräger ventilator offers this open, spontaneous breathing in all modes including the volume-targeted mode by activating their AutoFlow feature. This concept affords mechanical support of gas exchange while limiting the need to use pharmacologic agents for sedation in order to keep the patient synchronized with the ventilator. It is not a huge cognitive leap to suggest that fewer narcotics and paralytic agents should result in decreased time on the ventilator and less risk of complications for the patient.

In this author’s opinion, a few fundamental considerations are important no matter what particular ventilator or mode one is operating:

- Be completely familiar with machine operation and patient assessment while operating in whatever mode you may be utilizing.
- Maintain patient-ventilator synchrony.
- Minimize the use of sedatives.
- Seek the lowest possible peak inspiratory pressure (PIP).
- Optimize mean airway pressure (MAP) to meet oxygenation requirements with fraction of inspired oxygen (FiO₂) less than 0.5 whenever possible.
- Use enough positive end-expiratory pressure or Time High to keep the lungs open and prevent shearing with each breath; ventilate between the inflection points of the pressure-volume curve.
- High CO₂ is preferable to high pressures.
- Don't be fooled by weaning modes; PSV and synchronized intermittent mandatory ventilation (SIMV) are just alternate ventilation modes and may mask the patient’s efforts and work of breathing.
- Prone positioning is not a ventilatory mode, but it should be used as an adjunct with patients who have or are at risk for ARDS. It helps with APRV and similar lung-protection strategies.
- Graphic monitoring is very important. Although not necessary in every situation, a therapist not using graphics is like an airline pilot flying without instruments. When the situation becomes cloudy, you want/need those instruments to help guide the machine; and it is historically, there are two common fundamental approaches to ventilation: pressure and volume.

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nice to think your pilot checks those instruments even when things appear to be going well.

**Know your alphabet**

Knowing and understanding the alphabet soup, assessment, and monitoring of mechanical ventilation is the job of the respiratory therapist. In my opinion, advocating the best mode for the particular patient’s situation is also a professional responsibility. There just isn’t one best mode. It depends! A knowledgeable, competent therapist is the key to optimum quality of ventilatory support.

We should be asking the following questions regarding the ventilators we purchase and modes we choose from the patient’s perspective:
- What will get the job done?
- What is the safest mode with the least risk of further injury?
- What is most comfortable, avoiding undesirable work for the patient?

The real user of the ventilator is not the therapist or the physician; it is the patient, and we should choose the ventilator and mode that is the most user-friendly.

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**EDITOR’S NOTE**

Individual modes of ventilation will be covered in upcoming installments of this column throughout the year.

**SUGGESTED READING**


