EDITORIAL

Variable Ventilation Stochastic or Physiologic

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Variability of tidal volume and respiratory rate in normally breathing man has long been demonstrated [1]. However because of lack of knowledge and technology primary ventilators could only deliver a fixed tidal volume in a fixed rate the so called volume controlled ventilation (VCV). VCV was volume preset time triggered and cycled and there was no synchronization with patient's breaths. At that time ventiltory management was associated with serious lung damage caused by ventilator [2-3]. Today that is referred as ventilator induced lung injury.

Frequent complications of ventilatory support forced physicians and engineers to develop newer modes of mechanical ventilation. Advances in control mechanisms, servo valves, flow and pressure sensors led to introduction of synchronized modes of ventilation like synchronized intermittent mandatory ventilation (SIMV) and pressure support ventilation (PSV).

Synchronization of mechanical ventilation was a big step toward physiological ventilation and showed fewer complications compared with non synchronized ventilation [4]. Patient can interact with ventilator in initiation of inspiration and in PSV respiratory rate is controlled by the patient's inspiratory effort so patient is not locked to a fixed respiratory rate delivered by the ventilator. PSV is more physiological form of mechanical ventilation in being patient triggering, pressure limited and flow cycled. Although PSV was introduced as a weaning mode of ventilation it showed it is effectiveness in ventilatory management of respiratory failure [5]. Even in severe cases of acute respiratory failure PSV provided better oxygenation with higher tidal volumes and lower peak inspiratory pressure compared with assist control ventilation [6]. So it is commonly used in critical care setting.

After releasing patients from fixed respiratory rate during mechanical ventilation, technological advances in field of mechanical ventilation released patients from fixed support pressure and tidal volume by introduction of proportional assist ventilation (PAV) and neurally adjusted ventilatory assist (NAVA) in both forms of ventilation level of support pressure is determined by patient's inspiratory effort. For PAV negative pressure generated at the beginning of inspiration and for NAVA electrical activity of diaphragm controls the level of pressure support. Although tidal volume is variable during PSV but variability of tidal volume is more with PAV [7] and PAV is accompanied with lesser work of breathing and asynchrony than PSV [8] PAV and NAVA both prevent hyperinflation of lungs, decrease patient`s ventilator asynchrony and restore variability of tidal volume and breathing pattern compared with PSV [9].

Another form of ventilation recently introduced to clinical practice is noisy pressure support ventilation (noisy PSV).

In noisy PSV in contrast with PAV and NAVA there is no percent of support pressure setting and intensivist can set the level of support and percentage of variability in pressure support. Support pressure and tidal volume are randomly changing during ventilation so it is very similar to spontaneous breathing.

Suki B et al. showed the benefits of variability and noise in life support systems [10].

Variability of tidal volume is effective in recruiting atelectatic lung [11] also variable tidal volume improves lung mechanics and gas exchange in animal model of acute lung injury [12]. Noisy PSV is also superior to PSV and pressure controlled ventilation (PCV) in terms of oxygenation and lung protection [13]. Noisy ventilation improves lung function and reduces lung damage compared with standard lung protective strategies [14]. Noisy PSV in surfactant depleted pigs redistributes perfusion toward nondependent lung regions [15] variable tidal volumes enhances surfactant secretion in alveoli [16] in acute hypoxemic respiratory failure noisy PSV was associated with better synchrony than PSV [17].

Variable ventilation has many benefits in being similar to spontaneous physiological ventilation so patients with better respiratory condition have more variability of breathing and vice versa [18].

Variability of tidal volume generated by the computer is comparable with physiologically derived noise from the aspect of lung mechanics and gas exchange [19].

There have been tremendous advances in field of mechanical ventilation specially in assisted modes of ventilation but we do not see the same level of improvement in controlled modes of ventilation.

The question is: how can we help non spontaneously breathing patients? They have the same physiology and same lung so if spontaneously breathing patients benefit from variability of ventilation why should we fetter apneustic patients to a fixed rate and tidal volume.

Now it is time for ventilator producing companies to be more thoughtful of these patients and give them the chance to breathe more physiologically by adding stochastic noise or variability to their respiratory rate and tidal volume in conventional controlled modes of mechanical ventilation like pressure controlled or volume controlled ventilation.

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