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Proportional Asist Ventilation (PAV)

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Short Communication

The inspiratory muscle effort and the ventilatory results of this effort cause the patient to not be able to provide adequate ventilation to meet the metabolic need, and as a result, a form of ventilatory insufficiency called “poor neuroventilatory coupling” occurs [1]. PAV is a synchronous partial ventilatory support mode that amplifies spontaneous inspiratory effort in proportion to the patient's spontaneous effort (the greater the patient's effort, the higher the flow, volume, and pressure) without preset target pressure and volume in patients with respiratory effort. According to the concept of “Patient ventilator interactions (PVI)”; The trigger function is determined by the patient's ventilatory effort, flow distribution function, spontaneous inspiratory flow requirement, from inspiratory to expiratory function, spontaneous neural inspiratory time [2,3]. There should be an interface for continuous communication between physiological parameters and ventilatory support to detect physiological PVI. This can only be achieved with a closed loop circuit.

The closed loop circuit has 3 elements

i. Input: what will activate the system?

ii. Output: what will the system create?

iii. Control algorithm: connects input to output

In PAV, the ventilator perceives the patient's needs as input and continuously adapts the distribution of the inspiratory output (output) according to the needs of the patient (3). PAV is designed to increase or decrease airway pressure in proportion to the patient's effort. Airway pressure is amplified in proportion to instantaneous inspiratory flow and volume with a positive feedback (3). In PAV, pressure support is provided in proportion to the volume delivered (volume assist) and inspired instantaneous current.

Unlike modes that deliver preset tidal volume or inspiratory pressure, the amount of support varies with the patient's effort in PAV. The patient's inspr effort is an indicator of ventilatory demand and determines the ventilatory pressure.

The PAV algorithm has been developed from the "motion equation" formula:

Muscle pressure = (normal elastance x volume) + (normal resistance x flow) + abnormal load

Pmus + Pappl = PEEPi + Press + Pel

Respiratory elastance (K1) and resistance (K2) are used as feedback signals.

Ptotal (Pmuscle + Pappl) = (K1 x Volume) + (K2 x Flow)

Pappl: pressure added by the ventilator

According to motion equation, inspiratory instantaneous current resistive breath work and instantaneous volume elastic breath work are in proportional relationship. The ventilator determines the Pmuscle from the instantaneous current and volume values with its internal sensors and assists proportionally according to its value. Respiratory effort of the patient determines the breath rate and inspr time. FiO2, PEEP, Volume assist percentage, current assist percentage are set by the clinician. The volume assist percentage is related to the elimination of the forces associated with the elastance (K1) and the percentage of

the current assist (K2) related to the resistance.

If the volume and current assist percentages are set at values less than the elastance and resistance values, the pressure generated by the ventilator (Pappl) will be less than the pressure required to overcome the passive elements of the respiratory system; Thus, the patient will continue spontaneous respiratory activity and the ventilator will continue to operate by proportionally amplifying patient effort [2,3].

Assist percentages are routinely set to 80% (10-90%); It means that the ventilator will meet 80% of the respiratory work. If these assist levels are set to equal or more than 100% of the patient's elastance and resistance, the ventilator output passes the pressure required to overcome the impedance of the respiratory system, and leakage occurs, and the ventilator continues to apply pressure to the airway after the patient's inspiratory effort is over. Respiratory muscles are not used and central apnea develops. Since flow decreases and volume increases during inspiration, current support is highest at the beginning of inspiratory and volume support is highest at the end of inspiratory. Airway pressure changes from breath to breath during PAV as flow and volume differ from breath to breath. PAV also varies from breath to breath rate, inspr time and inspr pressure. With this feature, it contrasts the constant pressure in PS and the constant pressure and inspiratory time in PCV. Incorrect prediction of elastance and resistance during PAV disrupts the patient-ventilator relationship [1,3].

One method of making the correct settings in PAV is the "leak" method

The volume assist is set to 2 cmH2O/L (with 1 cm H2O/L / sec flow assistant) and is increased by 2cm H2O/ L pieces until leakage. The patient's elastane is estimated as "volume assist-1". The flow assist is then set to 1 cmH2O / L / sec (with 2 cmH2O / L volume assist) and is increased by 1 cmH2O /L /sec pieces until leakage occurs. Airway resistance is estimated as "flow assist-1". The PAV algorithm assumes that the elastance and resistance properties are linear. In cases of respiratory failure, the lack of linear characteristics of these variables may cause inappropriate ventilation in PAV.

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