Optimal patient-ventilator synchrony is of prime importance, as asynchronies lead to increased work of breathing and patient discomfort, and are also associated with higher mortality and prolonged mechanical ventilation (1, 2, 3).

Achieving optimal patient-ventilator synchrony is particularly challenging during noninvasive ventilation (NIV), due to variations in leaks and patient conditions.

When trying to synchronize the ventilator with the patient’s activity, there are two main settings to be considered: the inspiratory and the expiratory trigger. These dictate when the ventilator starts or ends a spontaneous breath.

On Hamilton Medical ventilators, the setting for the expiratory trigger is the expiratory trigger sensitivity (ETS). This value represents the percent of peak inspiratory flow at which the ventilator cycles from inspiration to exhalation. On Hamilton Medical ventilators, ETS can be set to anywhere between 5% and 80%. In general, increasing the ETS setting results in a shorter inspiratory time, while decreasing it results in a longer inspiratory time.

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On other devices, this flow cycle mechanism is called ‘ESENS’, ‘End Inspiration’, ‘Flow Cycle’, etc.

Another criterion for breath termination is TI max. This setting is used if gas leakage is significant and the set cycle is not reached, providing a back-up so that inspiration can be terminated. The ventilator switches over to exhalation when the set TI max is reached.
A typical ETS setting in a patient with normal lung mechanics undergoing NIV is 25%, which is the default ETS setting on Hamilton Medical ventilators. With obstructive patients, for example, in a patient with chronic obstructive pulmonary disease (COPD), ETS should be set higher to increase the expiratory time and thus avoid air-trapping and intrinsic PEEP.

Incorrect ETS settings leading to expiratory asynchrony may be recognized from either delayed or premature cycling leading to double triggering.

**Delayed cycling**

Delayed cycling can be recognized from an end-inspiratory peak in the pressure curve caused by an active expiratory effort, as well as a change in the slope of inspiratory flow towards the baseline. This is typically described in patients with COPD. The reduction in inspiratory flow is smaller, probably due to dynamic hyperinflation and airway resistance.

In the case of delayed cycling, increase ETS in increments of 10% to shorten the inspiratory time (TI) and adjust TI max according to the patient’s condition.

**Double triggering**

Along with short inspiratory times, double triggering is an indication of premature cycling. During premature cycling, the inspiratory muscles continue to contract, causing the ventilator to anticipate a second effort. This leads to double triggering, with delivery of higher tidal volumes, breath stacking, and higher work of breathing. A possible solution is trying to match the neural inspiratory time with the ventilator inspiratory time. Double triggering may also be caused by insufficient pressure support.

In the case of double triggering, decrease ETS in increments of 10% to lengthen TI, adjust TI max according to the patient’s condition, or increase Psupport to achieve the desired tidal
volumes.

The HAMILTON-C6 ventilator* also offers the option of automatic adjustment with IntelliSync+. The ventilator monitors incoming sensor signals from the patient, continuously analyzes the waveform shapes using a set of algorithms and then dynamically adjusts the setting in real-time to address changing patient or system conditions. IntelliSync+ can be set to automate trigger adjustment for inspiration or expiration, or both.

* The HAMILTON-C6 is not available in all markets.

References


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