HAMILTON MEDICAL'S GALILEO GOLD WITH ADAPTIVE SUPPORT VENTILATION (ASV)

by Bethene L. Gregg, RRT, PhD

The Galileo Gold ventilator (Hamilton Medical, Reno, NV) with Adaptive Support Ventilation (ASV) has been available in the USA for some time, but it probably hasn't been adopted as rapidly as its manufacturers had hoped. For example, Hamilton ventilators are still not commonly found in certain regions of the country, as in the central plains states. In addition, there's the whole question of "Who needs ASV?", not only from the standpoint of the staff who initiate it but also from the standpoint of the patients who receive it. Published discussions over the last several years have asked whether or not the newer closed-loop modes of ventilation are superior to existing modes and most experts say that there is insufficient evidence to answer those questions. Since those questions will always be difficult to test and any results would be relative to the patients studied and to the level of training of the staff making the ventilator decisions, it would be easier if we asked instead "So what's not to like about ASV?".

Let's look at mode initiation. ASV is easily initiated on the Hamilton Galileo. After calibrating the oxygen cell and flow sensor and completing the tightness (leak) check, simply select ASV from the Ventilation Mode window by turning the Galileo's right-hand knob and then pressing the knob to confirm the selection. The right-hand knob on the Galileo adjusts the controls and alarms whose icons are positioned on the right side of the screen. The left-hand knob selects parameter information, graphics or mechanics which are located along the left side of the screen.

Next, input the patient's predicted body weight using:

IBW = 50 + 2.3(Ht. inches – 60) *for men ,* or
45.5 + 2.3(Ht. inches – 60) *for women.*

The default or standard setting for Minute Volume % in the Galileo is 100%. Since ASV is a form of volume-targeted pressure control , or volume-targeted pressure support with patient-triggered breaths, set the high airway pressure alarm 10 cm H2O above the highest allowed airway pressure. A high airway pressure alarm setting of 40 cm H2O, for example, will allow the Galileo ventilator to automatically increase the pressure control/support to 30 cm H2O if necessary a nice feature of the unit. Closing the Ventilation Mode window starts ASV.

In ASV the ventilator initially delivers a short series of test breaths to measure the patient's dynamic compliance and expiratory time constant. The ventilation algorithms use those values, plus an anatomical deadspace ventilation estimate of 2.2 mL/kg, in Otis' minimal work equation to determine the frequency and tidal volume appropriate for the patient's respiratory system compliance and resistance. For machine (time-triggered) breaths, the level of pressure control is automatically adjusted to provide the target tidal volume. Algorithms within the Galileo calculate the target tidal volume as the predicted minute volume over the frequency that minimizes the work of breathing. The predicted minute volume for adults equals 0.1 L/min/kg x body weight (kg). Of course, PEEP/CPAP, FIO2 and trigger sensitivity must be set by the clinician. In summary of ASV initiation, the clinician sets the IBW, MinVol% and high pressure alarm (or sets alarms with Auto alarm set). That's quick and easy and will most likely meet the ventilatory needs of 85% of patients.

So, ASV is easily more than volume-targeted pressure control in that the algorithms set the frequency for machine breaths, too. The ASV graphic on the Galileo also incorporates a safety box that displays the high/low tidal volume and high/low frequency ranges considered "safe" around the least work of breathing minute volume target. This is a very nice feature of the Galileo. Various alerts/alarms will appear if the actual tidal volume or frequency is outside the box. The "lung-protective rules" governing the limits of the safety box set the minimum tidal volume at 4.4 mL/kg but allow the high tidal volume side of the box to go up to 22 ml/kg. Even though proper setting of the high pressure alarm and high tidal volume alarm would offer some protection against high tidal volumes, the high tidal volume side of the safety box should probably be re-programmed to a lower mL/kg level or made adjustable by the user. The minimum safe frequency for adults is 5 breaths/min. During the simulation trials in our laboratory, the frequency would always drop to the minimum frequency allowed after cessation of a series of "patient" triggered breaths. Over the next two minutes of machine triggered breathing, the frequency would gradually increase to the least work value. The high frequency safety box limit depends on the expiratory time constant. The minimum allowed expiratory time is two expiratory time constants. Two expiratory time constants, however, may not provide enough time for exhalation for some patients with obstructive airway disease, in which case the Minute Volume % setting should

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be decreased to reduce air-trapping. The ability to adjust this on the Galileo is another nice feature we appreciated.

Still another nice feature is the fact that the safety box will be displayed on the ASV graphic even if the patient triggers inspiration. Patient triggered breaths become volume-targeted pressure support (volume support) breaths and the ventilator attempts to maintain the target tidal volume. The patient may trigger breaths at a frequency that causes the minute volume to exceed the target minute volume. Therefore, high tidal volume/minute volume/frequency and end-expiratory flow alarms should be set appropriately. If the target tidal volume cannot be delivered, given the setting of the high airway pressure alarm, an alert to "check P-high limit" appears, an nice reminder for the clinician. In addition, the set Minute Volume % (range 10% to 350%) may need to be increased in cases of high ventilatory demand from patient triggering or to correct elevated carbon dioxide levels during mandatory breaths. And yes, since mandatory breaths and patient-triggered breaths are volume-targeted pressure limited breaths, the function of the ventilator to decrease inspiratory pressure in response to the patient's active inspiration, which causes a change in compliance, will also occur as with most volume-targeted pressure modes. And no, the exhalation valve is not "open" or "floating" in ASV, but is that necessary? If the patient is actively breathing, the mode becomes volume support and any patient expiratory effort will usually flow cycle the breath to end inspiration anyway. [The exhalation valve is open in the DuoPAP (bi-level or APRV) mode.] The flow cycle threshold is adjustable for pressure/volume supported breaths and Hamilton's user guide recommends setting the flow cycle at 40% for patients with obstructive airways disease. The flow cycle threshold could also be set by observing the point of airflow obstruction on a flow/volume loop.

Which brings up another point of what not to like, the graphics on the Galileo are absolutely superb. The P/V 2 tool in particular performs an inspiratory and expiratory pressure/volume curve maneuver by automatically dropping the peak flow to 10 LPM. The curve starts at the PEEP level, rather than at zero pressure, and continues to the user defined high PEEP level. The P/V 2 curve can include an alveolar recruitment maneuver by adding pause time to the total time of the maneuver. The freeze feature allows the user to move a cursor along the pressure/volume curve to observe compliance, volume and flow changes at any point in time on the curve to better identify the lower inflection point on the inflation limb or the point of maximal curvature on the deflation limb for adjusting PEEP.

So what's not to like about ASV? Any attempt to promote ASV as the ideal mode of ventilation for use by inadequately trained clinicians or as a reason to cut respiratory care personnel. As discussed above there are several ventilator management decisions that may be required to provide adequate ventilation to any given patient. The mode still requires vigilance in patient monitoring so that those necessary adjustments can be identified and made. Any suggestions implying that ASV can basically be initiated and forgotten or requires less time for respiratory care staff are less than accurate and fall outside the boundaries of safe patient care. The Hamilton Galileo provides this mode to clinicians in an excellent, well though-out manner involving well-researched algorithms, very well thought-out alarm features and well thought-out limits and other premises. It's graphics are probably the best this author has seen and of course Hamilton is a trusted, well known company, known for excellent after-purchase support and customer service. It is well worth a look the next time you're in the market for mechanical ventilators.

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