

AVOIDING THE WEANING PROTOCOL 'OFF RAMP'

by *John Marini MD*

Contrary to the medicine of prior decades, prevailing opinion, based primarily on published observational and clinical trials data, now holds that for the vast majority of patients there is no such thing as "weaning." In other words, the patient either is or is not ready for spontaneous breathing--graded withdrawal of support is neither necessary nor efficacious. While that "cold turkey" attitude might be valid for most patients, there are frequent exceptions. (In my experience, for many patients with impaired ventilatory efficiency or limited cardiac reserve, gradual accommodation and adaptation are needed.) Certainly, there is nothing wrong with basing bedside practice on relevant scientific evidence; that is what we all should strive to do, as far as it takes us. But the published database on which we rely to guide "best practice" is woefully incomplete. Some useful measures have not yet been tested, and many good sense practices might never be trialed. In a previous Focus article I made personal recommendations for the preparation phase of weaning and extubation, closing my comments with a threat to pass along some of my other experience-based (emphatically not evidence based) "tips and tricks" at a later time. Well, here goes...

Whether or not one believes that gradual weaning is needed after a failed spontaneous breathing trial, a judgment regarding the patient's readiness to breathe spontaneously still must be made. To me, evaluating readiness for ventilator removal and extubation is a much studied but frequently misunderstood topic of great importance. At the bedside, this deceptively complex exercise requires more attention than we commonly give. We always look for easy and fool-proof indicators--robust, easily gathered numerical criteria that anyone can look at to give the thumbs

up or down sign to extubation. In the current era of "evidence based" weaning protocols, unreliable indicators are easily encoded in the routines of the ICU.

Most spontaneous breathing trials or disconnection sequences (weaning protocols) mandate early "exit ramps" when the breathing rate and/or rapid shallow breathing index (RSBI) exceed an upper numerical cutoff. Understandable...the RSBI is easily calculated, well studied, often useful, and no one likes having to re-intubate. The re-emergence of respiratory distress is both a hazard and a setback for the patient. For the caregivers, premature extubation carries the stigma of judgment failure, whereas keeping the patient intubated for a bit longer and continuing to "support" the patient with mechanical ventilation does not. Yet, unnecessary prolongation of ventilation--a potentially avoidable management error--inflicts discomfort and exposes the patient to serious risks of a different type. It is my view that a number of important and easily quantified signs of patient readiness are passing just below our radar screen as we defer extubation to another day. Here are several that I use in my daily practice that seem to serve me well in fine tuning the judgment call.

Let's start by considering the exercise response of a healthy individual. When the heart needs to pump more blood, it increases stroke volume and heart rate. But as flow requirements increase, the stroke volume nears its upper limit well before heart rate does. Except at very low exertion levels, for more cardiac output, the ball is carried primarily by elevating heart rate. If we cared to calculate the heart rate to stroke volume ratio during progressive exercise, it would steadily rise--even in perfect health. (This is especially true if the heart is stiff or the body de-conditioned.) A similar relationship holds true for tidal volume and breathing frequency during exercise. Increased demand for ventilation is met by the product of tidal volume and breathing frequency, but the latter does more of the "heavy lifting" as a natural response to increasing the level of exertion. In patients with abnormal chest mechanics, the frequency to tidal volume ratio starts high, and increased effort often lifts the RSBI quickly into a high range--as in the abnormal, de-conditioned heart. How, then, can we tell whether the patient is failing, approaching the point of intolerance, or simply exhibiting a normal exercise response to the effort demand? I believe that one important clue is given by what happens

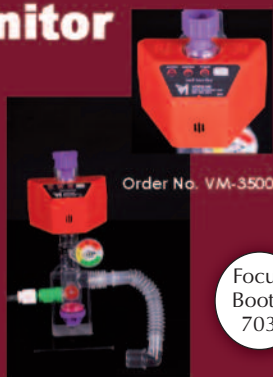
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simultaneously to minute ventilation. If minute ventilation (VE) rises smartly along with the f/VT, the patient may be simply exhibiting a normal exercise response despite a disquietingly high value for the RSBI. If VE remains stable or falls as the RSBI rises into "forbidden territory", the patient is likely to be decompensating and requires further ventilation support.

A second important clue to ventilatory reserve is offered by marked variation of the minute ventilation--not just during the spontaneous breathing trial, but also in the hours of ventilation support that preceded it. If the ventilation requirement of a waking patient sinks markedly during sleeping or resting periods, the underlying physiological demand of the patient for ventilation is not extreme. Although the minute ventilation requirement may rise markedly before or during the spontaneous breathing trial, this may simply be the result of anxiety heightened mental alertness or agitation. Other signs of adequate ventilatory reserve are to be found in the breathing pattern variability. Patients who are approaching their limits of compensation tend to regularize their inter-breath periods and I:E ratio.

A third neglected indicator is an assessment of tidal volume reserve. A useful but now all but abandoned weaning predictor is the ratio between vital capacity and tidal volume. A two-fold difference between them suggests untapped strength and endurance. One reason explaining why this logical indicator has been all but forgotten is that the voluntary effort required for the vital capacity maneuver is difficult to elicit. With few exceptions, however, coughing is accompanied involuntarily by at least one very deep breath. In preparation for spontaneous breathing trial and in routine daily cares of the ventilated patient, coughing is routinely induced by catheter or tracheal saline instillation. Pay attention to those flashing numbers on the ventilator's tidal breath readout during a coughing episode elicited during low-level pressure support--they usually give a pretty good idea of the inspiratory capacity.

The last step prior to okaying extubation is to estimate patency of the glottic passage. Too snug a fit between the tube and the larynx predicts stridor post extubation. Deflating the balloon cuff is and listening for air leaking around the tube during a positive pressure breath is routinely performed, with failure to detect pericuff leakage a clear trouble sign that halts progress toward extubation. (No question that it should, if reliable.) However, over time, thickened secretions accumulated above the tube cuff may form a viscous mucus seal that needs to be broken before the patient has a chance to pass the "cuff leak" test. To assess this, we apply PEEP of 15-20 cmH₂O for several breaths with normal tidal volume before concluding that the cuff leak test was not passed. The PEEP is then reduced to 5-7 cmH₂O to ensure that leaking past the broken mucus seal continues at this lower level. In my practice, I apply 15 cmH₂O PEEP during the actual process of tube extraction as well, so as to help propel supraglottic secretions into the mouth as the tube is physically withdrawn.

Breathing pattern variability, cough inspiratory capacity, high PEEP leak test and minute ventilation response often help avoid unnecessary diversions to the weaning protocol "off ramps" that keep patients chained to the ventilator. These observations, gained through personal experience and not yet documented by formal clinical trials of success and failure, have proven extremely helpful in my own practice.

Dr. Marini, Professor of Medicine at the Univ. of Minnesota, is a clinician-scientist whose investigative work has concentrated in the cardiopulmonary physiology and management of acute respiratory failure.