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The Decision to Liberate From the Ventilator

More Than Just a Number

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“What’s the most important thing that I need to learn about mechanical ventilation?” It was the first day of her rotation, and the second-year resident had expressed an interest to me in pursuing a career in pulmonary and critical care medicine. Learning about mechanical ventilation was a top priority. “You need to learn how to discontinue it,” I replied. “Liberating patients from mechanical ventilation is really important.”

My brief reply was a counterpoint to the complex discussion my team would have over the ensuing days that was informed by a complex body of knowledge that has accrued over several decades. For every additional day that a patient remains on mechanical ventilation, clinical outcomes, to include death, worsen.¹ Critical care providers have a strong mandate to liberate patients from mechanical ventilation as soon as possible to improve these outcomes. At the same time, we know that patients who are removed from mechanical ventilation and who require mechanical ventilation to be reinstituted within 48 hours, form a population of patients that has a very high mortality rate.² Intensivists are faced daily with a critical judgment as to whether to discontinue mechanical ventilation in these seriously ill

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patients. The daily spontaneous breathing trial (SBT) has been used to aid in this important decision.

Seminal work by Yang and Tobin³ that was published in 1991 indicated that the rapid shallow breathing index (RSBI; calculated by dividing the respiratory rate in breaths per minute by the tidal volume in liters) that was obtained during a *t*-piece trial of <105 supported a decision to discontinue mechanical ventilation. This metric was always imperfect in that a significant number of patients (approximately 10% to 20%, depending on the study) who met this threshold failed liberation from mechanical ventilation.⁴ One could consider that a very low rate of failed extubation might signal a strategy that lacks aggressiveness and leads to unnecessarily long ventilator duration. A modest rate of failure is acceptable if one wishes to adopt an aggressive liberation strategy. This would be particularly true if the re-intubation procedure itself was not the cause of poor outcomes. Studies suggest that failed liberation may be simply a clinical marker for poor outcomes and that the poor outcomes are not closely related to procedural complications of airway management during re-intubation in the absence of a difficult airway.⁵

Since 1991, our understanding and application of the SBT have become more nuanced. We learned in 1995 that a strategy of once daily SBTs was as informative a strategy as multiple daily SBTs.⁶ Pairing SBTs with daily awakening trials, and the use of intermittent sedation, led to improved outcomes.⁷ Asking our teams to use protocols that incorporate SBTs led to better patient results than not doing so.⁸ Guidelines strongly supported the use of SBTs in clinical practice.^{8,9}

Careful work reminded us that the RSBI was a continuous variable and not dichotomous and that full consideration of the RSBI, as such, provided more precise information.^{4,10} Considering that there is considerable overlap in the RSBI values of populations that are extubated successfully compared with those without a successful SBT led to further study to search for extubation failure risk factors. Risk factors identified for extubation failure among patients who had completed the SBT successfully have included progressively higher RSBI, pneumonia as an index diagnosis, positive fluid balance, and the ability to cough and protect the airway.^{10,11} The picturesque “white card

test,” in which patients try to expectorate sputum through their endotracheal tube onto a white card, added a practical useful element to this assessment.¹⁰ Modern ventilators allow us to perform the SBT without removing the patient from the ventilator, thus retaining the monitoring capabilities of the device. Subsequent study suggested that the application of inspiratory pressure augmentation during the SBT was associated with improved outcomes among patients who participate in SBTs, a suggestion that has been addressed in guidelines.⁹

In this issue of *CHEST*, Trivedi et al¹² have performed a systematic review and metanalysis that help to clarify this important topic. They examined the utility of using the RSBI that is obtained during an SBT to predict successful liberation. A careful analysis of 48 studies that included a robust population of nearly 11,000 patients revealed that the RSBI has a poor sensitivity and specificity in the prediction of extubation success. This finding was confirmed whether one considered a threshold value for the RSBI of either 105 or 80.

So, what should I say to my young protégé who wishes to learn about liberation from mechanical ventilation? The daily SBT remains a valuable clinical tool to assess a patient’s readiness to be liberated from mechanical ventilation. However, this tool must be used wisely, and a single metric such as the RSBI is insufficient by itself to determine if a patient is ready to liberate. In addition to specific physiologic metrics, we must also assess the level of sedation and mental status, the patient’s fluid balance, and the ability of the patient to protect the airway. We must apply judgment and consider the patient’s overall clinical status. Our desire to liberate patients aggressively from mechanical ventilation must be tempered by the realization that failure may be associated with adverse consequences. I will tell my young colleague that she will have an exciting future, because there is much more to

learn about how best to decide when to discontinue mechanical ventilation.

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