Success Stories: Use of Patient Vignettes to Assess the Ability of Physicians to Predict Extubation Success

Safely returning intubated, mechanically ventilated patients to independent breathing requires 3 steps.[1,2] First, clinicians must recognize when respiratory failure has resolved or improved enough to allow a spontaneous breathing trial (SBT). Second, a 30–120 min SBT should be used to test the patient's ability to breathe without the ventilator.[3] Third, if the SBT is successful, the physician must decide whether to extubate.

In many intensive care units (ICU), respiratory therapists and nurses drive the first 2 steps, which are relatively straightforward, guided by protocols.[4-6] The decision to extubate is more challenging.[1,7,8] Within 24–72 hours, 2–25% of newly extubated patients need re-intubation.[1,7,8] Failed extubations can lead to prolonged immobility, longer stay, and increased risk of ventilator-associated pneumonia, need for tracheotomy, and mortality.[1,7-9]

Identifying high-risk patients helps prevent premature extubation. Among those extubated, those at high risk merit careful monitoring and occasionally noninvasive ventilation to help prevent re-intubation.[7,8,10] Causes of extubation failure fall into 2 categories: those associated with ventilatory failure and inadequate gas exchange, and those associated with airway compromise. Ventilatory failure most commonly results from a strength-load imbalance. Effective screening and performance of SBTs should screen out most patients at risk for ventilatory failure before extubation. Some patients who pass SBTs will develop ventilatory failure over the ensuing hours to days (eg, those with congestive heart failure or neuromuscular disease).

Risk of airway compromise is more difficult to predict.[1,7-9] Two major causes include post-extubation laryngeal edema and inability to keep the airway clear of secretions. Although its accuracy is disputed, a "cuff leak test" can help identify patients with laryngeal edema who may benefit from corticosteroid treatment before extubation.[11] Attention to quantity of secretions, cough strength, and mental status may help identify patients unable to keep their airways clear and therefore unready for extubation.[12] In summary, a deliberate approach, combining careful screening, performing a 30–120 min SBT, and assessing airway risk can mitigate,but not eliminate, the risk of re-intubation.

Given the challenges and dangers associated with extubation decisions, we were pleased to see the study by Tulaimat and Mokhlesi in this issue of RESPIRATORY CARE, which explores the ability of ICU physicians to predict extubation success.[13] Tulaimat and Mokhlesi extracted a series of 32 clinical vignettes from a previously described-cohort of patients who had been extubated after an SBT on CPAP of 5 cm H_2O and pressure support of 5–7 cm H_2O.[14] Half were successfully extubated and the other half required re-intubation. The vignettes included ample clinical and physiological data, generally available to physicians making extubation decisions, including information on the patient's SBT performance, arterial blood gas results, and descriptions of secretion quantity and mental status. Fifty-five intensivists were asked to participate in the survey, and 45 responded. For each vignette the respondent was asked to decide if extubation was appropriate. If the respondent thought extubation was not appropriate, he or she was asked to describe the factor or factors influencing the decision. Accuracy was calculated by determining sensitivity (defined as the fraction of successfully extubated patients whom the surveyed physicians correctly decided to extubate) and specificity (defined as the fraction who required re-intubation and for whom the physicians correctly decided to postpone extubation). Reliability was defined by comparing decisions among physicians. A logistic regression model was constructed based on reasons the physicians cited to forgo extubation. The accuracies of the model and physician predictions were then compared.

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The physicians decided against extubation in 37% of the cases. Agreement between the physicians was characterized as fair. Both sensitivity and specificity were poor: 57% and 31%, respectively. In deciding whether to extubate, the physicians tended to rely on breathing pattern during pressure support ventilation and arterial blood gases, more than on mental status or quantity of secretions. The logistic regression model based on factors associated with failed extubation (pH, P_{CO_2}, secretions, breathing patterns, and mental status) proved more accurate than the physicians at predicting extubation outcome.

The most intriguing finding in the study is the observation that physicians frequently chose to extubate patients despite clinical data suggesting high risk of failure. Although we are not told the reasons for extubation failure in individual cases, it seems likely that inability to keep the airway clear played a major role: a larger number of patients in the failure group had moderate to copious secretions and a Glasgow coma score $\leq$ 10, which are clearly risk factors for re-intubation.[12] It seems, therefore, that the physicians paid insufficient attention to factors that strongly suggested the patients were unready for extubation.

We are less convinced by Tulaimat and Mokhlesi's attempts to quantify physician accuracy. This was a particu-

larly challenging population, by definition: half the patients failed extubation—a percentage that greatly exceeds published reports.[1,7,8] In turn, spectrum bias was almost certainly introduced, which would undermine Tulaimat and Mokhlesi's ability to extrapolate sensitivity, specificity, and accuracy calculations from their study to more typical ICU settings.[15-18]

Certain features of the vignettes may have undermined physician accuracy. First, because SBTs were performed using CPAP and pressure support ventilation, the reported frequency-to-tidal-volume ratios may have provided excessively optimistic estimates of patient readiness for extubation.[19] Second, because the population studied was limited to patients who were actually extubated, we cannot extrapolate the findings to populations that include patients who do not have the endotracheal tube removed because of excessive risk. Finally, we also question whether the decision to extubate high-risk patients necessarily constitutes an error of judgment. At least in some high-risk cases, a trial of extubation may be warranted, particularly among those who may have reached a point of maximal improvement and the only alternative may be tracheotomy or accepting the risks of prolonged intubation.[8]

What lessons can we derive from this intriguing study? First, clinical vignettes derived from real cases may offer a powerful approach to exploring the pitfalls of decision making. In future studies it would be interesting to look more deeply into the source of apparent judgment errors. For example, it would be helpful to know the extent to which knowledge gaps, practice style, or other factors led to decisions to extubate despite data predicting failure. Second, in making extubation decisions we need to ensure that appropriate attention is paid to factors related to extubation success, particularly evidence suggesting that the patient can keep the airway clear.[7,8,12] Third, additional work is needed to explore the potential utility of novel factors that may complement or improve upon our current diagnostic approach to determining extubation readiness.[7,8,20,21] Finally, it is important to acknowledge that, even with improved tools and excellent judgment, our ability to predict which patients can be extubated successfully will always be limited. Ultimately, the only way to know for sure is to remove the endotracheal tube.

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